

CORRESPONDENCE

Forum Essay — Response

WE refer to the Forum Essay, Aspects of ecologically sustainable forestry in temperate eucalypt forests — beyond an expanded reserve system, by David Lindenmayer and yourself (*Pacific Conservation Biology* 4: 4–10), particularly the comments about the Kingston project (p. 7). As we have been involved in the development and implementation of the Kingston project, we would like to respond to your criticism of this work.

You make the point correctly that few forest management by experiment and monitoring projects are underway in Australia and point to the Kingston project as one of these few. However, you then state that “concerns have been expressed that the Kingston study has been designed at an inappropriate spatial scale with both logging and control blocks being too small and not well separated.” You continue “The design of the study has also been confounded by simultaneous control programmes of the European Fox *Vulpes vulpes* and inadequate pre-logging surveys of the distribution and abundance of forest fauna. Properly designed studies and monitoring programmes need to recognise the inherent variability of forest ecosystems between seasons and years etc . . .”. You conclude this section “Studies need to be designed and monitored over appropriate temporal and spatial scales.”

We would like to respond to these statements separately.

1. “concerns have been expressed . . .”
We are not aware of any concerns being expressed in the scientific literature, and would appreciate the details of these.
2. Logging and control blocks too small and not well separated:
We assume you mean here that the sampling grids are too small, rather than the logging and control blocks. The sampling grids were 2.6 ha and were established to sample a range of vertebrate fauna including frogs, reptiles, small mammals and medium sized mammals. This grid size covered

the movement areas of the smaller species and for the medium sized mammals such as Brushtail Possums, Quenda, and Woylies with home range areas of 4–6 ha this was also quite adequate. In a typical Gap treatment the trapping grid occupied between 25 and 33% of the disturbed area. The additional advantage of this grid size and pattern was that it is the same as those used in other studies in Jarrah forest making comparisons possible between the Kingston project and other research on impacts of forest operations.

The study has two types of Controls, both internal (in unlogged buffers near to the treatment areas within Kingston block) and external (in the adjacent unlogged Warrup and Winnejup forest blocks). Close proximity of treatment and internal control blocks enables more precise comparison of treatment effects for the smaller species with small dispersal patterns. The external controls were located at least 1 km from any disturbance site and there was no evidence from either trapping or radiotelemetry studies, that medium sized mammals (other than the wide ranging Chuditch) travelled between control and treatment grids. Extremely tight rainfall gradients in the eastern jarrah forest, which provide both north-south and east-west variability in forest composition and structure, mean that Controls cannot be placed too distant from treatment areas as they would most likely be in a different vegetation type.

Because of the wide ranging nature of the Chuditch, it was never intended that the grid system would adequately sample this species in the study area. Road transects were used to sample Chuditch abundance at a forest block level rather than an impact site level.

3. The study has been confounded by simultaneous control of the European Fox: The design is not confounded by the fox control

programme, as both treatment and control sites are subject to the same fox control regime. Estimating treatment effects against a background trend of increasing wildlife numbers due to fox control is quite possible using the BACI design, as any of the numerous papers on this type of design demonstrate (e.g., Underwood 1981). An experiment to examine the impact of logging (or any other treatment) would not have been possible in the jarrah forest without fox control because fauna abundances would not have been at a sufficiently high level to detect any changes as a result of the treatment. Widespread fox control is now an operational procedure throughout the Jarrah forest and any impact study needs to incorporate standard procedures to be relevant.

4. Inadequate pre-logging surveys of the distribution and abundance of forest fauna: You comment further that properly designed studies and monitoring programmes need to recognize the inherent variability of forest ecosystems between seasons and years. Pre-logging sampling in the Kingston study spanned 12 months, sufficient to provide an adequate measure of abundance before logging. The presence of Control plots is far more important as they provide information on the seasonal and year to year variation that is more relevant than variation in the years preceding the experiment.

Appropriate temporal and spatial scales: Any experimental study such as the Kingston study will be brief relative to the forest process time scale, although the Kingston study will be maintained as one of CALM's most important fauna monitoring sites for many years to come. That is why retrospective (time for space) studies are important and why such a study was included in the proposal to examine the impact of logging on the Jarrah forest ecosystem.

5. Monitoring in the Jarrah forest is not regarded by CALM as second rate science as evidenced by its commitment to programmes such as the Kingston study and fire impact studies. An important consideration in any forest disturbance study is that sound information is obtained in a timely manner using available financial and human resources. This places logistic constraints on any experimental design and any study that is designed to meet these limitations

is bound to be criticized as being less than perfect. The Kingston study, however, represents one of the best such compromises to be found anywhere, not just within Australia. The presence of pre-treatment data, internal and external controls, an examination of a range of fauna (and flora/vegetation) and a proposed retrospective study makes this work more comprehensive, integrated and better designed than many forest impact studies. That you were

able to single out the Kingston study for criticism, suggests that it is the first such study set up to meet an urgent need for information on the effects of forest disturbance.

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REBUTTAL

THE comments on Kingston were not intended as a criticism of the Kingston study, but only as an illustration of the complexities of undertaking such studies. Unfortunately, there have been few such studies attempted in Australia and Kingston is the most recent. In reply to your response:

1. I am not aware of any concerns about the Kingston study being published in the scientific literature. However, concerns over the design of the study were expressed during the Kingston court action and have been aired in the media by environmental groups. It was these concerns that were referred to in the essay.
2. There are extraordinary difficulties in designing a logging study which operates at appropriate spatial and temporal scales. It is not so much the size of sampling grids, the number of grids or the dispersion of grids, but it is the problem of knowing the spatial scale at which logging effects operate on relatively mobile vertebrates. In the absence of any reasonable metapopulation data on forest birds and mammals, it is hard to specify the scale of studies required. While I will be the first to acknowledge the practical problems, it may be that multiple replicates of the (entire) Kingston study are required to adequately assess impacts on mammals and birds.

At Kingston, it does not seem unreasonable to suggest that the

logged and unlogged blocks together constitute the treatment and than one cannot control for the other.

The difficulty with sampling grids as small as 2.6 ha is that they are unlikely to contain the entire home ranges of many individual birds or mammals. As there are unlogged areas, as well as unlogged buffers, nearby, the impact of logging may be masked by virtue of the fact that few individuals rely solely on the area logged. If this is the case, then the impact of logging may not be evident until well into the logging cycle, as more of the forest is affected by logging.

3. Without question, the control of foxes results in significant increases in the abundance of mammals, and probably of ground-dwelling birds and reptiles as well. Given the issues of scale discussed above, a depression of animal numbers as a result of logging may therefore be masked by the response of populations to reduced predation.

I do concede that the design of the experiment at Kingston allows the impact of logging to be assessed in an environment where fox control is practiced. However, it is not possible to determine the interactions between fox predation and logging. This is unfortunate as observations in eastern Australia and Europe suggest that logging and the roading associated with logging facilitates the movements of foxes, allows them to penetrate into the forest, and probably allows

them to hunt more efficiently. As there are no guarantees that either a permanent control of foxes will be found or that broad area baiting of foxes will continue indefinitely, it is important to understand the effects of logging on native fauna in an environment where foxes are not controlled. The Kingston study will not do this.

4. Twelve months of pre-treatment surveys are not adequate. Population variation between years for birds and mammals is large and subject to regional influences. While jarrah forest appears uniform and lacks some of the topographical diversity of forests in eastern Australia, there is no basis for assuming that all populations within the forest experience the same seasonal and annual variations in numbers. This needs to be established before one can be confident that "controls" are "controls". Recognizing that there are practical limitations to the amount of time that can be devoted to pre-treatment surveys, without a solid basis for understanding "background" year to year variation in numbers, it is very difficult to attribute any change, or lack of change, in numbers to treatment effects. Regrettably, there are few, if any, long-term data on populations of forest animals in Australia and fewer still from Western Australia (see the articles by Calver and Dell in this issue).
5. The comments on monitoring were not directed (except by proximity