



Australian Government

Department of the Environment

**NOMINATION FOR LISTING THE DEGRADATION OF
LISTED SPECIES & COMMUNITIES BY URBAN AND
SEMI-URBAN & OTHER DEVELOPMENT AS A KEY
THREATENING PROCESS UNDER THE EPBC ACT**

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Key Threatening Process Nomination Form - For adding a threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Nominated threatening process – summary of eligibility

6. Name of threatening process

Ecosystem degradation, habitat loss and species decline due to urban, semi-urban, industrial & other similar development (e.g. infrastructure development) and subsequent human occupation affecting nationally critically endangered, endangered or vulnerable species or ecological communities or those likely to become so.

7. Criteria under which the threatening process is eligible for listing

Identify which criteria the threatening process meets (one or more). Please note that the information you provide in this nomination form should support your claim. For further details on the criteria, please refer to [Part A](#) of the Threatened Species Scientific Committee guidelines attached to this form.

- Criterion A - Evidence that the threatening process could cause a native species or ecological community to become eligible for listing in any category, other than conservation dependant.
- Criterion B - Evidence that the threatening process could cause a listed threatened species or ecological community to become eligible for listing in another category representing a higher degree of endangerment.
- Criterion C - Evidence that the threatening process adversely affects two or more listed threatened species (other than conservation dependant species) or two or more listed threatened ecological communities.



Section 1 - Name and Description

Conservation Theme

1. The conservation themes for the assessment period commencing 1 October 2010 (for which nominations close 25 March 2010) are 'heathlands and mallee woodlands', and 'terrestrial, estuarine and near-shore environments of Australia's coast'.

*How does this nomination relate to the **conservation themes**?*

The types of development included in this nomination and their human occupation has been a major contributor to degradation of 'heathlands and mallee woodlands', and 'terrestrial, estuarine and near-shore environments of Australia's coast' (carryover theme).

Name

2. *Name of nominated threatening process. The name should accurately reflect the scope of the process based on the description and evidence provided in this form.*

Ecosystem degradation, habitat loss and species decline due to urban, semi-urban, industrial & other similar development (e.g. infrastructure development) and subsequent human occupation affecting nationally critically endangered, endangered or vulnerable species or ecological communities or those likely to become so.

Description

3. *Description of the threatening process that distinguishes it from any other threatening process, by reference to:*
(i) *its biological and non-biological components;*
(ii) *the processes by which those components interact (if known).*

THE THREAT.

Urban development invariably occurs on fertile soils on flats and gently undulating plains at lower elevations in other words areas that were formerly arable farmland. Constructing the farmland destroyed the (often lush) native vegetation present in these areas to such an extent that the ecosystems remaining and the species they contained became threatened. In some cases species or communities or both became extinct. Replacing farming with urban development compounds the problem. It not only displaces much of the remaining seriously degraded (and sometimes not) remnants of threatened ecosystems but when it occurs, without an adequate buffer zone, in close proximity to the better quality remnants, it poses an intolerable threat as we hope to show in the following. In addition fertile (especially basaltic clay) soils are usually much more unstable than infertile soils and do not provide good foundation for roads and buildings. Fertile soil may be required for farming but it is neither necessary nor desirable for urban development. Development can also degrade threatened aquatic communities and ecosystems and any threatened species they support.

Unlike land clearing per se the erection of houses and other buildings, fences, roadways, shopping centres, car parks etc presents an abnormal barrier to the movement (which, for example, encourages inbreeding) of fauna and the fertilization and propagation of flora. In this and other ways it isolates remnants protected by land clearing restrictions and may in fact negate this protection. Patch sizes may be too small to withstand diseases and may not survive insect attack if also too small to support viable populations of insectivorous fauna. It also has distinctive effects on air movement and micro climate as well as producing a number of effects described below.

Therefore the potentially threatening process we are nominating is the degradation of listed (or likely to be) species and communities by urban, semi-urban, industrial and related development (e.g. infrastructure development) in their vicinity.



DEGRADING EFFECTS.

Some of the major degrading effects are as follows:

1. Hydrology: Invariably the hydrology of an area is altered by urban development. More obviously this occurs to ensure adequate drainage of the area and to minimize local flooding. This has a degrading effect on some remnant vegetation. For example, stands of Red Gums at Lyndhurst, southeast of Melbourne, are dying as a result of the changes to hydrology that were necessary to ensure proper drainage for residential development in the area (██████ – pers. comm.). Changes to hydrology can occur for other reasons, for example to provide a detention basin or to move a drainage line to what is considered to be a more appropriate location or to replace it with underground pipes. Changes to hydrology can degrade vegetation, which is especially important if the threatened communities are already in a degraded state as is frequently the case. None of the existing action statements seem to adequately address this issue. Ultimately, the solution could well be to keep urban development well away from threatened vegetation communities.

Increased run off from urban development can result from covering areas with impervious surfaces and this may have a degrading effect on both waterways and vegetation through which the increased flows pass. Furthermore, urban development usually increases the amount of pollution in storm water, which may also have a degrading effect especially on sensitive native vegetation. Again, this may not be particularly significant if the vegetation is not threatened as noted above. In addition, this does not appear to be adequately dealt with in action statements.

2. Traffic: Additional traffic (foot, cycle and even motor vehicle) associated with urban development, in and around remnants of threatened vegetation, can degrade vegetation by causing soil compaction and providing greater means for spreading disease (e.g. *Phytophthora cinnamomi*). Increased spread of diseases from these mechanisms is more likely to occur adjacent to urban development. This may not be significant if the vegetation is not threatened since it will most likely be more prolific and protected in other areas so that its degradation adjacent to urban development may not pose a serious threat. Where vegetation is highly threatened (perhaps critically endangered) all remnants, even the most degraded, may require special protection from disease (and other threats of increased traffic) if extinction is to be prevented. Threatened vegetation communities are usually grossly under represented in reserves or not at all.

3. Restricted management: Restriction on the techniques available for proper management of threatened vegetation adjacent to urban development results in further degradation. This is of great concern if a threatened vegetation community is involved. For example, many threatened vegetation communities require ecological burning as part of their management strategy but, due to other conflicting objectives, this is usually not possible abutting residential development. For example see Victorian FFG Action Statement No 53 Western (Basalt) Plains Grassland Community, which notes this shortcoming but does not mandate a remedy.

4. Introduced species: Proliferation of introduced species tends to occur more especially adjacent to urban development further degrading remnants of native vegetation. The disturbance zone created by adjacent developments is often more readily colonized by exotic species, due to a number of fringe effects (see for example 2.3.2 (i) para.2 in "Urban Bushland Under Threat: Review of Urban Bushland & Recommendations for its Protection", May 1996 The Nature Conservation Council of NSW). Again this may not be so significant if the vegetation is not threatened as noted above.

The presence of domestic animals and poor control of them and the increased risk of them becoming feral is greater where there is urban development. Feral animals threaten native wildlife by direct predation or increased competition. The destruction of wildlife may contribute to the degradation of vegetation community remnants and in threatened communities may place species at risk of extinction.

Introduced species of both flora and fauna normally associated with urban development, e.g. rodents, may compete with (or otherwise place stress on) native species of both flora and fauna thereby potentially contributing to the degradation of threatened communities already on the path to extinction and unable to withstand such pressures, pressures which non-threatened communities may be able to tolerate.

5. Change in assemblage: There are native species that thrive adjacent to urban development while others progressively decline. When this occurs in a native vegetation community it can distort the mix of species. If the species mix is altered significantly, this is an effective form of degradation. Again this may not be particularly significant if the community is abundant and not threatened as noted above. The effect can occur with fauna as well as flora, especially fauna that may be critical to the health of a threatened ecosystem remnant.

Some insectivores (e.g. pardalote) tend to decline adjacent to urban development. This can have the effect of



reducing the natural protection of native vegetation against debilitating pests. It is particularly significant if the vegetation is already stressed, as is usually the case with threatened vegetation communities.

6. Construction activities: The process of construction for both buildings and infrastructure (e.g. roads) can frequently degrade native vegetation and is especially significant if the vegetation is threatened. EPA rules help to minimize the damage caused by dust, trampling by foot and machinery, run-off from the construction site, waste etc but are frequently ignored. Degradation may occur inadvertently because the presence of the threatened vegetation has not been identified. This may be because the remnants are degraded or because it is a time of the year when their presence is not readily identifiable. The threat to listed species and communities could be eliminated if construction was kept well away from them. None of the existing action statements seem to adequately address this issue.

7. Pollution: Increased carbon dioxide level has been identified as a potential cause of dieback in both trees and other native vegetation. Increased levels of carbon dioxide tend to occur where there is urban development (from both motor vehicles and home heating). This degradation may not be of great consequence in vegetation communities that are not threatened but it can accelerate the decline of threatened vegetation communities that are invariably already degraded and in decline. Pollution from household and industrial waste tends to become more significant the closer the proximity to urban development. Such pollution affects vegetation communities as well as waterways. The degradation to non-threatened communities may not be of undue concern but its impact may be significant if it causes degradation to a threatened community. There are potentially two solutions: eliminate the waste or prevent development from occurring close to threatened vegetation communities (as distinct from non-threatened communities). Attempts to achieve the former have had limited success. If the latter approach were adopted it would most likely solve this problem.

Appendix A lists a number of extracts in support of the above as well as other degrading affects. Appendix D lists threats from urban and industrial development to our water environments and the species and communities therein and may apply to a greater or lesser extent depending on the circumstances. Many of the issues raised have implications for terrestrial ecosystems. Such threats have special significance for threatened communities. Maintaining adequate distance between development and waterways and drainage lines feeding them is crucial to prevent the degradation of threatened communities in water environments and adjacent riparian areas. When such distances are great enough intervening vegetation may also act as a filter.

While many non-threatened and abundant vegetation communities may be able to **withstand** some loss and degradation without being threatened with extinction, many of our threatened ecosystems are on the brink of extinction and others are not too far away. Most of our non-threatened vegetation communities are not only abundant but also protected in **green wedges and reserves**. Not so our threatened communities.

Conservation and reservation has tended to favour less depleted EVC's possibly because there are more good quality remnants of reasonable size. For example, Table A, Appendix A shows the reservation of broad vegetation types in the greater Melbourne area (Port Phillip & Westernport catchment) and shows the disproportionately neglected reservation of threatened vegetation types. A further example is FFG listed (Victorian Government Gazette, 20 September 2005) Western Basalt Plains (River Red Gum) Grassy Woodlands the reservation of which is zero.

The priority need therefore, is to provide protection to the threatened, rather than all native vegetation communities so as to direct the threat away from the weakest. Protection of all native vegetation communities against the urban threat could dilute the effect of that protection, protection which should be concentrated where it is most desperately needed.



Section 2 - Impacts on Native Species and Ecological Communities

Notes:

- General information on the mechanism of impact should not be included in this section - this is part of the description.
- In this section only one pair of questions 4/5, 6/7 or 8/9 need to be answered. However, providing all available evidence against each question will aid in assessment on the nomination.
- The criteria for listing a species ([Part B](#)) or ecological community ([Part D](#)) under the EPBC Act are and the Threatened Species Scientific Committee guidelines at the end of this form. It is important to refer to these criteria when answering questions in this section.
- The EPBC Act lists of threatened species and ecological communities are available on the Department of Sustainability, Environment, Water, Population and Communities website at: www.environment.gov.au/biodiversity/threatened/index.html

Non-EPBC Act Listed Species/Ecological Communities

4. Provide a summary of those species or ecological communities, other than those that are listed under the EPBC Act, that could become eligible for listing in any category, other than conservation dependent. Please include:

- For each species: the scientific name, common name (if appropriate), category it could become eligible for listing in;
- For each ecological community: the complete title (published or otherwise generally accepted), category it could become eligible for listing in.

Species/Ecological Community	Category

5. Provide justification that the species or ecological communities detailed at question 3 could become eligible for listing in any category, other than conservation dependent. For each species/ecological community please include:

- data on the current status in relation to the criteria for listing;
- specific information on how the threatening process threatens this species/community;
- information on the extent to which the threat could change the status of the species/community in relation to the criteria for listing.

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EPBC Act Listed Species/Ecological Communities

6. Provide a summary of those listed threatened species or ecological communities that, due to the impacts of the threatening process, could become eligible for listing in another category representing a higher degree of endangerment. Please include:

- a. For each species: the scientific name, common name (if appropriate), category it could become eligible for listing in;
- d. For each ecological community: the complete title (published or otherwise generally accepted), category it could become eligible for listing in.

Species/Ecological Community	Category

7. Provide justification that the species or ecological communities detailed at question 6 could become eligible for listing in another category representing a higher degree of endangerment due to the impacts of the threatening process. Please include:

- a. data on the current status in relation to the criteria for listing (at least one criterion for the current listed category has been previously met);
- b. specific information on how the threatening process significantly threatens this species/community;
- e. information on the extent to which the threat could change the status of the species/community in relation to the criteria for listing. This does not have to be the same criterion under which the species/community was previously listed.

8. Provide a summary of those species or ecological communities, listed as threatened under the EPBC Act, that are considered to be adversely affected by the threatening process. Please include:

- f. For species: the scientific name, common name (if appropriate) and category of listing under the EPBC Act;
- g. For ecological communities: the complete title (exactly as listed) and category of listing under the EPBC Act.

The following list is not exhaustive but includes threatened species and communities where development is identified as a threat in national recovery plans for those items. Extracts from relevant recovery plans are included in Appendix B.

THREATENED SPECIES

1. Acacia attenuata (Acacia attenuata)
2. Anglesea Grevillea (Grevillea infecunda)
3. Audas' Spider-orchid- (Caladenia amoena)
4. Bare-rumped sheath-tail bat- (Saccolaimus saccolaimus nudicluniatus)-
5. Black-throated finch- (Poephila cincta cincta)
6. Blue Babe-In-The-Cradle Orchid- (Epiblema grandiflorum var. cyaneum ms)
7. Cascade Tree frog- (Litoria pearsoniana)
8. Chingia australis- (Chingia australis)
9. Christmas Island Frigatebird- (Fregata andrewsi)
10. Christmas Island Shrew- (Crocidura attenuata trichura)
11. Crested Shrike-tit [northern (sub)species]- (Falcunculus (frontatus) whitei)
12. Davidson's Plum- (Davidsonia jerseyana)
13. Downy Wattle- (Acacia pubescens)
14. Eastern Spider-orchid- (Caladenia fragrantissima ssp orientalis)-
15. East Lynne Midge Orchid- (Genoplesium vernale)
16. Frankston Spider-orchid- (Caladenia robinsonii)
17. Glossy Black-Cockatoo (South Australian subspecies)- (Calyptorhynchus lathami halmaturinus)
18. Granite featherflower- (Verticordia staminosa subsp. cylindracea var. cylindracea)
19. Graptophyllum reticulatum- (Graptophyllum reticulatum)
20. Grassland Earless Dragon- (Tympanocryptis pinguicolla)
21. Great Desert Skink- (Egernia kintorei)
22. Great White Shark- (Carcharodon carcharias)
23. Greater Bilby- (Macrotis lagotis)
24. Green turtle- (Chelonia mydas)
25. Grevillea caleyi- (Grevillea caleyi)
26. Illawarra Greenhood Orchid- (Pterostylis gibbosa)
27. Illawarra Socketwood- (Daphnandra sp. C 'Illawarra')
28. Illawarra Zieria- (Zieria granulata)
29. Long-sepalled Daviesia- (Daviesia megacalyx)
30. Mahogany glider- (Petaurus gracilis)
31. Masked Owl [Tiwi Islands subspecies]- (Tyto novaehollandiae melvillensis)
32. Mitchell's Rainforest Snail- (Thersites mitchellae)
33. Moresby Range Drummondita- (Drummondita ericoides)



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34. Morrisbys gum- (*Eucalyptus morrisbyi*)
35. Mt Emu she-oak- (*Allocasuarina emuina*)
36. Narrow-petalled Featherflower- (*Verticordia plumosa* var. *pleiobotrya*)
37. Nodding Geebung- (*Persoonia nutans*)
38. Oxleyan pygmy perch- (*Nannoperca oxleyana*)
39. Pinnate-leaved Eremophila- (*Eremophila pinnatifida*)
40. Red handfish- (*Brachionichthys politus*)
41. Ripple-leaf Muttonwood- (*Rapanea* species)
42. Slender Andersonia- (*Andersonia gracilis*)
43. Smooth Davidsonia- (*Davidsonia johnsonii*)
44. Somersby Mint Bush- (*Prostanthera junonis*)
45. Southern cassowary- (*Casuarius casuarius johnsonii*)
46. Strickland mintbush- (*Prostanthera askania*)
47. Summer Leek-orchid- (*Prasophyllum morgani*)
48. Sunshine Diuris- (*Diuris fragrantissima*)
49. Swift Parrot- (*Lathamus discolor*)
50. Tasmanian Grasstrees- (*Xanthorrhoea arenaria* *Xanthorrhoea bracteata*)
51. Tasmanian Wedge-tailed Eagle- (*Aquila audax fleayi*)
52. Thymelaeaceae- (*Pimelea spicata*)
53. Tunbridge Buttercup- (*Ranunculus prasinus*)
54. Wallum sedgefrog and other wallum-dependent frog species- (*Litoria longburensis*)
55. Western Swamp Tortoise- (*Pseudemys umbrina*)
56. Whicher Range Dryandra- (*Dryandra squarrosa* subsp. *Argillacea*)
57. Yellow Chat (Dawson)- (*Epthianura crocea macgregori*)
58. Zieria involucra (*Zieria involucra*)

THREATENED COMMUNITIES

1. Aquatic root mat communities numbers 1-4 of caves of the Leeuwin-Naturaliste Ridge-
2. Eastern Shrublands and woodlands (nationally listed as Shrubland and Woodlands of the eastern Swan Coastal Plain)-
3. Eastern Suburbs Banksia Scrub Endangered Ecological Community- (Eastern Suburbs Banksia Scrub.)
4. Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)- (Natural Temperate Grassland of the Southern Tablelands (NSW and ACT))
5. Lord Howe Island Biodiversity-

9. Provide justification that the species or ecological communities detailed at question 8 are affected adversely by the threatening process.

The species and ecological communities detailed at question 8 are affected adversely by the threatening process (nominated here) as outlined in their EPBC act national recovery plans, extracts of which are provided as Appendix B.

Over 40% of nationally listed threatened ecological communities and more than 50% of threatened species occur in the urban fringe (Newman et al. (2001) P13. See appendix A). Their continuing decline and the threats from all aspects of development and occupation by humans is well documented (see appendices). Concentrations of threatened species frequently occur near development or areas proposed for development (Victorian Flora and Fauna Guarantee act Action Statements - see Appendix C). The largest present and future threat to endangered plants species is low numbers (Australia's Environment: Issues and facts (Cat. No. 4140.0 p 25 - see Appendix C). Reinstatement of threatened habitat is generally considered to be at least part of the solution. Development of land suitable for reinstatement prevents that reinstatement.

Although residential and industrial development is not at the head of the list it is implicated in other major items (e.g. roadworks, weed competition). While the present and future threat from agriculture is less than half the past threat, that from industrial and urban development remains the same. **There is no overwhelming reason why development needs to occur in areas where species and communities are at risk.** There are invariably suitable alternatives. Restriction of development to a healthy distance from these areas could substantially reduce the risk or at least stop it from becoming worse and thus make at least a similar contribution to that made by agriculture. It may also allow reinstatement of habitat. Further, it may improve the quality of development. By encouraging development away from farmland it is more likely to encourage it into stable but infertile upper slopes of hilly areas with a view and less prone to flooding and tsunamis.

Loss of biodiversity is further contributed to because development tends to occur where there is the least information about biodiversity (A Reference Guide to the Ecology and Natural Resources of the Melbourne Region" Mark J. McDonnell et al 1999 ARCUE - see Appendix C).



Existing clearing controls protect better quality remnants of threatened ecosystems but do not prevent them from being surrounded by development nor do they guarantee areas for recruitment necessary to ensure their long-term survival. Where connecting corridors are provided the resulting assemblages usually have an unnatural configuration and extraordinarily high perimeter to area ratio and are still surrounded by development. Clearing controls also do not guarantee a distance between remnants of listed communities and the threats posed by all aspects of development and which are generally common knowledge; a distance sufficient to provide reasonable protection and promote long-term viability.

Areas that have been cleared but not built on are potentially available for reinstatement but once they have been built on the loss is effectively permanent. Something in addition to clearing controls is necessary if those clearing controls are to be effective in ensuring the continued high quality of remnants and their ultimate survival. This nomination is intended to deal with the threats of development other than the clearing of good quality remnants and to complement the latter and to thus assist in halting the continuing decline of listed species and communities.

There are many rules and regulations designed to ensure the protection of threatened species and communities but their effectiveness is often compromised because they are difficult to police. Probably the major cause of biodiversity loss is, indirectly, the rezoning of areas for development that seriously affects listed items. A current example is the proposal by the Victorian government to extend the Melbourne urban growth boundary into listed grassland areas. We suggest listing the development, nominated here as a key threatening process, would discourage this practice, which we believe to be a contravention of the Convention on Biological Diversity.

Section 3 – Threat Abatement Plan

Threat Abatement

10. Give an overview of how threats posed by this process are being abated by current (or proposed) activities. Identify who is undertaking these activities and how successful the activities have been to date.

11. Would the development of a threat abatement plan be a feasible, effective and efficient way to abate the process? What other measures could be undertaken?

We are told that fertile land is scarce. Conversely, there is no shortage of marginal farmland around most Australian cities and towns, marginal farmland suitable for residential development, where there are no EPBC listed (or likely to be) vegetation communities or habitat for EPBC listed (or likely to be) species. There is therefore no need to develop in or near EPBC listed vegetation communities (or habitat for EPBC listed species). Buffer zones, between these areas and the nearest development, could be easily made to occupy great distances perhaps many kilometers negating any potential threat.

The cost of developing infertile areas is of the same order as developing arable farmland. The fertile soils of arable farmland, particularly the rich basaltic clays, are unstable and unsuitable for foundations. Flat, fertile areas are also usually prone to local inundation if not stream flooding. "In total, only a small area of the country has soils with the valuable characteristics of being deep and well drained with high fertility and high water holding capacity" (Sinclair 1999).

Marginal farmland is usually "land with a view" occurring on the upper slopes of undulating landscape remote from waterways and where drainage is invariably excellent. Infertile soil tends to be shallow and the subsoil quite stable and well suited to foundations. Historically the clearing of native vegetation in infertile areas occurred much less than fertile areas. Most vegetation communities associated with infertile areas are abundant, well reserved and not threatened.

At the very least consideration of alternatives to developing where there is listed vegetation (and habitat for listed species) should be a requirement and those alternatives a first choice rather than a last choice given that there are no obvious widespread social, economic or environmental factors inhibiting their use. Such a strategy for threat abatement would seem to align with the Convention on Biological Diversity and should be necessary before land is rezoned.

12. Should the threatening process be recommended for listing under the EPBC Act, what elements could a threat abatement plan include?



13. Is there other information that relates to threat abatement that you would like to provide?

Development is a necessary part of our existence and the degradation to the environment it causes cannot be eliminated. It is important to ensure it is sufficiently **remote from threatened communities** to be of little risk and where **vegetation has to be sacrificed** it should **not** be listed communities even if the remnants are **degraded**. All remnants of listed communities (especially those critically endangered) are important. Restoration of such remnants must be part of any strategy to arrest their decline and ensure the overall long term viability of threatened ecosystems. The issues justifying this nomination together with the extent and nature of the degradation caused by urban and related development described above would seem to strongly support the proposition that the degradation of listed (threatened) communities by urban, semi-urban, industrial and related development (e.g. infrastructure development) in their vicinity requires strong measures to stop that development from occurring. Appendix E sets out some information on buffer distances that may need to be specified. It is raw data and does not include any factor of safety.

Major Studies

14. Identify major studies that might assist in the assessment of the nominated threatening process.

Section 3 – References and Reviewers

Notes:

- The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below.
- Please provide copies of key documentation/references used in the nomination.

15. Reference list

1. Ives C et al (2010). New directions in urban biodiversity conservation: the role of science and its interaction with local environmental policy. *Environmental Planning and Law Journal* 27(4): 249-271
2. Ives C et al (2010). The influence of riparian corridor width on ant and plant assemblages in northern Sydney, Australia. *Urban Ecosystems* Volume 14, Number 1, 1-16, DOI 10.1007/s11252-010-0141-8
3. Taylor MP et al (2009). Legislative and policy challenges for the protection of biodiversity and bushland habitats: An evidence-based approach. *Environmental Planning and Law Journal* 26 : 35-48
4. Ives C et al (2007). Ecological condition and biodiversity value of urban riparian and non-riparian bushland environments: Ku-ring-gai, Sydney. In Wilson, A.L., Dehaan, R.L., Watts, R.J., Bowmer, K.H. and Curtis, A. *Proceedings of the 5th Australian Stream Management Conference. Australian Rivers: making a difference.* Charles Sturt University, Thurgoona, New South Wales, pp. 163-168.
5. Wright IA et al (2007). Aquatic macroinvertebrates in urban waterways: comparing ecosystem health in natural reference and urban streams. In Wilson, A.L., Dehaan, R.L., Watts, R.J., Bowmer, K.H. and Curtis, A. *Proceedings of the 5th Australian Stream Management Conference. Australian Rivers: making a difference.* Charles Sturt University, Thurgoona, New South Wales, pp. 467-472.
6. Drinnan IN (2005). The search for fragmentation thresholds in a southern Sydney suburb. *Biological Conservation* Volume 124, Issue 3, August 2005, Pages 339-349
7. Ives C et al (2005). How wide is wide enough? The relationship between riparian buffer width, condition and biodiversity: An assessment of urban creek systems in the Ku-ring-gai Local Government Area, North Sydney, NSW. In Khanna, N., Barton, D., Beale, D., Cornforth., R., Elmahdi, A., McRae, J., Seelsaen, N., Shalav, A.



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(Eds), Environmental Change: making it happen: 9th Annual Environmental Research Conference, 29th November to 2nd December 2005, Hobart, Tasmania.

8. Brumm H (2004). The impact of environmental noise on song amplitude in a territorial bird. *Journal of Animal Ecology* (2004) 73, 434–440
9. Chace JF & Walsh JJ (2004). Urban effects on native avifauna: a review. www.elsevier.com/locate/landurbplan
10. Longcore T & Rich C (2004). Ecological light pollution. *Frontiers in Ecology and the Environment* 2(4): 191-198.
11. Stenhouse RN (2004). Fragmentation and internal disturbance of native vegetation reserves in the Perth metropolitan area, Western Australia. *Landscape and Urban Planning* 68: 389-401.
12. Wilkins SD et al (2003). Measuring success: Evaluating the restoration of a grassy eucalypt woodland on the Cumberland Plain, Sydney, Australia. *Restoration Ecology* 11(4): 489-503.
13. Robinson NA & Marks CA (2001). Genetic structure and dispersal of red foxes (*Vulpes vulpes*) in suburban Melbourne. *Australian Journal of Zoology* 49: 589-601.
14. De Molenaar JG et al (2000). Road illumination and nature III: Local influence of road lights on a black-tailed godwit (*Limosa l. limosa*) population. *The Netherlands: Alterra, Wageningen*.
15. Sinclair IW (1999). Is there a Future for Australia's Agricultural Land? RAPI National Congress Darwin 1999.
16. Forman RTT & Alexander LE (1998). Roads and their major ecological effects. *Annual Review of Ecology and Systematics* Vol. 29: 207-231
17. Pal SK et al (1998). Dispersal behaviour of free-ranging dogs (*Canis familiaris*) in relation to age, sex, season and dispersal distance. *Applied Animal Behaviour and Science* 61: 123-132.
18. Sewell SR & Catterall CP (1998). Bushland modification and styles of urban development: their effects on birds in south-east Queensland. *Wildlife Research* 25: 41-63.



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Appendix A. Extracts relating to the nature of the threat and its degrading effects.

"In 1991, a rare spider orchid was found on Chris and Vasi Kondouris' property in Kilsyth South. The 23 plants were the only known survivors of the species and in order to protect them the Kondourises were prevented from extending their house and driveway. But fragile and endangered Victorian orchids are not always treated so respectfully. About half of the state's 300 or so orchid species are threatened, with many surviving on a handful of sites or a single location. The degradation of native grassland, one of the most endangered vegetation types in southern Australia, has contributed to their demise. (About half the grasslands remaining around Melbourne have disappeared since 1985, prey to roads, housing, weeds and industrial developments.)"

Now ecologists are concerned that Melbourne 2030, the State Government's urban development strategy, has no framework to protect the habitats of 120 endangered plants and animals. According to research by RMIT lecturer Sarah Bekessy and University of Melbourne research fellow Brendan Wintle, species living on the urban fringes, many in areas earmarked for housing over the next 30 years, include native orchids, the legless lizard, the orange-bellied parrot, the golden sun moth, the Eltham copper butterfly and the earless dragon. The ecologists support the aims of Melbourne 2030, which seeks to define the urban growth boundary and encourages higher density housing. But they say councils in Melbourne's outer areas that are responsible for managing biodiversity are ill-equipped to do so. They are also concerned that consultants are given only three weeks to conduct a biodiversity analysis for each corridor, which is not enough time. At present, "net gain" guidelines provide that in areas where land-clearing cannot be avoided, more trees are planted than cut down. But Dr Bekessy and Dr Wintle say the policy is untested.

Recently, the World Conservation Union announced its annual Red List of endangered species and warned that extinctions were occurring at up to 1000 times the natural rate. Victorians have a responsibility to the rare and vulnerable plants and animals that share the land with them. The ecologists have presented the State Government with an opportunity to correct an important oversight. They should not be ignored."

(Article in the Age "Protecting rare suburban species" December 22, 2004)

"The separation of the Australian continent from other landmasses following the gradual breakup of the Gondwana supercontinent about 140 million years ago, has provided the Australian flora and fauna a rare opportunity to evolve in isolation for at least the past 50 million years. Australia's numerous climactic zones and varied habitats have given rise to an enormous diversity of species. Many Australian species are unlike any other plants and animals elsewhere. A staggering 93% of Australian frogs, an astounding 89% of Australian reptiles, 85% of our flowering plants, 85% of our in-shore temperate zone fish and 84% of our terrestrial mammals are uniquely Australian and do not occur naturally anywhere else in the world (ABS 1996, SEAC 1996).

Species extinction has accelerated following European settlement. The last 200 years has seen a dramatic change in Australia's natural ecosystems. For instance, a wide range of exotic plants and animals were introduced, many of which have become weeds and destructive pests, causing widespread ecological problems at an unprecedented rate and scale. A third of all recorded world extinction of mammals this century have occurred in Australia. Moreover, there are more threatened species of amphibians and reptiles in Australia than in any other country.

The increase in population and the intense push for economic progress are two factors which have led to declines in biodiversity. The extensive clearing of land for development and poor land management practices, pollution of waterways, exploitation of natural resources, the impact of exotic and feral species, and commercial hunting by humans, are some of the major



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causes of natural habitat destruction and the subsequent demise of species. Many species of plants and animals have been driven to extinction by these forces, with many more threatened and endangered."

(<http://www.abs.gov.au/Websitedbs/c311215.nsf/20564c23f3183fdaca25672100813ef1/bc7dc08a640751f8ca2569e70003c7f6!OpenDocument>)

". . . and fragmentation of vegetation for urban and associated infrastructure development remain the main threats to lowland communities." **(ACT State of the Environment Report 2003 Indicator: Ecological Communities).**

"The more intensive forms which are generally irreversible, include urban growth."

.....Urbanisation places pressures on the natural biodiversity of an area. Urban sprawl into the bushland fringe causes the physical destruction of natural habitats, causes pollution (including nutrient enrichment), and introduces a range of animal and plant species, including predators such as cats and dogs. Such factors push back the boundary of the natural area, sometimes to the point where there is no longer enough area to support some elements of the biota.

The coastal zone in Tasmania has been particularly affected by urban development. Many wetlands have been drained and saltmarshes destroyed either directly by development, or indirectly through the alterations and contamination caused by run-off from such areas. Ribbon development along the shore, in particular, has seriously disrupted many ecologically important sea-to-land transitions which are essential for many species, including penguins, intertidal molluscs and crustaceans.

While urbanisation has not resulted in the extent of clearance that some other broad-scale land use activities have, Tasmania's larger urban areas are concentrated in areas containing vegetation types which have been substantially cleared, including: grasslands and grassy woodlands, coastal heathland, dry forests and wetlands....." **(State of the Environment Tasmania 2005 Biodiversity Urban Growth).**

"A variety of issues have threatened the fauna, vegetation and landscape of the park. These include urbanisation and recreation impacts.

Urbanization

Residential development (abutting the park's boundaries) is the single greatest threat to the indigenous fauna and flora of Dandenong Ranges National Park." **(Parks Victoria Dandenong Ranges National Park Page 32 Education Resource Kit Resource sheet 6 – Note: Although the ecosystems in the Dandenong Ranges National Park are **not** under threat of extinction this highlights the degradation caused by residential development).**

"Residential development, especially in growth corridors, city fringes and holiday towns often involves the clearing of native vegetation.

Even so-called sensitive development poses risks to the integrity of remaining natural ecosystems. Habitat degradation occurs with the introduction of pest plants and animals. The construction of buildings and roads alters drainage patterns and soil structure, while altered nutrient levels from run-off and septic tanks can also cause other long term problems.

The smaller the untouched ecosystems and the greater the intensity of development around



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the edges, the faster these destructive elements can cause a loss of habitat quality.

In some coastal areas the degrading influence of residential development may also extend to nearby foreshore and marine ecosystems.

Some ecosystems, especially grasslands and heathlands, are changed significantly by inappropriate fire regimes. Conflicts between ecological burning requirements and the need to protect residential development within or adjacent to these areas are difficult to resolve.

Case study: Termeil Guesthouse on the NSW South Coast required cabins to be built in a remnant rainforest area.

Recognising that any development on the site would have some impact....."
(<http://www.greenhouse.gov.au/yourhome/technical/fs51.htm> - Comment: In the case of listed ecosystems we cannot afford the luxury of "some impact" since some of them are close to extinction. It is interesting to note the reference to the "smallness" of the untouched ecosystem. Usually the more threatened the ecosystem **the smaller the remnants especially quality remnants.)**

"The loss of native vegetation is widely regarded to be the single most significant threat to biodiversity.

.....Subdivision of land into small to medium-sized blocks for residential development poses a threat to conservation of native fauna in many municipalities. Large areas of native habitat are being divided, and reduced to isolated fragments, too small to sustain viable populations of native animals."

(From a feature article published in the Tasmanian Year Book, 2000 cat. no. 1301.6 <http://www.abs.gov.au/Ausstats/abs@.nsf/90a12181d877a6a6ca2568b5007b861c/859875e0a9d1a38bca256c32002417b0!OpenDocument>).

"Although the growth of cities and towns has only affected land cover over a small area (less than 0.1%) (SEE FOOTNOTE 4), it can have regional effects. Most of the urbanisation has occurred around the coast, sometimes in regions of high biodiversity, while future housing development in some areas may entail clearing endangered (now remnant) woodland communities such as the Cumberland Woodland around Sydney, now an endangered ecological community. (SEE FOOTNOTE 5)"

(Measuring Australia's Progress 2002 [http://www.abs.gov.au/ausstats/abs@.nsf/0/1C36C09104A4765ACA256BDC001223FE?](http://www.abs.gov.au/ausstats/abs@.nsf/0/1C36C09104A4765ACA256BDC001223FE?Open) Open)

"The biodiversity value of remnant vegetation in the urban fringe is considered nationally significant, with over 40% of nationally listed threatened ecological communities⁶ and more than 50% of threatened species occurring in these areas."

(Newman et al. (2001) P13. *Human Settlements Theme, Australia State of the Environment Report 2001. An independent report to the Commonwealth Minister for Environment, Department of Environment, Sport and Territories. CSIRO Publishing.*)

"According to the Melbourne 2030 plan, Melbourne's Green Wedges, located outside the Urban Growth Boundary, are meant to ensure the permanent protection of critically important flora and fauna habitat in the greater Melbourne area. Unfortunately decision making and planning for urban fringe areas has been largely conducted in the absence of ecological knowledge. As a consequence we have little idea of whether the Urban Growth Boundary and Green Wedges guarantee biodiversity conservation in Melbourne. There are many areas



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of high biodiversity value in the identified urban fringe growth corridors, located within the Urban Growth Boundary.

The rapid growth of urban areas has resulted in the loss of native habitats and fragmentation of the landscape and **urbanisation** is now considered one the greatest threats to Australia's biodiversity. The biodiversity value of remnant areas in Australia is considered nationally and internationally significant, with over 40% of nationally listed threatened ecological communities and more than 50% of threatened species occurring in urban fringe areas." (<http://www.aius.org.au/indicators/casestudy.cfm?ThemeID=8&CaseStudyID=46&CaseStudies=true>).

"Metropolitan Melbourne is rich in indigenous flora and fauna – a fact that more of us need to know and celebrate. Approximately 1800 native plant species and 432 native vertebrate species (45 mammals, 293 birds, 35 reptiles, 18 amphibians and 41 fish) were recorded between 1994 and 2004. The greater Port Phillip and Western Port Region of which metropolitan Melbourne is a part, is one of the most biologically diverse regions in Victoria with 1860 indigenous plant species, 616 indigenous vertebrate fauna species and thousands of invertebrate species.....

Over 180 years of urban development and agriculture has left Melbourne with almost one-third (32%) of its original vegetation (Indicator BD1, but more detail can be found in Bulletin 6). A preliminary estimate of native vegetation quality across the region suggests that 25% of this vegetation is in poor condition, 25 % in medium condition and 50% in good condition. These statistics give the impression that the remnant vegetation of the metropolitan area is in reasonable shape.

A very **different picture emerges** of Melbourne's remnant vegetation if you consider that around 70% of the remaining 32% is in the forest areas of the outer water catchments. That means that in the rest of the metropolitan area only 10% of the original vegetation remains. Also, the vegetation of the outer water catchments is generally in good condition, whereas most of the metropolitan remnants are in poor condition. The urban remnants are highly fragmented, damaged, riddled with weeds, impinged on by development and agriculture, and invaded by introduced animals. Our city's remnant vegetation is in need of help.....

Australia has the world's worst record of mammal extinctions – we have lost 10 of 144 marsupial species and 8 of 53 rodent species in the past 200 years. Some 5% of flowering plants, 23% of mammals, 9% of birds, 7% of reptiles, 16% of amphibians and 9% of freshwater fish are extinct, endangered or vulnerable.

When a species is 'threatened' it means that it is at risk of extinction.....

Melbourne is home to an incredibly large number of threatened species. There are 70 plant species (4% of indigenous plant species), 66 animal species (14% of indigenous vertebrates) and 10 ecological communities that are listed as threatened (Indicator BD4). The threatened fauna consists of 7 mammals (16% of indigenous mammals), 43 birds (15%), 4 reptiles (11%), 3 frogs (11%), 6 fish (25%) and 3 invertebrates. Some of the species found only in the Melbourne area are the Helmeted Honeyeater (see case study), Kilsyth South Spider-orchid (case study Bulletin 6) and the Sunshine Diuris (see case study). Complete lists can be found in Appendices B and C.....

In summary, there are now 149 Nationally, 288 State, 406 Regionally and 72 Locally significant sites of biodiversity significance recorded in the Port Phillip Region, of which approximately 79% are mapped." (<http://www.aius.org.au/indicators/sectiontype.cfm?ThemeID=8&SectionTypeID=2&SectionTypes=true>).



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"Bushland remaining in the Sydney region is under threat from a broad array of pressures, including displacement by urban development and the effects of urban development on adjacent bushland. It is important to identify these threats in order to develop appropriate bushland management strategies.

A number of threats were identified by local councils in the SOE reports. These have been expanded from observation and from other reports (DOP 1991, NCC 1992 (a) & (b), Mather 1990, National Trust 1990, McLoughlin 1992, Urban Bushland Management 1992) to form a comprehensive list (see S 2.3.1 below). The major categories of threats to bushland are degradation, which occur on both publicly and privately owned land.

It is important to note that in relation to degradation, inadequate knowledge of the natural ecological values of bushland (including flora and fauna) invariably means that decisions on development and management of bushland are made without proper understanding of the impacts. Reference to the 'Precautionary Principle' is important in this context "where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental damage". "

"2.3.1 . . .

The . . . incremental loss, fragmentation and isolation of bushland threatens biological diversity and the integrity of ecological process in remaining bushland, as well as causing local extinctions and loss of a variety of environmental and sociological values. Once bushland has been cleared for development, it may be impossible to return it to its natural state.

Clearing decreases the size of the remaining habitat available for animals and plants to survive, interact and reproduce, and severs interconnection to other bushland areas, decreasing the opportunity for genetic interchange and for re-establishment of species following events such as bushfires. Clearing and development of catchments results in the loss of vegetative cover and leaf litter which plays a crucial role in the protection of soils and water quality and in promoting infiltration of stormwater. Clearing disrupts natural drainage patterns, increases stormwater run-off and causes erosion of soils and siltation of adjacent land and of watercourses.

Historically, natural vegetation has been retained on land which was unsuitable for residential development and rural use, such as steeply sloping land and land with low fertility. This has resulted in disproportionate loss of vegetation types and of species previously occurring on floodplain areas and on rich agricultural soils In addition, vegetation which was retained is often downslope or downstream of development and hence subject to greater degrading processes

(i) Urban development and associated infrastructure

Clearing is most often undertaken for the purpose of urban development or for purposes ancillary to urban areas such as urban services (power, sewerage, water, gas, communications links), community clubs and sports areas, rubbish dumps, parking areas, roads and motorways and many others.

(ii) Urban consolidation

Loss of.... (native vegetation).... through subdivision, paved parking lots and roadways, medium and high density development of existing lots and intensification of single lot



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residential development for extensions, additional garages, swimming pools, tennis courts and landscaping also results in incremental loss of habitat and can eliminate important vegetation and wildlife corridors.

(iii) Stormwater management

Reconstruction of creeklines associated with urban development and flood mitigation can also result in loss of valuable remnant vegetation. Even degraded remnants along semi-natural creeklines can provide important habitat, particularly for birds, reptiles and amphibians.

(iv) Transport corridors

Linear developments such as motorways in particular, but also other roads, railways, pipelines and cleared electricity easements hinder movement of many animal species across previously intact bushland. The reduced areas of permeable surface and disturbance to existing drainage aggravates stormwater run-off problems.

(v)..... other purposes

....., for purposes such as keeping horses, growing palm trees, preference for large mown areas, bushfire protection, and occasionally to demonstrate to the consent authority that there is 'nothing significant' on the site.

Loss of bushland also occurs in an insidious way by encroachment of adjacent landowners onto bushland, particularly through deposition of fill, but also by extension of private gardens and through understorey mowing and clearing of trees for views.

2.3.2 Degradation

The second major threat to bushland is from degradation, which results from an extensive array of factors, most of which are related to adjacent urban development:

The processes of bushland degradation result in loss of native plant and animal diversity and undermine natural ecological processes. Bushland generally shows the greatest degradation where the area of the remnant is small or where the bushland is fragmented or the ratio of perimeter edge to area is high. Degradation generally coincides with streamlines and drainage lines, particularly those which carry urban stormwater run-off or which contain sewer overflow points. It is also most likely to be apparent at urban perimeter zones, particularly where the bushland is downslope of the area of urban development.

..... For this reason, lack of management or mismanagement can be seen as an additional threat to bushland. Integration of management practices for adjacent areas of bushland is also important (for example the effectiveness of weed control or feral animal control will be greatly diminished if these species are not controlled on adjacent bushland).

(i) Weed invasion and urban stormwater runoff

The degrading process which is generally most apparent in bushland is weed invasion, usually accompanied by displacement of native plant species, changed fauna habitat and loss of diversity. A number of studies have shown the relationship between weed invasion and increased nutrients and soil moisture from stormwater run-off, as well as other chemical changes, particularly in soils derived from sandstone (see Leishman 1990, Clements



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1993, Wright et al 1993, Webb 1995).

Weed seeds and propagules are carried in stormwater or by wind or birds, or are deposited in the bush by people dumping garden refuse. Native species which are not local to the area, or exotic plant species may also be planted in bushland. Growth of weeds is favoured in areas of changed soil nutrient and moisture.

Disturbance at bushland margins, with increased light intensity and changed temperature regimes also favours weed growth, with resultant unfavourable change in plant and animal communities.

(ii) Diminished water quality and changed drainage

Water is an essential component of bushland ecosystems. Changes in drainage patterns and water quality can have major impacts on vegetation communities and fauna habitat, with associated loss and endangerment of species. Wetland communities are particularly vulnerable to water quality impacts. Water related impacts on bushland include:

Changed drainage patterns and water regimes (affecting microhabitats for flora and fauna), undesirable nutrient enhancement of run-off from garden fertiliser, unconsolidated blue metal, animal faeces, etc, pollution of streamlines, surface flow and ground water (particularly related to stormwater run-off - includes heavy metals, fluid hydrocarbons, grease, oil and tyre and break lining particles from cars, swimming pool overflows and general litter), chemical changes to water from gross pollutants (see Riley S. 1995), contamination of stormwater and streams from raw sewage due to designated discharge points, and location of sewage lines along creek lines, contamination by pesticides, herbicides and other toxic substances such as leachate from tips and by accidental spillage of hazardous chemicals into drainage systems, siltation and sedimentation of drainage lines and streams and associated loss of habitat for aquatic fauna, turbid water, with a high measure of suspended solids, gross interference with stream flow, such as damming, diversion or temporary removal of creek flow for major construction work, such as freeways and bridges, land reclamation and drainage of wetlands.

(iii) Impacts on soils

Human activities and stormwater run-off associated with urban development causes the following impacts:

Change in soil nutrients, changed soil conditions due to soil disturbance and introduction of soil from outside sources (eg for tip sites, construction of recreational facilities and roads), removal of topsoil or disturbance of soil structure, erosion (particularly along tracks which channel water and change drainage patterns, also in relation to use by riders of horses, bikes and trail bikes), siltation and sedimentation of soil surfaces, soil disturbance and compaction from construction works, including sewer and other pipe installation, track construction, etc; construction of fire trails and other roads results in destruction of vegetation and habitat, changed drainage, weed invasion, erosion, access for feral animals and access for inappropriate human activities.

(iv) Inappropriate fire management

Inappropriate fire regimes and lack of understanding of the cumulative effects of fire on natural systems leads to alteration of the composition and dominance of vegetation communities and ecosystems, resulting in loss of species diversity and predominance of fire adapted species. Ill considered hazard reduction burns can also contribute to increased fire frequency, weed invasion, soil erosion and unnecessary air pollution.



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(v) Specific fauna impacts / introduced animals

Introduced species such as foxes, cats, dogs, rabbits, indian mynahs, domestic hens, and the european wasp and honeybee compete for resources and hunt or predate on and displace native animal species.

Stress, habitat loss, water pollution and introduction of new diseases impact on the health of fauna populations.

Chemicals in our environment impact on fauna in ways which are poorly researched and which often go overlooked, eg, recent deaths of Tawny frogmouths associated with high blood levels of organochlorines (Wildlife Information and Rescue Service, 1995).

Linear developments such as roads separate fauna populations, cut through home ranges and increase risk of road kills.

Fauna residing in bushland areas are not restricted by bushland boundaries and are subject to a wide range of injury and accidental death from human made alterations to their environment, such as electrocution on electricity lines, drowning in swimming pools, starving to death with heads stuck in aluminium cans, etc. Well intentioned human activities such as feeding birds or garden design which promotes the survival of some animal species at the expense of others can also adversely affect natural processes and species survival.

(vi) Direct human interference

Undesirable human impacts include:

Dumping of garden refuse and other rubbish including cars, removal of plants and soil, removal of animals for private collection or sale, disturbance of habitat by collection of firewood and bushrock, trampling of vegetation, track formation, inappropriate vehicular use, destructive play and vandalism, arson , mowing of the understorey, bushland regeneration/restoration work which is carried out without guidance from trained bush regenerators or which does not take into account habitat values of degraded areas, such as lantana infestation which protects bandicoot colonies, Tradescantia albiflora providing habitat for the Gully Skink, old cars and sheets of tin providing habitat for herpetofauna."

(Urban Bushland Under Threat: Review of Urban Bushland & Recommendations for its Protection, May 1996 The Nature Conservation Council of NSW).

*"In fragmented landscapes, wildlife need to move between habitat patches to exchange genes, increase the size of declining populations and recolonise areas where animals have become extinct. For many species, roads may act as barriers that prevent or limit dispersal, potentially isolating some habitats and populations. The disruption to normal movement patterns and behaviour may increase the risk of mortality, as well as threatening populations and species with extinction. Roads are clearly critical to the social and economic health of all Australians. However, conflict often arises in areas where the cumulative effect of numerous relatively minor roads (e.g. in areas of high road density such as urban or urban-rural fringe areas) exceeds threshold levels." (**"Ecological effects of roads and traffic on flora, fauna and ecological processes"**, R. van der Ree, ARCUE)*

The following is an extract from Natural Heritage Trust Annual Report 2002-03 Chapter 4: Regional Partnerships (continued) Victoria (continued) Regional summaries (continued) Port Phillip:



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"The largest proportion of funding supported native vegetation, which is continually under threat from an expanding population and the pressures of urban and industrial development."

The following is taken from Victorian FFG nomination No. 706 (p. 20)

"Development of low lying areas necessitates changes to the hydrology to improve drainage and prevent local flooding which in turn ensures the demise of the River Red Gum trees. This is not just a lack of understanding but is essential to make these areas liveable. The effect of development on River Red Gum trees is evident in other areas where nearby development has occurred, for example, at Lindenhurst to the Southeast of Melbourne. Necessary changes to hydrology is just one of many threats posed by nearby development. In Beardsell C., 1997 Sites of Faunal and Habitat Significance in North East Melbourne, NEROC vol 1, p.182 (Issue 1: Habitat destruction, modification or fragmentation) Beardsell notes:

***"Urban Issues:** residential advance into bushland (this includes issues of weed and vermin invasions, habitat fragmentation, water pollution and disturbance."*

These threats are further illustrated by the following extract again from Victorian FFG nomination 706.

"Trying to protect biodiversity within a residential development of this size is impossible. Human habitat of this intensity and the natural habitat are uneasy bed partners. We have a cosmetic view of the environment. We like kangaroos, koalas (possums are cute too) and trees; kangaroos as long as they do not make a nuisance of themselves, koalas and possums provided they do not urinate or occupy our roof space. We like trees to look at provided they do not drop their limbs or leaves (which must be cleaned up at every opportunity). We put protective fences around heritage trees that only help to further isolate them. We don't like snakes, spiders, and insects of any kind, birds that screech, dig up our gardens, or attack fruit trees. We don't like the untidiness of bush or the messiness of native animals (for example wombats defecating on our pathways).

We are careless with poison bait and raptors and owls eat poisoned rodents. We pollute the atmosphere with insect sprays, building and other chemicals, garden pesticides, herbicides and exhaust fumes in large doses. We transport pests and diseases from one place to another on earth moving equipment and motor vehicles; with the help of our pets we trample the vegetation and compact the soil; our pets chase and sometimes kill the fauna; we disturb the invertebrates, bats and nesting birds in fact the whole ecosystem. We are scared of fire and will not allow the burning necessary to kill pests and diseases and to help regenerate a balanced ecosystem. We alter the microclimate by changing the air movement, heating our houses, by the general bulk of buildings and we increase the amount of electromagnetic (at all frequencies) and sonic (noise) radiation and we dramatically change the hydrology. We plant species in our parks and gardens that crossbreed with natives and produce genetically different hybrids.

"How can we expect natural ecosystems to survive? If they do, it is as unnatural ecosystems. Only the species that can tolerate close contact with human habitat survive; magpies, crows, native miners, possums and common types of vegetation none of which are threatened or likely to become extinct or truly represent the original ecosystems and the biodiversity thereof."



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Table 3

Table 7

BROAD VEG. TYPES	Original vegetation (ha)	Existing vegetation (ha)	Proportion Remaining (%)	Area reserved (ha)	Proportion original reserved (%)	Proportion of total reservation (%)	Cumulative proportion (%)	Conservation status
Valley Grassy Forest	28,891	274	<1	131	<1	0.09	0.09	Endangered
Grassland	204,724	6,137	3	780	<1	0.52	0.61	Endangered
Riverine Grassy Woodland	5,128	213	4	1	0	0	0.62	Endangered
Plains Grassy Woodland	176,091	8,351	5	501	<1	0.34	0.95	Endangered
Riparian Forest	26,621	1,308	5	214	<1	0.14	1.10	Endangered
Box Ironbark Forest	6,246	314	5	81	1	0.05	1.15	Endangered
Swamp Scrub	26,696	1,456	5	509	2	0.34	1.49	Endangered
Montane Grassy Woodland	125	7	6	0	0	0	1.49	Endangered
Lowland Forest	93,973	7,150	8	1,089	1	0.73	2.23	Endangered
Coastal Scrubs and Grasslands	35,054	4,436	13	1,912	5	1.29	3.51	Threatened
Coastal Grassy Woodland	33,549	5,175	15	1,626	5	1.09	4.61	Threatened
Montane Dry Woodland	847	184	22	11	1	0.01	4.61	Threatened
Heathy Woodland	44,017	13,578	31	9,126	21	6.14	10.75	Not threatened
Heath	26,213	8,123	31	2,168	8	1.46	12.21	Not threatened
Dry Foothill Forest	278,718	123,502	44	35,785	13	24.07	36.28	Not threatened
Herb-rich Woodland	6,688	3334	50	822	12	0.55	36.84	Not threatened
Moist Foothill Forest	266,236	179,916	68	82,127	31	55.25	92.08	Not threatened
Montane Moist Forest	11,308	11,304	100	9,993	88	6.72	98.81	Not threatened
Unknown	6,647	2,066		1,582		1.06	99.87	
Undefined	0	2,344		196		0.13	100	
TOTAL	1,277,773	379,171	30	148,654	12	100		

TABLE A. BROAD VEGETATION TYPES IN RESERVES IN THE GREATER MELBOURNE AREA (PORT PHILLIP & WESTERNPORT CATCHMENT).

(Source: PP&W Draft Native Veg Plan August 2000 – Vic Govt.)



Appendix B. EXTRACTS FROM NATIONAL RECOVERY PLANS IDENTIFYING THE NOMINATED THREAT.

Acacia attenuata (*Acacia attenuata*)

“Based on current knowledge of the biology, ecology and distribution of *A. attenuata*, the persistence of this species is mainly threatened by the loss and fragmentation of suitable habitat through urban development along the coastal plains of southeast Queensland..... Drainage of coastal lowland habitats for urban development may lead to the displacement of native species adapted to wet environments by those adapted to drier conditions. There is also the potential for long distance flood dispersal of seed to be impeded through drainage operations.....However it is likely that the disjunct distribution of *A. attenuata* has been exacerbated through the reduction of suitable habitat by human activities

Anglesea Grevillea (*Grevillea infecunda*)

“.....Current distribution is fragmented, reflecting residentialdevelopment in the region.....”

Aquatic root mat communities numbers 1-4 of caves of the Leeuwin-Naturaliste Ridge-

“Activities such as large tourist developments caravan parks and hotels that produce substantial amounts of effluent and require large quantities of water already occur near caves that contain root mats on the Leeuwin-Naturaliste Ridge, and these types of development could be expected to expand in future.....Long term planning and liaison with landholders and water managers are therefore required to ensure developments do not impact the cave streamsDevelopments in the catchments and adjacent to caves have the potential to impact the caves through direct physical impacts such as cave collapse, or by indirect effects such as altering water quality or quantity in the caves.....”

Audas' Spider-orchid- (*Caladenia amoena*)

“.....Habitat of *C. amoena*, *C. audasii* and *C. rosella* has been severely reduced and altered by more recent urban development. For the remaining taxa (*C. fragrantissima* ssp. *orientalis*, *C. hastata*, *C. robinsonii* and *C. thysanochila*), habitat destruction has been caused by the urban and industrial development of their near-coastal habitat. These taxa now occupy areas close to and within urban development and the subsequent impacts associated with this and the management constraints placed on these sites are the largest threats to extant populations of these taxa.....”

Bare-rumped sheath-tail bat- (*Saccolaimus saccolaimus nudicluniatu*s)-

“.....Parts of its range have been subjected to urban development.....Tree hollow availability is likely to be reduced in some areasExtensive areas of tropical coastal woodland may be occupied by this species, some of which may be under threat by urban development.....”

Black-throated finch- (*Poephila cincta cincta*)

“.....urban development has potential to further fragment remaining black-throated finch habitat along the urban fringe in the Townsville and Thuringowa Shires and other areas, especially near the coast.”

Blue Babe-In-The-Cradle Orchid- (*Epiblema grandiflorum* var. *cyaneum* ms)

“.....The proximity of urban development is likely to result in increased fire frequency in the area.....”

Cascade Tree frog- (*Litoria pearsoniana*)

“.....Threats to water quality and altered flow regimes arise from adjacent and upstream land uses (e.g. housing development).... Upstream urban development (e.g. Mt Tamborine) are all likely to have affected flow regimes and water quality.....Many sites where *M. iteratus* occurs are the lower reaches of streams that have had major disturbances such as urban development in their headwaters Upstream urban development have reduced habitat and are likely to have affected downstream flow regimes and water quality in some localities (for example Kondallila Falls).....”

Chingia australis- (*Chingia australis*)

“.....The major threats to *C. australis* are listed below in order of significance from most threatening to least threatening. Logging/clearing for agriculture, urban development, road building and redirection/damming of creeks.....*Chingia australis* occurs in specific sites within rainforest habitat



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and requires surrounding rainforest or gully/creek communities to provide the local microclimate it needs to complete its lifecycle.

Christmas Island Frigatebird- (*Fregata andrewsi*)

Since early settlement, the nesting distribution of Christmas Island Frigatebirds has been fragmented by human development resulting in the three colonies that remain today.....Most of the nesting habitat currently used by Christmas Island Frigatebirds is close to areas of high human activity.....the cemetery colony is adjacent to an area proposed for residential and commercial development in the proposed Town Plan (Rumpff, H. pers. comm.).....”

Christmas Island Shrew- (*Crocidura attenuata trichura*)

“...There is a possibility some shrews may be road killed, and such a threat is likely to increase with a substantial growth in vehicular traffic associated with developments....”

Crested Shrike-tit [northern (sub)species]- (*Falcunculus (frontatus) whitei*)

“.....The eastern subspecies of partridge pigeon occurs in the peri-urban area around Darwin, where there is increasing land development for horticulture and rural residential estates.....There is some risk of at least localised detriment to all four taxa from current and proposed residential expansion.....”

Davidson's Plum- (*Davidsonia jerseyana*)

“Habitat alteration and fragmentation through urban development has destroyed or isolated many Davidson's Plum subpopulations. As a result of isolation, the function of pollinators, seed dispersers, seed predators and herbivores may have been interrupted and gene flow between many areas may have ceased. A continuation of current trends in urban expansion in Byron and Tweed Shires may result in further destruction and isolation of some sub-populations.....Davidson's Plum habitat occurs in coastal and lowland subtropical rainforest. Such vegetation communities are scarce within the range of Davidson's Plum, having largely been cleared for development.....”

Downy Wattle- (*Acacia pubescens*)

“.....Eleven of the sites recorded on the Atlas for NSW Wildlife (NSW NPWS 1998) no longer contain *A. pubescens* (see Appendix 2). Most of these sites have been lost due to residential development. Many old records indicate that the species occurred in locations that have now been developed.....A potential threat at some sites is the planned development of those sites. A large percentage of sites occur on lands zoned for residential and industrial uses. The species may be lost from these sites due to development for these uses, or developments may introduce impacts onto the site which degrade the habitat.....It will not be possible to recover the species to its former distribution, given the degree of development.....In fact, unless actions are taken to reduce threats, it is likely that reductions will continue to occur in the current number of sites and the species will become locally extinct in some areas.....”

Eastern Shrublands and woodlands (nationally listed as Shrubland and Woodlands of the eastern Swan Coastal Plain)-

“.....This system has been extensively urban development.....”

Eastern Spider-orchid- (*Caladenia fragrantissima* ssp *orientalis*)-

“.....Habitat of *C. amoena*, *C. audasii* and *C. rosella* has been severely reduced and altered by recent urban development. For the remaining taxa (*C. fragrantissima* ssp. *orientalis*, *C. hastata*, *C. robinsonii* and *C. thysanochila*), habitat destruction has been caused by the urban and industrial development of their near-coastal habitat. These taxa now occupy areas close to and within urban development and the subsequent impacts associated with this and the management constraints placed on these sites are the largest threats to extant populations of these taxa.....”

Eastern Suburbs Banksia Scrub Endangered Ecological Community- (Eastern Suburbs Banksia Scrub.)

“.....A major threat to ESBS is the further loss and fragmentation of habitat as a consequence of development. Less than 3% of the original distribution of the community exists and remaining stands are small and fragmented.”



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East Lynne Midge Orchid- (*Genoplesium vernale*)

“.....developments may have also removed some habitat.....”

Frankston Spider-orchid- (*Caladenia robinsonii*)

“..... urban development has undoubtedly been the major cause of the decline to virtual extinction of the Frankston Spider-orchid. Suburbs close to Melbourne such as Sandringham where the species once grew, have been settled now for many decades. Considerable housing development occurred during the 1970s and 1980s around Frankston, which was responsible for the demise of the Frankston North population. The site at Rosebud was reserved as part of subdivision and residential housing development there during the 1980s. Residential development now stretches in a virtually unbroken band along almost the entire eastern shoreline of Port Phillip Bay, to a distance of almost 100 km from Melbourne.....”

Glossy Black-Cockatoo (South Australian subspecies)- (*Calyptorhynchus lathami halmaturinus*)

“....Loss of critical habitat through development / subdivision.”

Granite featherflower- (*Verticordia staminosa* subsp. *cylindracea* var. *cylindracea*)

“.....details of current and possible future threats. Developments in the immediate vicinity of populations or within the defined critical habitat of *Verticordia staminosa* subsp. *cylindracea* var. *cylindracea* require assessment.....”

Graptophyllum reticulatum- (*Graptophyllum reticulatum*)

“Urban development, weeds and the potential for fire and other disturbance are all threats to *G. reticulatum* populations. The urban development surrounding the Buderim population increases the additional risks of land slips, hydrological changes and associated nutrient pollution, as well as potential hybridisation between *G. reticulatum* and congeners planted in local gardens. In addition, fragmentation and disturbance of native ecosystems may have influenced insect and predator dynamics and caused a decline in the reproductive capacity of the species as there are few reports of seed production for this species.....It is also the plant community considered to be most at risk on the south-east Queensland coast and only occurs as remnant patches in the Sunshine Coast area (SOQ 1998); a situation likely to be exacerbated by ongoing development in the region.....Housing development is a significant threat to the *G. reticulatum* population at Buderim. Several blocks containing *G. reticulatum* have recently been subdivided, although the plants are subject to council environmental covenants, and other blocks are proposed for subdivision or development.....Fragmentation from increasing urbanisation may have detrimental effects on ecosystem processes. Isolation within urban development may change local climatic and environmental conditions, lead to increased levels of disturbance, and imbalances in them ecosystem i.e. predation of seed may prevent recruitment.....”

Grassland Earless Dragon- (*Tympanocryptis pinguicolla*)

“The main factors involved in the decline of *T. pinguicolla* are thought to be loss and fragmentation of habitat due to urban, industrial development.....Urban development appears to be detrimental to lizard populations.....”

Great Desert Skink- (*Egernia kintorei*)

“Populations at Yulara (near Uluru) are currently under threat from increasing tourism development. Tourism infrastructure at Yulara and within Uluru-Kata Tjuta National Park has occasionally been inadvertently sited close to active Great Desert Skink burrows, resulting in burrow abandonment, or mortality of lizards on roads.....”

Great White Shark- (*Carcharodon carcharias*)

“The following actions may hamper the species viability and recovery if carried out along the Australian coastline.....Activities that have the potential to alter habitat quality (such as aquaculture, new sewerage/storm water outfalls and other coastal development in areas known to be frequented by White Sharks.....”

Greater Bilby- (*Macrotis lagotis*)

“Known and potential threatening processes include.....habitat degradation and destruction resulting from feral and domestic herbivores, unsuitable fire regimes, other development; drought; and



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road mortality.....The impacts of predation may be increased by development.....Other developments, including the recently completed Alice Springs to Darwin railway, major roads (e.g. Stuart Highway), and inland gas pipelines (Jackson to Mt Isa) occur within bilby habitat. Construction of these structures has destroyed bilby habitat and introduced a number of negative indirect consequences.....”

Green turtle- (*Chelonia mydas*)

“Alteration or development of the beach foreshores may prevent females from nesting, alter the sex ratio that the beach produces or result in light pollution that attracts hatchlings inland.....Development, vehicular activity and recreational activities have been identified as threats to the natal habitat..... urban and industrial development and their associated management Australia-wide are identified as an overall issue for concern. residential or industrial development has the potential to affect turtle populations at various times of the life cycle. It may directly deny nesting habitat or create light pollution that can disorient nesting adults and hatchlings (McFarlane 1963, Philibosian 1976, Witherington 1992). It may also alter the characteristics of the beach in terms of available nesting habitat and alter the pivotal temperature that will in turn alter the sex ratio of any hatchlings (Morreale *et.al.* 1982, Mrosovsky and Yntema 1995).....”

Grevillea caleyi- (*Grevillea caleyi*)

“.....Recent urban infrastructure developments in Terrey Hills, and road widening works in Terrey Hills and Belrose, have had detrimental impacts in recent years.....Recently, a newly discovered site was lost to urban development in Belrose (site 22). If the rate of habitat destruction continues, which appears a possibility, a number of sites of *G. caleyi* may disappear from the wild state in only a few years.....Given the locations of *G. caleyi* populations, that is near roadsides and adjacent to urban development, there is a great potential for weed species to impact on *G. caleyi* and its habitat.”

Illawarra Greenhood Orchid- (*Pterostylis gibbosa*)

“.....Population numbers have probably decreased since the arrival of Europeans due to urban development and other activities.....In 1981 the Yallah Bush site was sold and foreshadowed for future urban development.The main potential threats to *P. gibbosa* plants, both for the plant and its pollinator(s), are habitat loss and degradation from development....Habitat loss from urban development has reduced the area of available habitat on the Cumberland Plain and Illawarra to isolated remnants. The capacity of the species to extend beyond its known range in the Illawarra, Hunter and Shoalhaven regions is limited by the availability of suitable habitat. In areas, such as the Hunter Valley and Nowra, there may be suitable habitat and these areas may be subject to future development pressures.....Habitat loss from urban development has greatly reduced the area of available habitat for the species. Further habitat loss will threaten the long-term viability of the species by further reducing population sizes and rendering extant sub-populations more vulnerable to stochastic events (NPWS 2000).....”

Illawarra Socketwood- (*Daphnandra* sp. C 'Illawarra')

“.....Extant *D. sp. C* 'Illawarra' sites are threatened by residential development and road construction.....The main threat to the survival of the species is residential development and road construction.....Population growth in the Illawarra area is likely to place *D. sp. C* 'Illawarra' sites under increasing pressure from residential development. Such development, in addition to directly impacting upon the species through habitat loss and fragmentation, can indirectly affect sites in proximate or downslope locations by modifying environmental conditions and contributing to habitat degradation.....Urban development in close proximity to *D. sp. C* 'Illawarra' sites is likely to cause modification of habitat through altered hydrological conditions and soil pH, soil nutrification, weed invasion, potential introduction of plant pathogens and altered fire frequency. Subsequent increases in pedestrian and/or vehicular traffic to sites may result in trampling, soil compaction, soil erosion and the rubbish dumping.....*D. sp. C* 'Illawarra' habitat has been fragmented by urban development

Illawarra Zieria- (*Zieria granulata*)

“.....The main threat to the species is the further loss of habitat as a consequence of residential development and road constructionPopulation growth in the Illawarra is likely to place *Z. granulata* under increasing pressure from residential development. Such development, in addition to directly impacting upon the species through habitat loss and fragmentation, can indirectly affect sites



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in proximate or downslope locations by modifying environmental conditions, and contributing to habitat degradation.....Recent residential developments at Shellcove (Zg22) and Blackbutt (Zg1) have resulted in the loss of *Z. granulata* plants and habitat.....High risk sites are those sites that are considered to be at greatest risk from Class I threats. This category contains all sites that are presently zoned for residential development.....”

Long-sepalled Daviesia- (*Daviesia megacalyx*)

“.....Developments in the immediate vicinity of the population or within the defined habitat critical to the survival of *Daviesia megacalyx* require assessment for the potential for a significant level of impact.....”

Lord Howe Island Biodiversity-

“.....further development in the settlement area continues, significant vegetation communities and habitats may be threatened. For example, the vegetation community Sallywood Swamp Forest, which has always had a restricted distribution, is listed as an Endangered Ecological Community on the TSC Act due to the ongoing impacts of clearing and grazing in the settlement area..... It is considered that a possible past reduction in the Flesh-footed Shearwater (*Puffinus carneipes*) population may be due to increased residential buildings in the settlement area which has reduced their habitat. Priddel et al. (2006) has calculated that the total extent of nesting habitat for this species has been reduced by 35.6% since 1978. This is associated with increased urbanisation and development, especially around Stevens Point and Middle Beach.....”

Mahogany glider- (*Petaurus gracilis*)

“.....Urban residential development pressures in some areas threaten habitat as small blocks or parts of supporting mahogany glider habitat have been severely modified. In an area where habitat is already severely fragmented, small incremental losses over time may eventually lead to a landscape matrix not able to support local mahogany glider populations.....”

Masked Owl [Tiwi Islands subspecies]- (*Tyto novaehollandiae melvillensis*)

“.....There is some risk of at least localised detriment to all four taxa from current and proposedresidential expansion.....The eastern subspecies of partridge pigeon occurs in the peri-urban area around Darwin, where there is increasing land development for residential estates.....”

Mitchell's Rainforest Snail- (*Thersites mitchellae*)

“.....The major cause of the decline of Mitchell's Rainforest Snail is habitat destruction (Stanisic 1998; Stanisic 2000). urban development across the species' range has been extensive, and many of the small areas of surviving habitat remain at risk of development.....”

Moresby Range Drummondita- (*Drummondita ericoides*)

“.....Particular note will be made of the level of threat posed by the increased human presence due to the residential development adjacent to Population 1. Possible threats arising are dumping of rubbish and garden waste, damage through recreational activities and increased risk of fire.....”

Morrisbys gum- (*Eucalyptus morrisbyi*)

“.....Past records indicate a decline of at least 50% in the area occupied by the species in the Cremorne area (Calverts Hill and nearby remnants) since European settlement. This decline has been largely due to urban development. Given that the remaining trees are in a narrow coastal strip adjacent to a housing subdivision, much of the original Lumeah Point stand is likely to have been cleared.....”

Mt Emu she-oak- (*Allocasuarina emuina*)

“.....The creation of a new *A. emuina* population is planned to replace an anticipated population loss due to development (Envirobusiness Update, 2002)..... Although the fire history of many *A. emuina* habitats is not recorded, the area's fire regime is known to have changed significantly as a result of encroaching development.....All sites are located in a region that is subject to increasing urban development.....Potential future development of the heathland retained by DNRM is likely to have an adverse impact on the population if measures are not put in place to minimise the impacts.....The remainder of the population occurs on freehold land to the south, where housing



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development approvals for the Peregrine Springs development have been granted and construction commenced.....The development, however, will impact upon a total of 839 plants.....The most significant potential threatening process to *A. emuina* stems from expanding coastal development and the resultant loss of suitable habitat (McKiernan, 1997)..... The development of the Sunshine Motorway and associated earthworks may have contributed to the decline of populations at Peregrine Springs, Finland Road, Coolum Ridges and the Emu Swamp section of Noosa National Park (Kruger, 2002; McKiernan, 1997). Weed introduction and inadequate drainage (incorporating increased nutrients) resulting from the earthworks may have also facilitated this decline.....In addition, stormwater run-off from roads (and developments adjacent to heathland) increases soil moisture and nutrients encouraging growth of exotic plant species.....Urban development is impacting directly upon known populations in some circumstances.....”

Narrow-petalled Featherflower- (*Verticordia plumosa* var. *pleiobotrya*)

“.....The taxon is thought to be rare due to extensive urban development The largest most sustainable population, was, until recently, under significant threat. The owner of this private property had approval for development of this area and had begun subdividing the property to build houses.....”

Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)-

“.....The remaining Natural Temperate Grassland is a small fraction of its estimated original extent. as a result of urban, and infrastructure development.....urban development and infrastructure, have greatly reduced the extent and integrity of Natural Temperate Grassland in the region.....An estimated 99.5% has been destroyed or grossly altered since European settlement (Kirkpatrick *et al.* 1995). In most areas the grassland has been replaced by urban and infrastructure development.....: This is particularly relevant to the ACT where the most extensive areas of Natural Temperate Grassland have been destroyed during the development of urban Canberra.....Threats to remaining grassland areas from urban and infrastructure development are of two types: direct loss of sites, and deleterious impacts on the natural integrity of the grassland from adjacent urban areas.....”

Nodding Geebung- (*Persoonia nutans*)

“.....The main threats to the survival of *P. nutans* are habitat loss and fragmentation (due to residential development).....”

Oxleyan pygmy perch- (*Nannoperca oxleyana*)

“.....urban development has significantly reduced and fragmented these habitats.Oxleyan pygmy perch – with their limited distribution, rarity and dependence on specific habitats – are particularly vulnerable to a range of threatening processes. The most serious threat is habitat degradation and loss..... residential development and drainage impacts have led to a severe reduction in wallum heaths and remaining areas are highly fragmented. While some important tracts of wallum heaths are protected within coastal national parks, other remaining areas of pygmy perch habitat are found on private or Crown land that could be developed in the future.....There are also several pygmy perch sites known to exist close to residential areas (or areas zoned for development) and the survival of these populations may be threatened by surface run-off and other activities that degrade habitats.....Housing development and road construction projects pose major habitat threats

Pinnate-leaved Eremophila- (*Eremophila pinnatifida*)

“.....The main threats are housing development, road maintenance, erosion, weeds, degraded habitat and inappropriate fire regimes.One population of *Eremophila pinnatifida* ms occurs in an area of Shire land that had been set aside for possible future housing development.....This population is in an area subject to a housing development proposal and is extremely degraded and weedy.....clearing of nearby vegetation is likely to further reduce populations of pollinators, and an influx of people is likely to increase the recreational usage of the conservation reserve. In addition, the habitat may be affected by the addition of fertilisers to gardens and the water table affected by water usage.....”

Red handfish- (*Brachionichthys politus*)



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“.....Siltation of key estuaries caused by coastal developments, particularly those that involve dredging also threaten handfish habitat.....”

Ripple-leaf Muttonwood- (*Rapanea species*)

“..... urban development in the NSW North Coast Bioregion is probably the major cause of the decline of the Rippleleaf Muttonwood population to a critical level.....Muttonwood is present in an area of proposed development.....”

Slender Andersonia- (*Andersonia gracilis*)

“.....Populations are restricted to areas of remnant vegetation surrounded by urban developmentdue to urban development, much of the habitat for the species has been destroyed and ‘filled in’ over time for human use.....”

Smooth Davidsonia- (*Davidsonia johnsonii*)

“.....conversion of land use to development in NSW and south-eastern Queensland may have lead to the destruction of subpopulations of this species. The continuation of this trend poses a threat to remaining sub-populations.....”

Somersby Mint Bush- (*Prostanthera junonis*)

“.....historical populations of *P. junonis* are likely to have been destroyed as a result of extensive development of the Somersby Plateau.....Degradation has occurred as a result of slashing, development, clearing and soil removal.....Development, and various types of disturbance threaten populations of *P. junonis*.....The known habitat of *P. junonis* occurs at the rural-urban fringe where active development is occurring.....there have been frequent occurrences of unauthorised vegetation clearance including known and potential habitat sites for *P. junonis*. Clearing of known and potential habitat of *P. junonis* will have an impact on the long-term viability of the species.....Five of the nine populations have been either directly or indirectly affected by development (see 7.5 above). A further three populations (populations 1, 2 & 6) are likely to be subject to development within the next 1-5 years.....Although development has not yet knowingly resulted in the complete removal of any of the *P. junonis* populations, the cumulative impacts of development and long term indirect impacts of habitat loss, fragmentation and degradation remain a serious concern for this species.....Adjacent development can significantly alter overland flows and thus impact on adjacent habitat through intensified runoff (leading to erosion canals), increased sediment loads, or in some cases, the diversion of the natural flow of water. Soil erosion and siltation are processes very likely to disrupt the life cycle of *P. junonis*, particularly in relation to a soil-stored seed bank.....The most significant population (2) was threatened by industrial development.....”

Southern cassowary- (*Casuarius casuarius johnsonii*)

“.....Dog attacks: urban development brings more domestic dogs..... While Wet Tropics Vegetation Management Codes regulate clearing, housing development still threatens local populations as supporting habitat is cleared. In Mission Beach incremental losses to severely fragmented habitat may eventually destroy the viability of the local population. Even low density housing brings more traffic and dogs.....Roads are also precursors to future impacts, because they often facilitate land development and the further expansion of the road network itself. Crome and Moore (1993) found that the home ranges of approximately half of the cassowaries in the Daintree lowlands are intersected by roads.....”

Strickland mintbush- (*Prostanthera askania*)

“.....The major threat to *Prostanthera askania* is the further loss of plants and populations, and loss and fragmentation of remaining habitat, as a consequence of development for residential, industrial ... uses..... continues to occur for residential, industrial development. Population growth in this area is likely to place *P. askania* under increasing pressure from such development. At least one subpopulation in the Gosford suburb of Niagara Park is thought to have become locally extinct following residential subdivision (██████████, pers. comm.)..... the fragmentation of *P. askania* habitat, with populations and subpopulations of the species separated by severely modifiedareas. Fragmentation impacts may include the creation of small isolated populations with limited gene flow between them, leading to inbreeding depression and reduced potential to adapt to environmental change. In addition, small isolated populations may be subject to local extinction from



stochastic (random) events. Fragmentation may also lead to the loss or severe modification of the interactions between *P. askania* and other species, including those interactions – such as with pollinators – that are important for the survival of the species. The hostility of the surrounding modified environment is a major factor in limiting movement of organisms between patches. Furthermore, the physical environment within patches themselves may be altered as a result of creation of edges and associated anthropogenic influences.....Altered flow patterns due to urban development may be the cause of riparian zone stream bank erosion which appears to be directly affecting the habitat of *P. askania* at one site (Pa_05b)..... Urban development in close proximity to *P. askania* sites is likely to cause modification of habitat through altered hydrological conditions, soil pH and nutrient levels, weed invasion, potential introduction of plant pathogens and altered fire frequency. Subsequent increases in pedestrian and/or vehicular traffic through sites may result in trampling, soil compaction, erosion and rubbish dumping.....”

Summer Leek-orchid- (*Prasophyllum morganii*)

“.....There is little doubt that the species has suffered a major decline in abundance, with initial declines attributedto a lesser extent, urban development and infrastructure.....”

Sunshine Diuris- (*Diuris fragrantissima*)

“.....Much of the original native grasslands to the west of Melbourne have been destroyed forindustrial and urban development, and the remaining areas are mostly small, highly fragmented and usually substantially degraded..... These habitats once covered about 10% of Victoria, but have now been reduced to less than 1% of their original extent (Barlow & Ross 2001; Stuwe 1986). It is highly likely that, with the habitat substantially reduced and so few plants remaining, ecological processes such as natural pollination have also been disrupted. Very low natural rates of pollination have been reported, with a maximum of only 7% of flowers producing seed pods (Cropper 1993), which is possibly a function of the rarity of the orchid and hence few opportunities for pollinators to find flowers and effect pollination.....Some plants have also been illegally removed, and two stems with maturing seed capsules were suspected to have been removed in 2005. Future industrial and transport development may also pose a threat.....”

Swift Parrot- (*Lathamus discolor*)

“.....Woodlands and forests within the parrot’s over-wintering range and its restricted breeding distribution have been fragmented and substantially reduced byurban and coastal development.”

Tasmanian Grasstrees- (*Xanthorrhoea arenaria* *Xanthorrhoea bracteata*)

“.....Over half the known threatened grasstree sites occur on private land and plants may be threatened by continuing land conversion, housing/development, habitat degradation, tramplinghealthy forest communities that are threatened with further reduction in size and diversity through impactssuch as land(development and conversion) and *Phytophthora cinnamomi*.....”

Tasmanian Wedge-tailed Eagle- (*Aquila audax fleayi*)

“.....Prime nesting habitat is found along major estuaries where residential and industrial development is concentrated, thus placing the species under pressure from habitat loss and disturbance.....There has been a progressive increase in the number of nests found prior to land development with a subsequent decrease in the number of nests located during disturbance.....White-bellied Sea-eagles are concentrated in estuarine areas around Tasmania many of which are the sites of significant residential, tourist and industrial developments and recreational pursuits. These activities, acting alone or in combination, pose a potentially significant threat to the survival of this species through nest disturbance or depletion of available habitat. The absence of forest regeneration on productive coastal land depletes the potential nesting habitat necessary for future nest establishment.....”

Thymelaeaceae- (*Pimelea spicata*)

“.....urban and rural development has destroyed much of the natural habitat of the species and the remaining habitat is restricted, degraded and highly fragmented. The main threats to the survival of the species are further habitat loss as a result of residential development and habitat degradation, particularly from weed invasion.....*Pimelea spicata* currently meets the requirements for endangered due to residential development.....Cumberland Plain Woodland, which provides habitat for



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P. spicata across western Sydney, has been reduced to only 8.5% of its pre-European settlement extent, with a further 13 percent remaining as scattered trees across the landscape (NSW NPWS 2002)..... The two populations and one of the subpopulations (CD1e) were lost to residential development and the second sub-population (HO1b) was lost to industrial development.....The main factor that influences the species' current status as endangered is habitat loss as a result of residential development.....”

Tunbridge Buttercup- (*Ranunculus prasinus*)

“.....All known populations of *Ranunculus prasinus* are on private land and are at future risk of destruction by draining or roading.....”

Wallum sedgefrog and other wallum-dependent frog species- (*Litoria olongburensis*)

“.....The species in this plan have suffered significant habitat loss due to urban and resort development Habitat loss and fragmentation due to urban development remains one of the main threats to wallum frog species, particularly in coastal south-east Queensland and northeast New South Wales.....Since European arrival, however, the area of occupancy² of these species has been significantly reduced due to resort and residential development (Ingram and McDonald, 1993)..... The habitat utilised by these frogs, particularly that on the mainland, has been extensively drained for resort and residential development (Ingram and McDonald, 1993; Ehmann, 1997; Lewis and Goldingay, 2005)..... With population growth in coastal areas on the increase, much of the remaining habitat on freehold land may be lost to residential development and associated infrastructure (i.e. roads and sewerage lines). In terms of habitat degradation, it is those areas adjacent or adjoining residential and resort developments (including golf courses) that are most under threat.....Increased connectivity between water bodies or increased water permanence, caused by changes to hydrology, may increase the chance of introduction of the mosquito fish and therefore should be avoided. Changes in hydrology, which may affect this introduction, can be caused by urban development.....”

Western Swamp Tortoise- (*Pseudemydura umbrina*)

“.....Ellen Brook and Twin Swamps Nature Reserves protect wetland ecological communities that are now threatened because of urban development.....”

Whicher Range Dryandra- (*Dryandra squarrosa* subsp. *Argillacea*)

“.....Adjacent land developments have the potential to alter hydrological processes, and therefore to threaten the populations.....”

Yellow Chat (Dawson)- (*Epthianura crocea macgregori*)

“.....Industrial development has the greatest potential to impact existing areas of known Capricorn yellow chat occurrence.....”

Zieria involucreta-

“.....threats to its survival from inappropriate fire regimes, weed invasion andurban development. Population growth on the northern outskirts of the Sydney metropolitan area is likely to place *Z. involucreta* in these areas under increasing pressure from such development.....*involucreta* through habitat loss and fragmentation, such development and associated increases in human activity can directly and indirectly affect the species by otherwise contributing to habitat degradation and modifying the environmental conditions experienced at those sites. Such impacts can result from factors including: increased pedestrian and vehicular access to sites, resulting in greater likelihood of trampling, rubbish and garden waste dumping, weed infestations, bush rock removal and transmission of the root-rot fungus (*Phytophthora cinnamomi*); more frequent fire because of bushfire hazard reduction works and arson; altered overland flows (and associated problems with sedimentation and erosion); and changed soil pH and nutrient levels.However, weeds may become an increasingly important threat to populations in catchments where rural-residential and agricultural development along ridgetops is a vector for weed species and promotes their spread through increased nutrient levels in run-off.....Development in close



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proximity to *Z. involucrata* sites is likely to cause modification of habitat through altered hydrological conditions, soil pH and nutrient levels, weed invasion, potential introduction of plant pathogens and altered fire frequency. Subsequent increases in pedestrian and/or vehicular traffic through sites may result in trampling, soil compaction, soil erosion and rubbish dumping. Other proposals that result in grazing, slashing, spraying or burning of *Z. involucrata* habitat are also likely to result in the modification of that habitat.....threatening processes relevant to this species include slashing and herbicide spraying to maintain road verges, grazing and trampling by livestock, weed invasion, rubbish dumping (including green waste, household rubbish and construction materials) and the other disturbances associated with adjacent urban development.....”

Appendix C. Issues related to threats.

The following table shows the species of conservation concern occurring in population growth areas.

State/Growth area	Plants No.	Mammals No.	Birds No.	Reptiles No.	Fish No.
New South Wales	518	4	29	28	12
Greater Sydney	113	0	12	10	4
South-east	n.a.	n.a.	n.a.	n.a.	n.a.
North coast	n.a.	1	18	15	3
Victoria	815	6	30	12	10
Greater Melbourne	92	1	16	8	3
Queensland	1,197	18	34	75	20
South-east	186	2	17	21	6
Cairns/Townsville	528	2	12	21	5
Rockhampton	29	1	7	16	5
South Australia	185	8	33	17	5
Greater Adelaide	95	0	11	9	0
Western Australia	1,372	20	33	33	23
Perth & the South-west	582	5	17	7	3

(a) Species of conservation concern are those that have been listed nationally as being endangered, vulnerable, rare or poorly known and may occur in more than one growth area.

(b) The geographical extent of growth areas was based on boundaries used to agglomerate information on biodiversity distribution at the State and national levels. Agglomerations of biodiversity regions were selected that included the city itself, satellite towns and the hinterland and adjacent agricultural regions over which the population disperses, travels, builds roads, dams and holiday homes.

Source: Australians and the Environment (Cat. No. 4601.0 p 339).

(<http://www.abs.gov.au/Websitedbs/c311215.nsf/20564c23f3183fdaca25672100813ef1/bc7dc08a640751f8ca2569e70003c7f6!OpenDocument>)

In Victoria there are 815 species of plants under threat (more than 10 percent of these in Melbourne) and 30 species of birds (more than half of these in Melbourne). The figures are not insignificant.

The following table looks at the causes of extinction and past and present threats to endangered plant species.

Threat	No. of species Number of endangered species		
	presumed extinct Presumed cause	Past threat	Present & future threat
Low numbers		10	85
Roadworks	1	8	57
Weed competition	4	12	57
Grazing	34	51	55



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Agriculture	44	112	50
Industrial & urban development	3	20	21
Fire frequency		10	17
Collecting		6	17
Mining	1	3	11
Forestry		10	10
Recreation			7
Dieback			7
Clearing		2	5
Railway maintenance		2	4
Salinity			4
Insect attack			3
Quarrying			3
Trampling by pigs & buffalo		1	3
Changes in hydrostatic pressure in artesian basin		1	
Drainage		1	2
Flooding		4	2
Other			2
Rubbish dumping			2
Vehicle damage		1	2
Erosion	1		1
Habitat degradation			1
Rock falls			1
Visitation			1
None identified	1	5	
		12	6

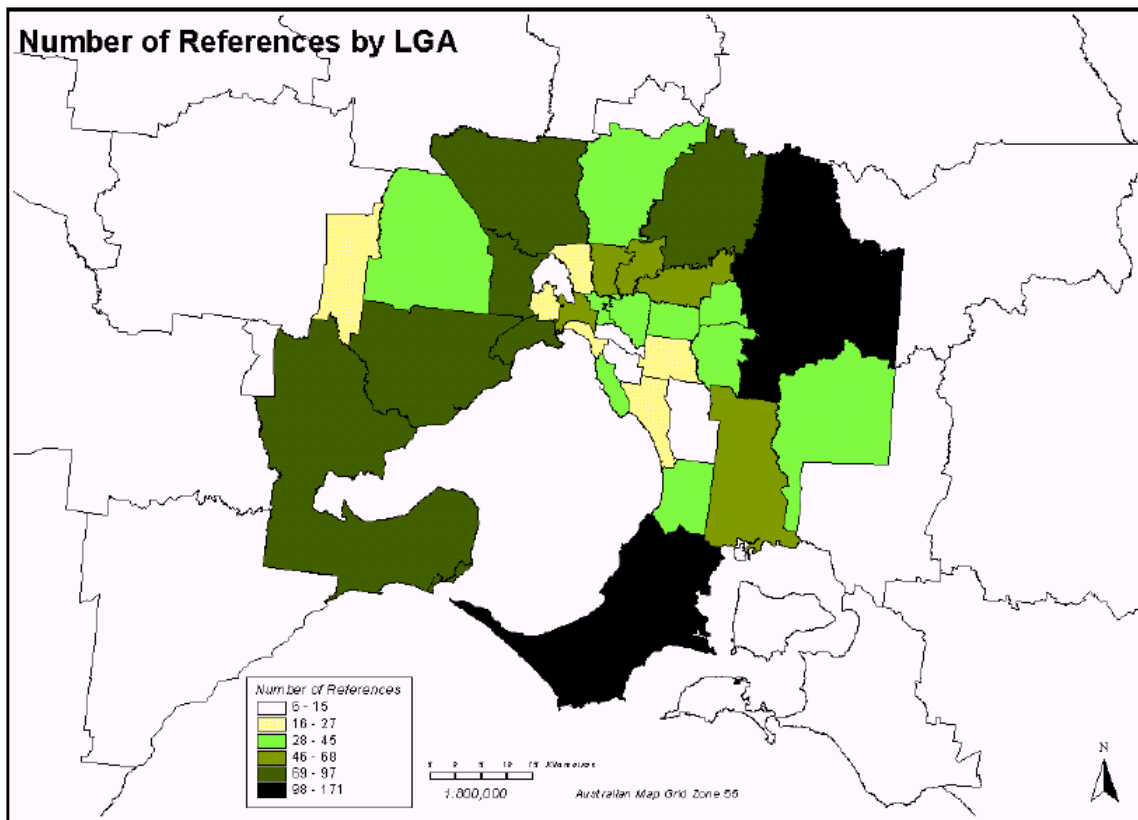
Note: Many species are affected by more than one threat.

Source: Australia's Environment: Issues and facts (Cat. No. 4140.0 p 25).

(<http://www.abs.gov.au/Websitedbs/c311215.nsf/20564c23f3183fdaca25672100813ef1/bc7dc08a640751f8ca2569e70003c7f6!OpenDocument>)

The largest present and future threat is from low numbers. While the present and future threat from agriculture is **less than half the past threat**, the threat from industrial and urban development remains the same. The threat is exacerbated because most of the threatened species in developing areas and areas proposed for development fall into the "low numbers" category. Residential development prevents the **reinstatement** of habitat and of necessity involves "roadworks" and other listed activities so that the real figure for industrial and urban development could be much higher. Since there is no reason why development needs to occur in areas where species are at risk (there are invariably suitable alternatives), prohibition of development in these areas could substantially reduce the risk or at least stop it from becoming worse and therefore possibly make a similar contribution to that made by agriculture. It may also allow **reinstatement** of habitat.

The following map shows the extent of biodiversity reference material for local government areas around Melbourne.



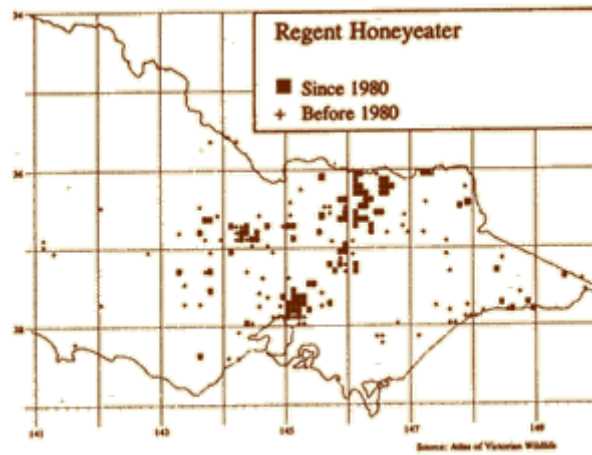
Source: “A Reference Guide to the Ecology and Natural Resources of the Melbourne Region” Mark J. McDonnell et al 1999 ARCUE.

It is not surprising that development tends to occur where there is the least information about biodiversity. The map shows that the most information is available in areas where there are few threatened communities while the least is available in areas with the most threatened communities, which is where development tends to occur.

The following information is taken from Victorian Flora and Fauna Guarantee act Action Statements and elsewhere and highlights the proposition that concentrations of threatened species frequently occur near development or areas proposed for development.

No 41 Regent Honeyeater *Xanthomyza phrygia*.

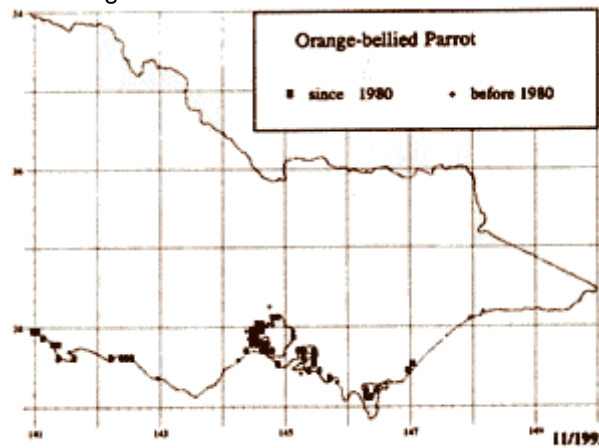
The significant distribution to the Northeast of Melbourne coincides with areas of Valley Grassy Forest a principal species of which is Yellow Box one of the favourites of the Regent Honeyeater. The draft Port Philip and Westernport Naive Vegetation Plan shows that development has diminished Valley Grassy Forest (BVT) from a pre-1750 coverage of 28, 891 hectare to an extent of just 274 hectare (August 2000). More recent sightings to the north and west of Melbourne probably occur in River Red Gum Plains Grassy woodland. The River Red Gum is also on its list of more favoured species. Proposed development in these areas poses a significant threat to its survival as one of our most endangered Honeyeaters.



Distribution

No 43 Orange-bellied Parrot *Neophema chrysogaster*.

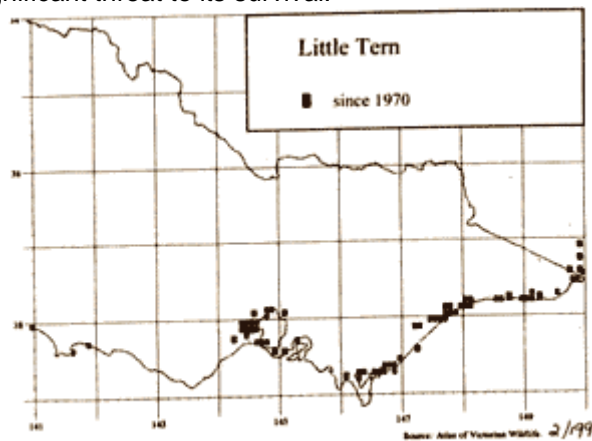
The occurrence of the Orange-bellied Parrot to the west of Melbourne and in developing coastal areas means that development poses a significant threat to its survival.



Distribution

51 Little Tern *Sterna albifrons sinensis*.

The distribution of the Little Tern to the west of Melbourne and in developing coastal areas means that development poses a significant threat to its survival.

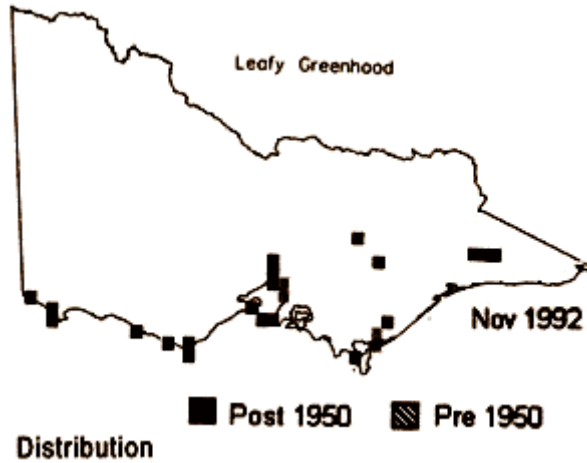


Distribution



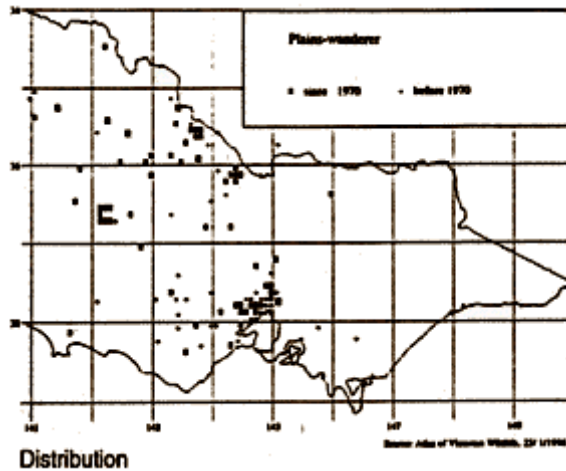
54 Leafy Greenhood *Pterostylis cucullata*.

Because Leafy Greenhood mainly occurs in developed and developing areas further development in these areas poses an unacceptable threat.



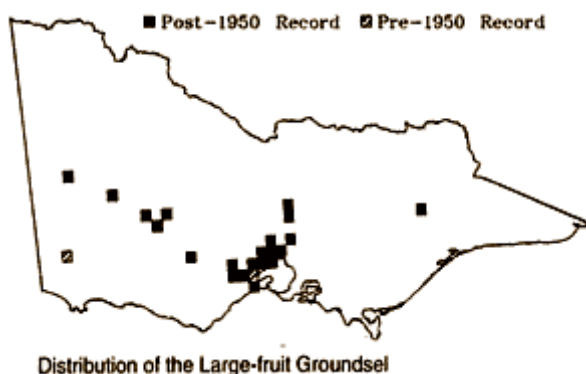
No 66 Plains Wanderer, *Pedionomus toquatus*.

The action statement distribution map shows significant Plains wanderer territory to the north of Melbourne. Because this area is being (or has been) developed new development will further destroy crucial habitat.



68 Large-fruit Groundsel *Senecio macrocarpus*

The distribution of this listed species to the north and west of Melbourne means it is in the areas proposed for development as well as those already developed. Development poses a significant threat to its survival.



Appendix D.

Extracts from "Threats to our water environments" 2005
(http://www.epa.sa.gov.au/water_threats.html)

Pollution by urban stormwater

Urban stormwater is run-off from buildings, streets and footpaths, and includes the major flows during and following rain as well as 'dry-weather flows'. Dry weather flows come from garden watering, wash-downs and illegal discharges.

Stormwater can contain litter, dust, soil, oil and grease from roads, garden waste, chemicals, and excess nutrients from animal faeces and fertilisers. This pollution can kill fish, cause unsafe swimming conditions, entangle aquatic animals in rubbish, and create toxins in them.

Nutrient enrichment

Nutrients can accumulate in waters naturally and increase aquatic plant growth. However, some human activities can accelerate this process, creating excessive nutrient loads (eutrophication) in lakes, rivers, harbours and estuaries. Nutrients from human activities include, sewage effluent, urban stormwater.....

An increase in nutrients (nitrogen and phosphorus) results in an increase in the growth of algae. In this environment algae often multiply quickly to dominate an ecosystem and cause a bloom. Algal blooms can have many different and adverse effects on an ecosystem. Blooms can smother aquatic plants and compete with plants and other organisms for light and space. When they die they reduce the amount of oxygen in the water, killing fish.

Some blue green algae (cyanobacteria) release toxins when they die. This has been a major problem in the River Murray, where it has killed fish and poisoned stock water. Blue green algae is also a health hazard for humans who come into contact with the water, causing skin irritation, swollen lips, eye soreness, earache, and asthma.

Nutrient enrichment of Gulf St Vincent has resulted in an increase in algae that attach themselves to other aquatic plants for support (epiphytic algae). Epiphytic algae has resulted in the loss of over 6000 hectares of seagrass between Port Gawler and Aldinga. Loss of seagrass has led to more sediment in our coastal waters, an increase in coastal erosion, and a dramatic loss of biodiversity in sub-tidal reefs.

In the Port River, nutrient enrichment from urban stormwater and industries causes the water to turn red/brown. The discolouration of the water, known as a 'red tide', is due to blooms of algae. Some of these blooms can produce toxins which can cause severe gastro-intestinal and neurological illnesses such as paralytic shellfish poisoning (PSP).

Algal blooms can force water restrictions and the closure of waterways to fishing, swimming and boating. It can cause fish kills and severe economic costs to agriculture, tourism and water authorities.



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It has been estimated that algal blooms cost Australia \$150m a year (Land and Water Resources Development Commission, 1999).

Sedimentation

Sedimentation occurs when mineral and organic particles of different sizes are transported from their place of origin by water, wind, gravity, or ice. This process occurs naturally; however, human activities can accelerate it, causing unnaturally high levels of sediment in our rivers, lakes and streams. Human activities that increase sedimentation include:-

- land clearance, which can lead to gully erosion .
- poorly managed building sites, which allow soils and other pollutants to enter the stormwater system .
- unsealed roads near waterways .
- uncontrolled stock access to streams and rivers, which increases erosion of river banks .
- construction of dams and reservoirs.

Sediments carry nutrients, and nutrient enrichment reduce water quality and promote algal blooms. Increased sedimentation leads to increased turbidity in our waterways, in-filling of creek pools, and weed growth. High levels of sedimentation can also smother plants, suffocate fish, and make habitats unsuitable for native wildlife.

Oils, heavy metals and other chemicals

Pollutants such as oils, heavy metals and chemicals can cause substantial environmental damage. They often contaminate the stormwater system that flows untreated into natural waterways. Sources of pollution include:-

- leaking cars . fuel stations and mechanical repair shops .
- auto dismantlers and crash repairers .
- auto services .
- paint . batteries .
- timber treating works .
- leather tanning works .
- carpet cleaning .
- airconditioning coolants .
- pesticides and fertilisers

Oil and grease are toxic to animals and plants and form a film over the water surface, making it difficult for organisms to breath. Heavy metals such as cadmium, chromium, copper, zinc and lead are also toxic. These substances can accumulate in aquatic animals such as mussels and have a dangerous impact through the food chain.

Alteration of natural flows

Water is pumped from rivers and underground water supplies for use by rural towns, farms, industries and cities. Many rivers also feed dams and reservoirs for public water supplies and hydro-power, and are used as transport routes for boats. While these activities provide economic and social benefits, there are many adverse environmental impacts associated with altering the natural flow of rivers (river regulation). These include the decline and loss of native species of plants and animals, encouragement of habitats favourable to pest species (carp, gambusia and redfin), declining water quality, and loss of amenity.

River regulation in the Murray-Darling Basin is so severe that giant river redgums which rely on frequent flooding are dying and the Murray cod is threatened.

Clearing vegetation

Native vegetation clearance has wide-ranging impacts on water quality, local habitats and biodiversity. Clearing the landscape of trees and shrubs also changes the direction and rate of rain



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run-off, and increases erosion. This means more sediment, nutrients, salt, pesticides and other toxicants are transported into rivers and streams.

Towns and cities cause an increased volume of stormwater due to their large area of impervious surfaces (roads, roofs, footpaths, carparks) compared to well-vegetated catchments.

Loss of habitats

Habitats are the places where organisms live. Loss of habitat can range from the removal of whole wetland ecosystems, to the removal of a small stand of reeds in a swamp or creek. The major effect of the loss of habitats is invariably the loss of biological diversity.

This can limit the ability of the local environment to tolerate the effects of climatic variation and the adverse impacts brought about by human activities. It can also affect the ability of the environment to recover from the effects of a major event such as a drought, or the significant discharge of a pollutant.

Pest species

Pests or invasive species are usually introduced by humans. They threaten the survival of native plants and animals; they can also damage valuable agricultural and personal resources.

Terrestrial and aquatic pests impact on the health of our waterways as well as native animals and plants. For example, mosquito fish (*Gambusia holbrooki*) were introduced from the USA to control mosquito numbers. However, they now outnumber native fish in many parts of south eastern Australia as they out-compete the indigenous species for food. Exotic trees such as willows (*Salix* sp) are another problem. Willows create a dense shade, resulting in bare banks that are susceptible to erosion. The trees provide a poor wildlife habitat for land animals, while the number and diversity of aquatic invertebrates and native fish is greatly reduced under their canopy.

Threats to groundwater

Processes and activities threatening groundwater include urban and commercial development.....

Overuse of groundwater supplies can dehydrate many ecosystems and habitats by lowering the groundwater level to beneath the rooting depth of many plants, reducing the water seeping into rivers, and destroying habitats in cave and aquifer ecosystems.

Diversion or impoundment (i.e. dams) of surface waters can elevate groundwater levels and cause similar problems. Some groundwater-dependent species may be advantaged over others, while some may die from waterlogging. The elevated groundwater levels hold accumulated salts, causing salinity that can lead to plant death, and the loss of native fauna that depend on those plants.

Excavation during construction activities and the lowering of groundwater levels can activate acid sulphate soils and severely impact aquatic ecosystems. Acid sulphate soils are wetland soils and unconsolidated sediments that contain iron sulphides. When covered permanently with groundwater, the iron sulphides are stable and the soils are weakly alkaline. However, when groundwater levels are lowered, the iron sulphides are exposed to oxygen, the sulphides oxidise and, in the presence of water, form sulphuric acid (Powell and Ahern 1997). This process has a disastrous effect on aquatic ecosystems by poisoning them with heavy metals, acidified water, and iron.

New urban or commercial developments can lower and raise groundwater levels through increased domestic watering, and recreational and industrial uses. In turn, native vegetation and wetlands are threatened, and salinity increases. Urban development can also affect the quality of groundwater through effluent from septic tanks, leakage from underground fuel tanks, and the use of chemicals and fertilisers.



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..... and residential development often pump large quantities of water from under the ground and aquifers. This action can lower the level and flow rate of underground water, and reduce aquifer pressure.



Appendix E Urban impact buffer distances.

1. Urban impact notes. (RMIT 2006)

Table 1	How wide should buffers be?
Domestic Dogs	1-2 km (Pal, Ghosh et al. 1998).
Domestic and feral cats	Limited information in the Melbourne context. Studies in Canberra suggest that domestic cats will hunt up to 900 m into bushland adjacent to urban areas (Barrett 1998).
Foxes	Seasonally up to 3.5 km (Robinson and Marks 2001).
Nutrient migration	Limited data – possibly not more than 50 m on flat country – considerably further downslope. Would vary considerably depending on soils and climate. (Leishman, Hughes, et al 2004)
Environmental Weeds	Strong temporal as well as spatial element as weed populations spread. Few detailed studies available as there are many weed taxa with a wide range of dispersal mechanisms. Weeds may readily invade natural ecosystems from neighbouring pasture and croplands. A majority of bird-dispersed seeds are avoided within 250 metres of feed source in wet forest ([REDACTED] [REDACTED] Unpublished data).
Lights	Limited comprehensive information in urbanising environments, particularly in Australia. Most information available on invertebrate and vertebrate fauna. Very little on plants. A Netherlands study found that the density of bird nests was statistically lower up to 300 m away from lights in a lighted area compared with unlighted areas (De Molenaar, Jonkers et al. 2000; Longcore and Rich 2004).
Noise	Limited information. Overseas studies have indicated that multi-laned highways (>30 000 vehicles/day) can impact on grassland birds for a distance of approximately 1200 m from the road and the impact of multi-laned highways on forest birds occurs for several hundred meters (Forman, Reineking et al. 2002). Impacts on grassland birds can be detected up to 700 m from a road carrying 15 000 to 30 000 vehicles per day and for 400 m from roads carrying 8 000 to 15 000 vehicles/day (Forman, Reineking et al. 2002). Traffic noise is the most likely cause of these impacts. The amount of distance where there is an impact is likely to vary with the continuity of the sound, that is, whether it is chronic, singular or intermittent. Singular or intermittent noises may have a greater impact than chronic noises. The extrapolation of overseas results on road noise to Australia may be confounded by different road management practices. Australia has been recognised for its ecological approach to road management by, for example, leaving natural vegetation strips of 10 – 200 m in many agricultural landscapes in contrast to other countries such as the United States of America (Forman and Alexander 1998).

2. Bushland modification and styles of urban development: their effects on birds in south-east Queensland

Sven R. Sewell and Carla P. Catterall

PDF available from: http://www.publish.csiro.au/?act=view_file&file_id=WR96078.pdf

Abstract



Variation in bird assemblages associated with forest clearing and urbanisation in the greater Brisbane area was assessed by counting birds in sites within six habitat categories: large remnants, small remnants, no- understorey remnants, canopy suburbs (original trees present), planted suburbs, and bare suburbs. Total bird abundance and species richness were generally highest in canopy suburbs. Individual species showed many significant abundance differences among the habitat types, and were classified into three major response categories: bushland species (3 in summer, 13 in winter), tolerant species (13 in summer, 13 in winter), and suburban species (12 in summer, 11 in winter).

The commonly proposed notion that urbanisation results in lowered bird species richness and increases in introduced species is broadly consistent with the observed differences between bare suburbs and large remnants. However, it does not adequately describe the situation in the planted and canopy suburbs, where there was high species richness and extremely high abundance of some native species (including noisy miners, lorikeets, friarbirds, and butcherbirds) but low abundance of a majority of the species common in the original habitats (including fantails, wrens, whistlers, and other small insectivores). Retained forest remnants are essential for the latter group. Urban plantings of prolifically flowering native species do not reverse the effects of deforestation, but promote a distinctive group of common native suburban bird species. Origins of the urban bird assemblage are discussed.

Wildlife Research 25(1) 41 - 63

Full text doi:10.1071/WR96078

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3. *Frontiers in Ecology and the Environment*: Vol. 2, No. 4, pp. 191–198, Ecological light pollution ,Travis Longcore,a and Catherine Richa

The Urban Wildlands Group, PO Box 24020, Los Angeles, CA 90024-0020
(longcore@urbanwildlands.org)

Ecologists have long studied the critical role of natural light in regulating species interactions, but, with limited exceptions, have not investigated the consequences of artificial night lighting. In the past century, the extent and intensity of artificial night lighting has increased such that it has substantial effects on the biology and ecology of species in the wild. We distinguish “astronomical light pollution”, which obscures the view of the night sky, from “ecological light pollution”, which alters natural light regimes in terrestrial and aquatic ecosystems. Some of the catastrophic consequences of light for certain taxonomic groups are well known, such as the deaths of migratory birds around tall lighted structures, and those of hatchling sea turtles disoriented by lights on their natal beaches. The more subtle influences of artificial night lighting on the behavior and community ecology of species are less well recognized, and constitute a new focus for research in ecology and a pressing conservation challenge.

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4. *Journal of Animal Ecology* Volume 73 Page 434 - May 2004 doi:10.1111/j.0021-8790.2004.00814.x Volume 73 Issue 3

The impact of environmental noise on song amplitude in a territorial bird, HENRIK BRUMM, Institute of Biology, Behavioural Biology, Free University, Berlin. *Journal of Animal Ecology* (2004) 73, 434–440 Blackwell Publishing Ltd.

Summary

1. The impact of environmental background noise on the performance of territorial songs was examined in free-ranging nightingales (*Luscinia megarhynchos* Brehm). An analysis of sound



pressure levels revealed that males at noisier locations sang with higher sound levels than birds in territories less affected by background sounds.

2. This is the first evidence of a noise-dependent vocal amplitude regulation in the natural environment of an animal.
3. The results yielded demonstrate that the birds tried to mitigate the impairments on their communication caused by masking noise. This behaviour may help to maintain a given transmission distance of songs, which are used in territory defence and mate attraction. At the same time, birds forced to sing with higher amplitudes have to bear the increased costs of singing.
4. This suggests that in songbirds the level of environmental noise in a territory will contribute to its quality and thus considerably affect the behavioural ecology of singing males.

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5. Annual Review of Ecology and Systematics Vol. 29: 207-231 (Volume publication date November 1998) (doi:10.1146/annurev.ecolsys.29.1.207)

ROADS AND THEIR MAJOR ECOLOGICAL EFFECTS Richard T. T. Forman and -Lauren E. Alexander-
Harvard University Graduate School of Design, Cambridge, Massachusetts 02138

A huge road network with vehicles ramifies across the land, representing a surprising frontier of ecology. Species-rich roadsides are conduits for few species. Roadkills are a premier mortality source, yet except for local spots, rates rarely limit population size. Road avoidance, especially due to traffic noise, has a greater ecological impact. The still-more-important barrier effect subdivides populations, with demographic and probably genetic consequences. Road networks crossing landscapes cause local hydrologic and erosion effects, whereas stream networks and distant valleys receive major peak-flow and sediment impacts. Chemical effects mainly occur near roads. Road networks interrupt horizontal ecological flows, alter landscape spatial pattern, and therefore inhibit important interior species. Thus, road density and network structure are informative landscape ecology assays. Australia has huge road-reserve networks of native vegetation, whereas the Dutch have tunnels and overpasses perforating road barriers to enhance ecological flows. Based on road-effect zones, an estimated 15–20% of the United States is ecologically impacted by roads.

6. Urban effects on native avifauna: a review, Jameson F. Chace, John J. Walsh (2004), www.elsevier.com/locate/landurbplan

Abstract.

The effect of urbanization can be immense, yet our understanding is rudimentary. Here, we compile the most recent information on urban impacts on avian populations and communities. Compared to other vertebrates, birds are easily monitored by skilled observers and provide a mechanism to explore urban effects and responses to different urban designs. Taxonomically, bird communities in distinctly different habitats are most different in the least disturbed sites and the most similar in the most urbanized sites. Urbanization tends to select for omnivorous, granivorous, and cavity nesting species. Increased urbanization typically leads to an increase in avian biomass but a reduction in richness. Unlike most passerines, raptors may have home ranges that extend beyond the urban boundary and therefore do not need to meet all their ecological requirements within urban areas. Urban habitats are often of superior quality to raptors because there they are often free from persecution and have an adequate food supply. The processes that underlie the patterns of population and community level responses need more attention, but several areas of have been identified as being important. Birds respond to vegetation composition and structure, and urban areas that retain native vegetative characteristics retain more native species than those that do not. Avian fecundity in urban areas is a reflection of species-specific adaptability to urban resources, and to levels of nest predation and nest parasitism. Additionally, non-consumptive human activities that increase with urbanization are recognized as having negative impacts on avian populations and communities. Avian survivorship in urban areas is influenced by risk of collision with man-made objects, changes in the predator



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assemblage, food supply, and disease. Missing are thorough investigations in the regions of highest human population growth, e.g. Southeast Asia. Additionally, there is a paucity of information from regions of high avian diversity, e.g. tropical forests. Clearly, local knowledge and study is required before implementation of management policies to reduce urban impacts on bird communities. Hopefully, such policies will include long-term monitoring. Demographic parameters of fecundity and survivorship need to be examined in conjunction with measures of community diversity and density across the urban gradient to better understand the quality of different urban habitats, and the variation of quality among spatial patterns of urbanization within the native habitat matrix. © 2004 Elsevier B.V. All rights reserved.

