FORUM ARTICLE

Measuring accuracy of land cover data and content of cover classes: a reply to Brockerhoff et al. (2008)

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In a response to our recent paper (Walker et al. 2006), Brockerhoff et al. (2008) reiterate the need to assess ongoing loss of habitat for indigenous species, and for more reliable data to support assessment of status and trends in indigenous biological diversity. However, they question our conclusion, based on comparison of national land cover databases (LCDBs), that 'plantation forestry remained one of the major causes of indigenous cover loss' between 1996/07 and 2001/02. In this reply, we address matters of land cover database accuracy and the content of cover classes.

Land cover database accuracy

We (Walker et al. 2006) compared national land cover databases (hereafter LCDBs: LCDB1 and LCDB2, based on imagery from 1996/97 and 2001/02, respectively). Brockerhoff et al. (2008) repeated this exercise, using our assignment of cover classes to 'indigenous' and 'non-indigenous'. They obtained identical results showing exotic afforestation accounted for over 65% of transformation from 'indigenous' to 'non-indigenous' cover classes, but suggest error in the LCDBs is too large to attach confidence to this result.

We wholly agree that the LCDBs contain error, and that more adequate quality assessments of the databases are needed. As Walker et al. (2006, p. 175) stated: 'mapping and classification errors in the databases remain unidentified but are likely to be large in relation to detected change.' However, we question how well Brockerhoff et al. (2008) clarify LCDB accuracy and advance insights into land cover change.

First, they characterise only one component of potential error. Afforestation undetected in LCDB2 was not determined, guaranteeing the impression that afforestation was less than indicated. They assert it is 'not acceptable' to assume undetected afforestation might cancel out the error they found. We suggest unbiased assessment requires quantification of both error types.

Second, Brockerhoff et al. (2008) used subjective manual interpretation (as with the LCDBs) of various unstandardised sources. The precision of their estimates is unknown, but assumed to be 100%: appendix 1 implies two-decimal-point precision, and table 2 assigns zero standard error to the largest polygon class. Such precision is unlikely from opinion-based (rather than sampling-based) estimates of cover type proportions, which we suggest is neither 'detailed examination of actual areas' nor verification of 'the entire area of each change polygon'. Error in opinion-based estimates based on multiple imperfect determinants may in fact be considerable – perhaps greater than in the LCDBs.

Thus, having emphasised that error quantification is vital, Brockerhoff et al. (2008) quantify just one component of LCDB error, and fail to quantify error in their determinations at all. Crucially, while their deductions differ from those in the LCDBs, we cannot know if theirs are indeed more accurate without sampling to assess this. Because error exists in both, it is false to assert that disparity between their determinations and those of the LCDB is 'misclassification' or 'error rate' in the LCDBs; this assertion is central to their results and interpretations.

Cover classes and indigenous biodiversity

Both our paper and Brockerhoff et al. (2008) highlight the fact that biodiversity inventory in New Zealand remains inadequate to assess what biodiversity is associated with coarsely assigned land cover classes. All cover classes are heterogenous and support both native and exotic species. Statistically robust field sampling is needed to establish their biotic content because conclusions based on a few sites chosen for unrelated purposes may be subject to bias.

Brockerhoff et al. (2008) make several assertions regarding the native content of cover classes. These are supported by reference to studies, but no systematic evidence is presented. Existing South Island plot data collated by Cieraad (2007, unpubl. contract report) support two of their assertions: that native species occur in exotic forests (but also in other 'non-indigenous' cover classes) and that pine forest conversion to high-producing exotic grassland could reduce native species richness (Table 1). However, the plot data do not support notions that afforestation of low-producing grasslands could result in indigenous biodiversity gain, nor that afforestation in secondary shrublands may be of minor concern for biodiversity conservation. We emphasise that Cieraad's (2007) data cover just one biotic group (plants), do not offer statistically robust samples of cover classes, and that the disputed classes remain poorly sampled. Therefore results in Table 1 will have biases and are incomplete. Our point is simply that plot-based datasets may lead to different deductions than those of Brockerhoff et al. (2008).

Brockerhoff et al. (2008) highlight benefits of exotic forests for indigenous biodiversity. They observe exotic forests often contain native vegetation remnants and support native species, and are increasingly managed to protect these. While we agree with these observations, we point out that additional factors need consideration when assessing biodiversity contribution. For a start, biodiversity encompasses more than numbers or proportions of species. Ecosystems and ecological processes dominated by indigenous species are ingredients of biological diversity and enable persistence and continued evolution of species. Indigenous dominance is low in many exotic forests. Assessments of contribution must also take account of complementarity (i.e. how much unique threatened biodiversity now occurs only in exotic forest?). Pine forests might provide important refuges where regional biodiversity loss has been extreme, but where they support common and secure species (low complementarity) their contribution may be smaller. Finally, assessment of the contribution of exotic forests to long-term security of native biodiversity must consider periodic loss of habitat and repeated isolation of interstitial indigenous remnants through harvest, and insecurities associated with land-use changes, as demonstrated by current conversions to dairying.

Conclusion

High quality land cover data are of great value for biodiversity and conservation assessment nationally and locally, and initiatives leading to improvement in the resolution accuracy and currency of New Zealand's land cover data are unquestionably needed. Despite shortcomings, Brockerhoff et al. (2008)'s methods are probably sufficient to confirm our impressions, and those of many others, of classification errors in the LCDBs. However, in order to reliably measure the accuracy of land cover data and interpret derived indicators of indigenous biodiversity and conservation performance, such initiatives must entail systematic and statistically robust field sampling.

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Table 1. Percent native species and average of native and exotic vascular plant species in South Island plots, from Cieraad (2007, unpubl.). Averages are in bold, and lower and upper 95% confidence limits respectively are in normal type.

LCDB2 cover class	No. plots	% native species	No. native species	No. exotic species
Indigenous Forest	748	95–**96**–96	26.6– **28.0** –29.5	0.6– **0.7** –0.8
Broadleaved Indigenous Hardwoods	61	80–**86**–90	16.4– **20.7** –26	1.5– **2.2** –3.2
Tall Tussock Grassland	304	79–**81**–82	15.9– **17.0** –18.1	2.8– **3.2** –3.6
Manuka and/or Kanuka	76	75–**79**–83	20.1– **23.1** –26.5	2.9– **3.9** –5.3
Grey Scrub	16	64–**76**–85	15.6– **20.7** –27.4	2.9– **5.1** –8.5
Depleted Tussock Grassland	39	63–**69**–75	9.5– **11.7** –14.3	4.2– **5.1** –6.1
Low Producing Grassland	182	58–**62**–65	9.9– **11.1** –12.4	5.9– **6.7** –7.5
Pine Forest – Closed Canopy	26	42–**55**–67	3.0– **5.1** –8.2	3.5– **5.2** –7.6
Pine Forest – Open Canopy	14	32–**44**–56	4.6– **7.7** –12.5	1.3–**13.2** –15.5
Gorse and Broom	31	33–**43**–53	2.9– **4.8** –7.6	6.6– **8.9** –11.8
High Producing Exotic Grassland	172	34–**39**–44	2.3– **3.0** –3.9	9.5–**10.5** –11.5

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