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Landscape preferences, ecological quality and biodiversity protection

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LANDSCAPE PREFERENCES, ECOLOGICAL QUALITY AND BIODIVERSITY PROTECTION

ABSTRACT: The loss of biological diversity is a major environmental problem occurring on a global scale. Human-environment researchers have an important role in shaping policy and programs at a local, national and international level. This paper explores human preference for landscapes relative to ecological quality and assesses the relationship between these preferences and land management behavior. A survey of more than 1000 urban and rural residents of southeastern Australia examined preferences for 36 black and white photographs of native vegetation. There was more commonality than difference between urban and rural preference for different arrays of native vegetation. Preference for *Eucalyptus* species was higher than preference for non-*Eucalyptus* species. Preference ratings indicate minimal differences across landscapes with distinct variation in ecological quality. The study suggests that preference for landscapes of relatively high ecological quality is associated with behavior that is protective of this resource.

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The earth's rich variety of life forms – plants, animals and microorganisms as well as the genes they contain and the ecosystems they form – are a global asset of immeasurable value. Despite this, human activity continues to result in the extinction of species world-wide; the biological diversity on which we depend is severely threatened.

At a global level, concern for biodiversity loss is expressed in the international Convention on Biological Diversity sponsored by the United Nations Environment Program (UNEP); Australia became a signatory to the Convention on World Environment Day, 1992 (Commonwealth of Australia, 1996a). At a community level, however, there is relatively little concern for loss of species and ecosystems. In 1998, 22% of Australians surveyed considered loss of trees and ecosystems to be an important environmental issue and less than 10% were concerned about loss of animals and wildlife (Australian Bureau of Statistics, 1998). Australians were more likely to be concerned about pollution of air and waterways; similar priorities have been noted in the United States of America (Bidwell & Barro, 1996).

Lack of public concern is an important consideration since preventing further loss of biological diversity depends on cooperation of government, industry and the broader community. In Australia, the largely urban community has a particularly important role, sustaining political will and the financial base from which to implement the National Biodiversity Strategy (Commonwealth of Australia, 1993). While the rural population is much smaller, its contribution is equally important, managing the declining amount of fragile remnant native vegetation that is found on private land (Commonwealth of Australia, 1996b). There is clearly an urgent need to find more effective means to communicate the importance of biological diversity to both rural and urban communities. In this paper, we explore human perceptions of native vegetation, examine the relationship between these preferences and ecological quality of the vegetation, and discuss the implications for protecting natural ecosystems.

Orientation and attraction towards nature are important aspects of human experience (Kellert, 1997). Numerous studies have demonstrated preference for environments with natural elements over those that are predominantly built (Kaplan & Kaplan, 1989) and one might therefore predict that humans will prefer those environments which are most natural and rich in a variety of life forms. In fact, three decades of research concerning human response to different types of largely natural landscapes (Kaplan & Kaplan, 1989) raises the possibility that the most natural environments may not be the most preferred. Observing apparent preference for modified savanna environments, Gobster (1994; 1995) has speculated that the psychological processes which underpin preference for nature may also promote dispositions less consistent with protection of biological diversity.

Landscape architects have noted that natural ecosystems are often considered less attractive than more manicured environments. Both Nassauer (1995) and Thayer (1989) have suggested that the appearance of natural habitat transgresses American cultural norms for neat appearance of landscapes. Observing the social “language” of landscape among Americans, Nassauer (1995) suggested that through regular mowing of grassy areas and pruning of larger plants, landowners communicate their intention to care for their property; neatness equates with good management or stewardship of land. In this social context natural ecosystems may be viewed as messy and untended (Thayer, 1989). Such social expectations signal significant challenges for those wishing to promote the value of biologically diverse ecosystems.

Preference for neat landscapes may reflect more ancient and widespread landscape responses than has been recognised by the writers mentioned above. The anthropologist Rhys Jones (1985) has observed a preference for neat landscapes among Australia’s indigenous people. Australian aborigines managed their landscape for thousands of centuries prior to colonisation by Europeans. An important form of management involved regular burning of vegetation, a practice thought to have resulted in the creation of large areas of savanna-like landscapes (Barr & Cary, 1992). Jones reports that this burning was undertaken for a variety of reasons:

...to clear the ground to hunt, to drive game, to signal, for fun, but especially (in their own words) to 'clean the country.' Aborigines perceive an unburnt piece of ground with tall dry grass, with its skin penetrating seeds and the lurking dangers of snakes, rather as we would a dirty, untidy room. They set fire to it in order to curate it, to look after it. (p. 204)

The practice of regular burning continues in some parts of Australia today, and recent indigenous writers (Stanley, 1998) have suggested that contemporary indigenous people continue to perceive "good country" to be that which is open and has relatively low understorey growth.

Such anthropological analysis raises the possibility that social norms for neat landscapes might have a basis in more universal psychological processes. There is considerable evidence that humans prefer landscapes that are relatively open and smooth (Kaplan, Kaplan & Brown, 1989). These seemingly universal preferences are most commonly attributed to inherited predispositions. Orians (1980) has argued that innate preference for very open landscapes provided an evolutionary advantage for hunters and gatherers living on the ancient savanna of East Africa at the time when the human brain, including structures associated with emotion, was developing. These more open landscapes provided the best shelter, hunting and disease-free environments. Processes of natural selection have ensured that innate attraction to such landscapes still influences the attitudes of humans today. Other writers have attributed preference for open landscapes to other survival needs of humans including the need to see potential predators and prey without being seen oneself (Appleton, 1975) and to navigate and move through a landscape with ease (Kaplan, 1991).

The preference for park-like landscapes has also been attributed to learned responses. Gobster (1995) suggests that 18th century fashions in landscape design have led to familiarity with and preference for traditional English style park-scapes in nations which were originally British colonies. Whatever the psychological origin, it is clear that preference for

open and smooth landscapes may have important implications for human response to biologically diverse environments. The landscapes through which we can view and move with greatest ease are often those which have been most heavily modified through removal of understorey plants.

Gobster (1994) observed that the spatial configurations which humans most prefer are consistent with the visual characteristics of vegetation of poor ecological quality. He examined preferences for such modified landscapes among North American children. Gobster showed children photographs of five savanna landscapes in the Chicago district and found children's preference for savanna decreased as naturalness increased; children actually preferred the more degraded environments. Gobster's findings however are not consistent with other work in this area. For example, Kaplan, Kaplan and Brown (1989) report a non-significant but positive relationship between naturalness and landscape preferences, while other research (Van den Berg *et al*, 1998) suggests that biodiversity has a positive relationship with beauty ratings, but that perceived biodiversity differs with educational and occupational background of respondents.

Preferences for natural landscapes which have been "tidied up", and from which understorey species have been removed clearly present a significant obstacle for those seeking to protect biological diversity within ecosystems, but clearly further research is required. This is particularly true within Australia as very little is known concerning human perceptions of the Australian landscape and vegetation. The few existing studies have examined responses to broad ranging landscape types (Fenton, 1985; Kaplan & Herbert, 1987; Purcell, 1987), providing little insight to the problem of preference for openness, smoothness and naturalness in Australian landscapes. This study will examine landscape preferences of urban and rural landholders in south eastern Australia. It will test whether there is evidence of preference for landscapes which are of lower ecological quality, and examine the relationship between landscape preferences and behavior which promotes protection of biodiversity.

METHOD

The study used a principal components analysis approach to identify categories of perceptual preference for landscapes representative of native vegetation in south eastern Australia. Five vegetation types were identified from patterns of preference for vegetation presented in black and white photographs. Preferences for these five categories were compared with expert ratings of vegetation ecological quality and with landholders' reported biodiversity protection behavior.

Participants. The study involved both urban residents and rural landholders. Residents of metropolitan Melbourne were selected at random from the metropolitan telephone directory and correctly completed responses were returned by 664 residents (response rate 44%). Rural respondents were drawn from three regions (Victoria's Wimmera, upper southeast South Australia and the Midlands of Tasmania) selected on the basis of broad similarities in land use and vegetation characteristics. Populations were defined according to municipal boundaries and all landholders owning property of 5 hectares within specified parishes were posted a survey. Correctly completed forms were received from 568 landholders (response rate 38%).

Materials. The photo questionnaire presented 36 black and white photographs showing native vegetation characteristic of the three rural study sites. Vegetation included woodland and forest, but excluded open grassland and wetlands present in these areas. Photographic sites were selected in consultation with local botanical experts to represent a range of values related to dominant species, spatial configuration (smoothness and openness of vegetation) and degree of human modification of landscape (through grazing or wood collection). Water and built landscape features such as fences and tracks were excluded from the photographs. Photographs showed a relatively small area of bushland; as much as can be captured in a single photograph using a standard 50mm lens while standing in a small clearing.

Photographs were presented in two different sequences to eliminate effects associated with order of presentation.

Landholder and urban residents questionnaire. Respondents rated preference for the photographs using a five point scale (ranging from “like very much” to “do not like at all”) and provided some general demographic information. Surveys of rural landholders also measured reported biodiversity protection. A list of 11 actions was presented (for example “kept stock out a paddock [field] for a time to allow regeneration”, “collected seed from local plants for planting”, “left dead wood on the ground for wildlife habitat”) and landholders were asked to tick actions they had taken to protect the biological diversity of native vegetation on their own property.

Follow up interviews and surveys were conducted with 131 landholders and 126 urban residents to obtain verbal descriptions of representative vegetation types. Respondents were shown one scene from each of five vegetation categories and asked to describe liked and disliked aspects of each scene.

Ecologist ratings. A panel of 15 ecologists and botanists with expertise in assessing native vegetation also rated the 36 photographs. Experts rated the ecological quality or integrity of the vegetation on a five point scale ranging from “excellent” to “poor”. Ecologists typically reported utilising a number of cues to estimate ecological quality including presence of understorey plants such as shrubs and native grasses, leaf and wood litter on ground for habitat, and different age classes of trees (both mature and regenerating).

RESULTS

Underlying patterns of preference were examined using principal components analysis with a varimax rotation (Norussis, 1993). This process determined five components which account for 57% of variance in preferences across all responses. Following the Category

Identification Method outlined by Kaplan and Kaplan (1989), loadings on these components were used to define 5 categories of vegetation. The nature of these categories, summarised in Table 1, was identified through visual inspection of the photographs and through analysis of respondents' verbal descriptions of each category. Verbal descriptions were analyzed according to frequency of word use utilising the computer software package CATPAC (Terra Research & Computing, 1993).

Components 1, 2 and 3 are all characterised by the dominant *Eucalyptus* canopy vegetation, but distinguished from each other by spatial configuration and understorey plants. For example, photographs loading on Component 1 show dense *Eucalyptus* vegetation with a heavily textured understorey (Figure 1). This contrasts with photographs loading on Component 2 which are generally *Eucalyptus* trees in an open configuration with a lightly textured grassy understorey (Figure 2), while the very open vegetation with smooth, heavily grazed understorey shown in Figure 3 is typical of the scenes loading on Component 3.

Scenes loading on Component 4 were clearly distinguished by the vegetation type *Allocasuarina luehmannii*, commonly known as Bull-oak or Casuarina woodlands. Bull-oak woodland occurs in two distinct forms depending on its management. In areas that are grazed, the Bull-oak trees are typically widely spaced with a smooth pasture understorey (Figure 4). Where no grazing occurs this vegetation is characterised by small, thickly growing trees under which very few understorey plants can grow (Figure 5). Although both forms were represented in the study, the component was more heavily weighted toward the dense form of Bull-oak vegetation.

Photographs loading on the final component were also distinguished by the species of canopy plants; all scenes depict *Allocasuarina verticillata*, sometimes known as She-oak (Figure 6). These trees have needle-like foliage similar to the Bull-oak, but generally have a more spherical form and occur in more open woodlands with a rock-strewn grassy understorey.

The mean ecological quality for photographs loading on each of the five components is presented in Table 1. Analysis of variance with a repeated measures design indicates clear differences between the five categories with regard to ecological quality ($F(10,4)=85.09$, $p=.00$). In particular, the three categories dominated by Eucalyptus vegetation exhibit distinct ecological values, with dense eucalypt scenes having high ecological quality, open grazed woodland very low ecological quality and grassy woodland moderate ecological quality. Both She-oak and Bull-oak vegetation types have moderate ecological quality and there is somewhat higher variation of quality within these categories.

Vegetation preferences. Table 2 shows the mean preferences of rural and urban respondents for each of the five vegetation categories. The overall preference patterns of urban and rural respondents are very similar. While multiple analysis of variance (MANOVA) indicates significant differences between the two groups ($F(1226,5)=5.181$, $p=.00$), these are very small. Univariate analyses with the appropriate Bonferroni adjustment for multiple tests were conducted to further examine these differences and identified rural-urban differences in two regards: preferences for Grazed Woodland and for She-oak Woodland. Results indicate that urban respondents have somewhat higher regard for heavily grazed woodland than rural respondents ($F(1230,1)=8.93$, $p=.00$). Analysis of verbal data indicates that urban residents consider the grazed woodlands to be pleasant, park-like environments well suited to walking. In contrast, rural landholders described these scenes as overgrazed and lacking the grass needed to feed cattle and sheep. Urban residents also have slightly lower preference for She-oak vegetation ($F(1230,1)=5.28$, $p=.02$). Verbal data suggests that urban residents may be much less familiar with this vegetation type; rural landholders were 7 times more likely to name the vegetation as Casuarina or She-oak.

For both groups, there were significant differences in preference for vegetation types represented in the five categories (for urban respondents $F(660,4)=149.78$, $p=.00$; for rural

respondents $F(564, 4)=85.07, p=.00$). The most striking result of pairwise comparisons indicates that both rural and urban respondents have significantly lower preference for the two non-eucalypt vegetation categories (Bull-oak and She-oak) relative to the three eucalypt vegetation types. During interviews, respondents explained their dislike for these categories by describing the vegetation as dry or dead. In addition, the distinct leaf-less foliage (known as branchlets or cladodes) was often considered to indicate an unhealthy tree and the dark bark interpreted as indicative of a fire damaged tree.

Vegetation preference and ecological quality. A comparison of Tables 1 and 2 provides some insight to the relationship between ecological quality of vegetation and preference for vegetation types, but this relationship is not simple. Focusing on the three Eucalypt Categories (1, 2 and 3), it can be seen that urban respondents express some preference for the two vegetation types with lowest ecological quality. This is clearly not the case however for rural respondents, who expressed equivalent preference for the ecologically poor Grazed Woodland and the ecologically superior Dense Woodland.

The complexity of the relationship between preference and ecological quality is illustrated in Figure 7. For the three Eucalypt vegetation types, mean preference for each photograph (averaged across all rural landholders and urban residents) is plotted against mean ecological quality as judged by ecologists. While vegetation in the three Eucalypt categories is clearly differentiated with regard to ecological quality, each category contains photographs with a wide range of values in regard to preference. There is therefore no apparent relationship between ecological quality and preference at this level of investigation.

Vegetation preference and behavior. For each rural landholder, the number of actions taken to protect the biological diversity of native vegetation was totalled providing an overall Biodiversity Protection Behavior score (BPB). The relationship between this score and vegetation preferences was investigated in two ways. Table 3 presents the correlation

between BPB and individual mean preference for each vegetation type. For the four vegetation types with moderate to high ecological quality there is a small but significant positive relationship between preference and protection of biodiversity; landholders who report higher preference for these vegetation types also report undertaking a higher number of behaviors which will preserve the ecological quality of these ecosystems. In contrast, there is no association between BPB and preference for vegetation which is low in ecological quality. Landholders who are attracted to vegetation of low ecological quality are no more or less likely to report biodiversity protection behavior.

In a second analysis, landholders were separated into two categories: those undertaking 3 or less actions to protect native vegetation (low BPB) and those reporting 4 or more actions (high BPB). The vegetation preferences of these groups were compared through MANOVA which indicated significant differences ($F(344,5) = 8.49, p=.00$). Follow up univariate analyses reported in Table 4 show that preference for vegetation types of moderate to high ecological quality (Dense, Grassy, Bull-oak and She-oak vegetation) was higher among landholders with a high BPB scores. There were no significant differences between landholders with high and low BPB scores in regard to preference for the ecologically poor Grazed Woodland scenes.

DISCUSSION

A striking aspect of perceptually derived categories reported in this study is that the two least preferred categories are differentiated with regard to tree species (the Bull-oak and She-oak categories). Species-based classes are not commonly reported in perceptual preference research (see Kaplan and Kaplan, 1989 for example), and where reported may be seen as having significance only within a geographical region. In this case, we believe species-based categories may have more general implications for landscape perception theory. Respondents' descriptions of Bull-oak and She-oak vegetation types highlight the importance of water, healthy vegetation and safety in the environment. Visual characteristics of the trees,

including form, foliage and bark, were interpreted as indicative of an unhealthy, dry and fire prone environment. In one sense these interpretations were incorrect since the trees were neither unhealthy nor fire damaged. More generally however, respondents interpreted the landscape with some accuracy; the needle-like foliage and tough bark of She-oak and Bull-oak trees are unique adaptations to a harsh, dry environment.

The use of tree characteristics to infer the productivity and safety of the landscape is consistent with the evolutionary theories of Orians and Heerwagen (1992). There have been few studies of human perception of individual tree species to date. Those in existence generally focus on the relationship between tree form and preference (Sommer and Summit, 1995; Summit & Sommer, 1999). The present study suggests the value of investigating perception of other tree characteristics such as foliage and bark since these characteristics may also provide perceptual cues to the relative productivity of the landscape.

The three eucalypt woodland categories derived from perceptual preferences in this study appear primarily distinguished by spatial configuration and ecological quality. The importance of perceived naturalness is reflected in respondents' descriptions of the photographs. For example, photographs included in the Dense Woodland category show relatively densely growing trees with a heavily textured understorey. The key concepts which interviewees use to describe this category do not refer directly to the spatial configuration but to the content of the photographs and particularly the perceived naturalness of these scenes. The importance of perceived naturalness is highlighted by the clear differences in ecological quality between the three eucalypt vegetation types. Consistent with work by Kaplan and Kaplan (1989), even when environments contain no built elements, perceived naturalness continues to be a critical aspect of human landscape perceptions. This study lends support to Gobster's (1994; 1995) assumptions concerning the relationship between spatial configuration and ecological quality. In doing so, it reinforces the importance of incorporating theories of

landscape perception in the development of programs to promote the protection of ecological quality and biodiversity.

While the study confirms the relationship between spatial configuration and ecological quality, this should not be taken to indicate that the relationship between ecological quality and landscape preference is simple. On the basis of these findings, there is no evidence that ecological quality is a negative predictor of human landscape preference as has been suggested by Gobster (1995) and others. There is a need for further research to explore the problematic assumption that biodiverse environments satisfy human preferences, whether such preferences be determined by evolution or a learned aesthetic. While the broad parameters of landscape preference are now well understood, preference for more complex, ecologically rich landscapes (particularly based upon learned preference) will itself be complex and more difficult to identify in typical cross-sectional surveys.

While there were no large differences in the landscape preferences of rural and urban respondents, verbal descriptions of the vegetation suggest these landscapes have different meanings for rural and urban cohorts. Rural landholders described vegetation largely in terms of its value for their stock, a major source of income, and prefer those landscapes which provide grass for stock feed. In this study, urban residents were more likely to describe the value of vegetation for passive recreation and preferred landscapes best suited to walking and similar activities. Differences in rural and urban preferences, while not as substantive as the similarities, suggest programs to encourage increased biodiversity should differentially emphasize the functional needs of rural and urban people

Finally, the study showed a positive association between landscape preferences and protection of natural environments. The complex relationship between landscape perceptions, ecological quality and protection of biodiversity highlights the critical role which social sciences play in the management and conservation of biological resources (Endter-Wada *et al*,

1998). Environmental perception research is an important component of participatory land management, indicating both community views and behavioral tendencies which should be considered in the management of ecosystems.

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TABLE 1
Description and ecological qualities of five components

Component	Brief description	Key concepts (interviewees)	Spatial configuration		Ecological quality	
			Density	Texture	Mean	Std Dev.
1. Dense Woodland	Canopy species <i>Eucalyptus</i> family; scrubby understorey	Natural, undergrowth vegetation	High	High	4.10 ^a	.44
2. Grassy Woodland	Canopy species <i>Eucalyptus</i> family; grassy understorey	Grass, native, open	Low	Mixed	2.96 ^b	.50
3. Grazed Woodland	Canopy species <i>Eucalyptus</i> family; cleared understorey	Open, grazed, cleared	Low	Low	1.82 ^c	.40
4. Bull-oak Woodland	Canopy species <i>Allocasuarina Luehmannii</i>	Fire, dense, natural	High	Mixed	2.70 ^{bd}	.52
5. She-oak Woodland	Canopy species <i>Allocasuarina Verticillata</i> ;	Rocks/rocky, dead, dry	Mixed	Mixed	3.20 ^d	.65

^{abcd} For columns, matching superscript letters indicates no significant difference between values for these vegetation categories

TABLE 2**Mean preferences for vegetation categories:****Comparison of urban and rural respondents.**

Vegetation Category	Rural preference		Urban preference	
	Mean	Std Dev.	Mean	Std Dev.
1. Dense Woodland	3.30 ^{ab}	1.02	3.26 ^a	.92
2. Grassy Woodland	3.36 ^a	.71	3.34 ^b	.78
3. Grazed Woodland	3.25 ^b	.73	3.38 ^{b***}	.74
4. Bull-oak Woodland	2.84 ^c	.89	2.80 ^c	.82
5. She-oak Woodland	2.96 ^d	.89	2.84 ^{c***}	.86

^{abcd} For columns, matching superscript letters indicates no significant difference between values for these vegetation categories

*** For rows, asterisks indicate rural and urban preferences are significantly different for this vegetation category.

TABLE 3**Correlation between vegetation preference and biodiversity protection behavior**

Vegetation Category	Correlation
Dense Woodland	.31**
Grassy Woodland	.22**
Grazed Woodland	.01
Bull-oak Woodland	.26**
She-oak Woodland	.31**

**Correlation is significant at the 0.01 level (2-tailed).

TABLE 4
Preference for vegetation types: Landholders with high and low levels of biodiversity
protection behavior

Vegetation Type	Low BPB (n=267)		High BPB (n=283)	
	Mean	Std Dev.	Mean	Std Dev.
Dense Woodland**	3.07	1.01	3.53	.98
Grassy Woodland**	3.25	.71	3.47	.69
Grazed Woodland	3.26	.71	3.24	.75
Bull-oak Woodland**	2.66	.83	3.01	.92
She-oak Woodland**	2.73	.83	3.17	.90

** mean preferences for vegetation category significantly different at p=.00



Figure 1: Dense Woodland (Component 1)



Figure 2: Grassy Woodland (Component 2)



Figure 3: Grazed Woodland (Component 3)



Figure 4: Bull-oak Woodland (Component 4), open form



Figure 5: Bull-oak Woodland (Component 4), dense form



Figure 6: She-oak Woodland (Component 5)

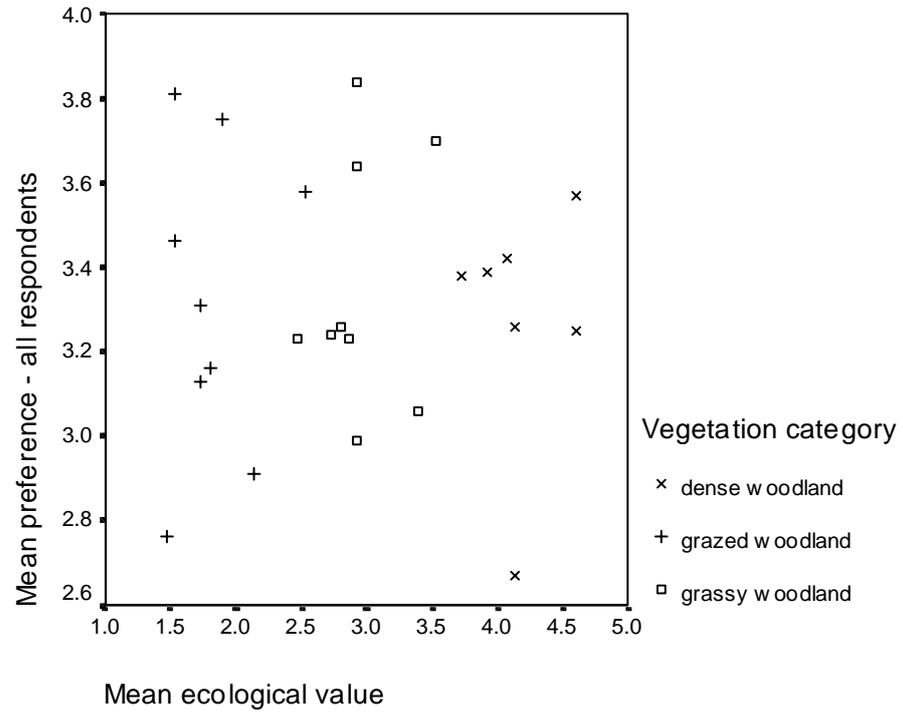


Figure 7: Preference and ecological quality of eucalypt woodlands: Comparison of Dense, Grazed and Grassy vegetation categories.