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Reframing the evidence base for policy-relevance to increase impact: a case study on forest fragmentation in the oil palm sector

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Running title: Increasing the impact of science in policy

Summary

1. It is necessary to improve knowledge exchange between scientists and decision-makers so that scientific evidence can be readily accessed to inform policy.
2. To maximise impact of scientific evidence in policy development, the scientific community should engage more fully with decision-makers, building long-term working relationships in order to identify and respond to “policy windows” with science that is reframed for policy-relevance.
3. We illustrate the process and challenges using a case study in which we synthesised evidence from studies of habitat fragmentation to provide information for improved biodiversity conservation in the oil palm sector, resulting in the uptake of this research into new industry guidelines.
4. *Policy Implications.* The case study demonstrates how having an in-depth understanding of the “policy arena” (the state of policy and the actors and influencing factors that affect policy) and responding with relevant and specific information, enabled effective uptake of science to inform the design of conservation set-asides in the oil palm industry.

Key-words: communication; habitat fragmentation; biodiversity; species-area relationship; ecosystem functioning; knowledge exchange; oil palm; policy window; tropical, forest

Introduction

Science can provide decision-makers with valuable evidence to make better decisions on how to balance social, economic and environmental needs (Sutherland *et al*. 2004). Additionally, scientists increasingly need to show that their research is benefiting society (Sutherland *et al*. 2011a). However, the uptake of science into policy is often slow: time lags from research to policy have been measured in decades (Sutherland *et al.* 2011a) and many conservation decisions are not primarily based on the available scientific evidence (Juntti, Russel & Turnpenny 2009; Adams & Sandbrook 2013). Political and socioeconomic pressures can result in environmental policies that override the scientific evidence, but often a lack of effective dissemination prevents this knowledge from even being considered (Bainbridge 2014). When provided with scientific information, conservation managers will often choose more effective management options (Walsh, Dicks & Sutherland 2015), implying that overcoming barriers to communication between scientists and decision-makers is critical. There are increasing numbers of initiatives to facilitate this process among research councils (eg. NERC Knowledge Exchange Fellowships, www.nerc.ac.uk) and scientists (e.g. Borneo Futures, www.borneofutures.org) but there is a lack of knowledge of best-practice.

“Policy windows” are infrequent, short-term opportunities to make changes to policy, brought about by a combination of factors including the necessity to address a pressing problem and public pressure (Kingdon 1995). To increase the impact of science in policy, scientists need to be able to identify and react to these windows of opportunity. Several authors have described processes for identifying policy-relevant research topics, so that research can be designed to target policy priorities better (Sutherland *et al.* 2006, 2011b; Dicks *et al.* 2013, Bainbridge 2014). However, we argue that one-off or occasional workshops and consultations are insufficient to understand the dynamic policy arena. Instead, we promote an approach whereby dedicated personnel build long-term working relationships with stakeholders to understand the deeper context of the policy process and be in a position to identify and react to windows of opportunity.

Often there is already a substantial evidence base available to draw on, but findings may not be interpretable or readily accessible to non-academics. The challenge is to make the scientific information available to the appropriate people and organisations in a timely way, while being understandable and policy-relevant (Sutherland & Freckleton 2012). By “policy-relevant” we mean that the scientific evidence is framed to directly inform the questions and issues that decision-makers are trying to answer, given that the evidence is often generated for a different purpose. Our relationship-building approach allows us to target policy needs and to identify specific issues that a single stakeholder or a group of stakeholders are tackling, allowing us to provide highly tailored information.

Here we illustrate our approach with a case study on a policy window for providing scientific evidence to help define viable forest patch characteristics to improve guidelines for reducing biodiversity losses from oil palm cultivation (Fig. 1). This case study resulted in adoption of scientific evidence to inform new industry guidelines on forest patch size for sustainable land-use planning.

The palm oil industry

The palm oil industry is responsible for substantial deforestation (Gaveau *et al.* 2014). High productivity and increasing demand for palm oil globally has encouraged the clearing of rainforests to plant oil palm, which supports comparatively low carbon (~20% of above ground carbon found in primary forest, Ziegler *et al*. 2012) and biodiversity levels (~15-30% of species which occur in forest, Fitzherbert *et al.* 2008; Savilaakso *et al.* 2014). The palm oil industry is vital to the economies of Malaysia and Indonesia, which together produce around 85% of the world's palm oil (USDA-FAS 2015). Therefore, it is essential to improve the sustainability of the industry.

The Roundtable on Sustainable Palm Oil (RSPO) has developed the main sustainability standard for the palm oil industry. It addresses biodiversity conservation by banning all clearing of primary forest, and by retaining areas supporting High Conservation Values (HCVs) within plantation concessions (RSPO 2013). HCVs include high concentrations of biodiversity, endangered species or habitats, or important ecosystem services (Senior *et al*. 2015). Growers are responsible for identifying and retaining these HCV areas, and for ensuring that HCVs are maintained. Scientists have previously highlighted the need for greater scientific input into the HCV process (Edwards, Fisher & Wilcove 2011; Senior *et al.* 2015), and our case study demonstrates how existing scientific knowledge can be used.

Identifying the "policy window"

Over several years we have developed working relationships with stakeholders in the sustainable palm oil community with the support of the SE Asia Rainforest Research Partnership (SEARRP, www.searrp.org, stage 1 in Fig. 1). On-going activities include: attending the annual RSPO conference, holding an expert advisory seat on the RSPO's Biodiversity and HCV working group, and engaging with plantation companies where we conduct our research. We have developed – and continue to maintain – a "Knowledge Exchange Network" of industry stakeholders including growers, Non-Governmental Organisations (NGOs), government, and palm oil consumer companies. From this network, we identified a window for influencing policy on avoiding biodiversity loss in oil palm landscapes (stage 2 in Fig. 1). Pressures from a number of directions came together to create motivation for policy change, including: RSPO's application to the International Social and Environmental Accreditation and Labelling Alliance, which requires robust monitoring of impact; a growing number of zero net deforestation pledges from important palm oil buyers, traders and growers requiring the incorporation of carbon stock assessment into decision-making for conservation set asides (http://highcarbonstock.org); and the development of an HCV assessors licensing scheme to improve the quality of HCV assessments (www.hcvnetwork.org).

Through discussions with stakeholders it emerged that a key barrier to creating better policy was a lack of understanding about the effectiveness of retaining forest patches within oil palm plantations for conserving biodiversity. There was a lack of knowledge about how much biodiversity these patches could support, whether patches would maintain biodiversity over time, and how HCV forest patches could be optimised to maximise biodiversity and ecosystem functioning.

Reframing the scientific evidence base

The scientific literature on habitat fragmentation contains useful data to inform policy on this topic, but academic papers often make conclusions about general ecological patterns, such as: larger patches support more species (Laurance *et al.* 2002), and this is inadequate for stakeholders who want to know “how big is big enough?” to draw practical conclusions to aid decision-making. To reframe the evidence base for policy-relevance (stage 3 in Fig. 1), we collated data from published studies and unpublished PhD theses on biodiversity and ecosystem functioning in forest patches within oil palm landscapes (See Appendix S1 in Supporting Information for detailed methodology). We collated species richness data for five taxa from seven fragmentation studies (carried out in oil palm-dominated landscapes in Sabah, Malaysia), and we also collated ecosystem function data for six ecosystem processes (see Appendix S1 for studies included) and found dipterocarp tree regeneration to be the process most affected by fragmentation. We used these data to determine biodiversity and regeneration capacity of patches varying in size relative to lowland forest contiguous with an extensive forest tract of several million ha (Fig. 2, see Appendix S1 for detailed results). From these analyses, we distilled the findings into four key messages:

1. Large tracts of forest are essential to avoid biodiversity losses: species numbers did not begin to match levels found in continuous forest until patches reached sizes of 10,000-1.2 million ha
2. To maintain regeneration of dipterocarp trees forest patches need a core area of at least 200 ha; a patch of this size could support around 60-70% of the species richness of the same area of continuous forest.
3. Forest patches need to have a core area of at least 20 ha to consistently raise species numbers above those found in oil palm plantations. In small, low quality forest patches dipterocarp trees may not be able to naturally regenerate.
4. Patch size is the most important site characteristic, but higher quality forest could improve levels of species richness within sites of a given size.

Communicating results: addressing the risks and challenges

Synthesising and communicating scientific information to decision-makers, especially in the time-limited period of a policy window, is a source of justified anxiety to scientists (Lach *et al.* 2003, stage 4 in Fig. 1). There are challenges associated with disseminating science to those responsible for translating the information into on-the-ground decisions. Our approach of developing in-depth knowledge of the policy arena, and building long-term working relationships with users of the information, enables us to reduce some of the risks and solve some of the challenges. In this section we address the key issues and explain how we dealt with them in our case study.

Clear communication

The language used by scientists and decision-makers is often very different. By engaging with the stakeholders we could incorporate their language and remove scientific jargon that would inhibit understanding. We disseminated the results of our synthesis to decision-makers through a workshop attended by growers, Non-Governmental Organisations (NGOs), palm oil users, traders and RSPO representatives, thereby creating a controlled environment for sharing the results and allowing time for clarifications and discussion. Time was spent designing effective communication materials using diagrams and animations to demonstrate ecological concepts, and removing or clearly defining scientific terms that stakeholders may be unfamiliar with, recognising that some participants may have considerable scientific expertise while others are unfamiliar with the field (see Appendix S2 for PowerPoint slides).

Misuse or misinterpretation of science

Once research has been communicated, scientists have little control about how it is used. Scientific information may be misinterpreted or misused accidentally or deliberately by stakeholders. However, these risks can be reduced if situations where the information is likely to be applied can be anticipated. For example, our results were based on research from Sabah in Malaysia, therefore they are likely to be applicable to lowland dipterocarp forest in SE Asia, but may be less applicable to other regions such as Africa or Latin America, so we advised a precautionary approach in the absence of stronger evidence for these areas. We used small group discussion sessions, facilitated by scientists, that allowed stakeholders to question the scientists about the implications of the findings, and gave researchers an opportunity to identify and address any areas where the findings might be misinterpreted (see Appendix S3 for full workshop agenda).

Uncertainty

Dealing with uncertainty when communicating science to stakeholders can be a large source of confusion, and often results in science not being taken up in policy decisions (Bradshaw & Borchers 2000; Bainbridge 2014). It is important that scientists communicate the level of uncertainty to retain scientific integrity and to avoid presenting information as certain when it is not. However, decision-makers are unlikely to adopt scientific evidence if the information is presented in a way that suggests that it is unreliable. We have found that it helps to explain the levels of confidence qualitatively as ‘High’, ‘Medium’ or ‘Low’, using the same principles of assessing the level of agreement and robustness of the evidence as used by Mastrandrea et al. (2010) for the Intergovernmental Panel on Climate Change. For example, we have ‘high’ confidence that biodiversity increases with patch size, because of the large number of robust empirical studies that report this pattern. By contrast, we have ‘low’ confidence in specific threshold sizes for patches because of the small number of studies we were able to include in our analysis, and because of the many factors that could affect biodiversity levels other than patch size, such as the taxon studied, the level of connectivity and the quality of the habitat. We explained to stakeholders that it is important to take a precautionary approach when making decisions based on evidence with medium or low confidence. In this case, this means that new conservation set-asides should be larger than the minimum size guidelines wherever economic and social considerations permit, but that preexisting small forest patches should not be removed or assumed to have low biodiversity value. This approach allowed us to move beyond the general recommendation that “bigger is better”, towards providing practical information on likely viable patch sizes.

Ecological complexity

Too much complexity can also dissuade decision-makers from using scientific evidence. Ecological systems are highly complex, and there are numerous factors to consider for improving biodiversity levels in oil palm landscapes. We focussed strongly on the main drivers of biodiversity change in oil palm landscapes but our relationship-building approach means we can add to this information over time (stage 5 in Fig. 1). Future projects will likely address topics such as habitat connectivity and endangered species. In this way, we can systematically and sequentially address the complexity of the system with the understanding that ecology is only one of many factors, including economics and reputational risk, which decision-makers have to consider.

Incomplete and changing evidence base

Knowledge of a subject is never complete, and we can only present the information currently available. Non-scientists can become distrustful if the scientific evidence changes over time. We addressed this issue by managing expectations from the outset, explaining that the science process continually adds to the knowledge base. Dicks and colleagues (2015) addressed the problem by ensuring that the package of recommendations they produced could be modified as new data emerged and our long-term networking approach ensures that communication channels remain open to provide updates and discuss advances in the future (stage 5 in Fig. 1 see www.sensorproject.net/outputs for examples of our ongoing communications).

Maintaining an unbiased position

Maintaining an unbiased position as a communicator of scientific evidence rather than an advocate for a particular agenda is essential for ensuring scientific integrity and building trust amongst diverse stakeholders (Lackey 2007). This can become challenging in an approach that necessarily involves embedding oneself in the political arena and building relationships with stakeholders. We addressed this issue in three ways: the first was to report only information that is supported by evidence, and not to report information that we think may be correct, but for which there is currently no empirical evidence. Secondly, we ensured that the scientific information we presented broadly agrees with the wider scientific literature, and was not just drawn from the subset of papers used in our analysis. Thirdly, by holding a multi-stakeholder event we ensured that everyone received the same information with the same emphasis whether they were growers, NGOs, consumer goods companies or others.

Measuring Success

Linking policy changes and impact to original research can be very difficult (Sutherland *et al*. 2011b, stage 6 in Fig. 1). The pathway to impact has several stages, and maintaining a dialogue with stakeholders after the initial dissemination of information is vital to track outcomes (stage 5 in Fig. 1). The initial stage is “engagement”. We captured information about the initial success of the workshop by conducting a feedback survey, which indicated a high level of engagement and understanding. The second stage is the “uptake” of the science into policy. Through continued interactions with policy-developers (see Appendix S4 for a list of follow-up activities) we have enabled the uptake of our patch size recommendations to inform policy guidelines as a direct result of our knowledge exchange activities (e.g. informing viable forest patch size for High Carbon Stock guidelines (Raison *et al.* 2015)). The ultimate measure of success is “change”, which may not be realised for years or decades after initiation of knowledge exchange. In our example this might be measured as an increase in the average size of conservation set-asides in oil palm plantations.

Conclusion and recommendations

Building detailed understanding of the policy arena, developing long-term relationships with stakeholders and reframing the scientific evidence appropriately is key to enabling scientists to respond effectively to windows of opportunity for informing policy, and thus leverage the greatest impact. We recommend:

1. Building a network of stakeholders addressing broad research themes, or engaging with existing networks. This is likely to be more effective than many short-term groupings for very specific topics. These established networks are then well placed to receive results from new research projects as they occur and to feedback knowledge gaps for policy-making in a timely way.

2. Developing a reputation as a reliable source of scientific information by being responsive to information requests, listening to the questions and challenges faced by stakeholders, and being visible, through e.g. talking at industry conferences.

3. Employing dedicated Knowledge Exchange staff who are well-integrated into research teams. This is essential because the process is time- and effort-intensive, and requires in-depth understanding of, and sensitivity to, the local context – particularly for initiating and developing strong relationships with decision-makers. Dedicated staff can keep abreast of changing policy objectives, collate and synthesise science for policy-relevance, and develop skills for effective communication.

Authors’ contributions

J.M.L. conceived and designed the synthesis and process, G.P. analysed data, Y.K.L , D.P.E and M.J.S contributed data, J.M.L, Y.K.L, S.S and G.R. designed and ran the workshop, J.M.L and J.K.H. led in writing the manuscript. All authors contributed critically to drafts and gave approval for publication.

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Data accessibility

Data available from the Dryad Digital Repository http://dx.doi.org/10.5061/dryad.tg01f 9 (Lucey *et al.* 2016)

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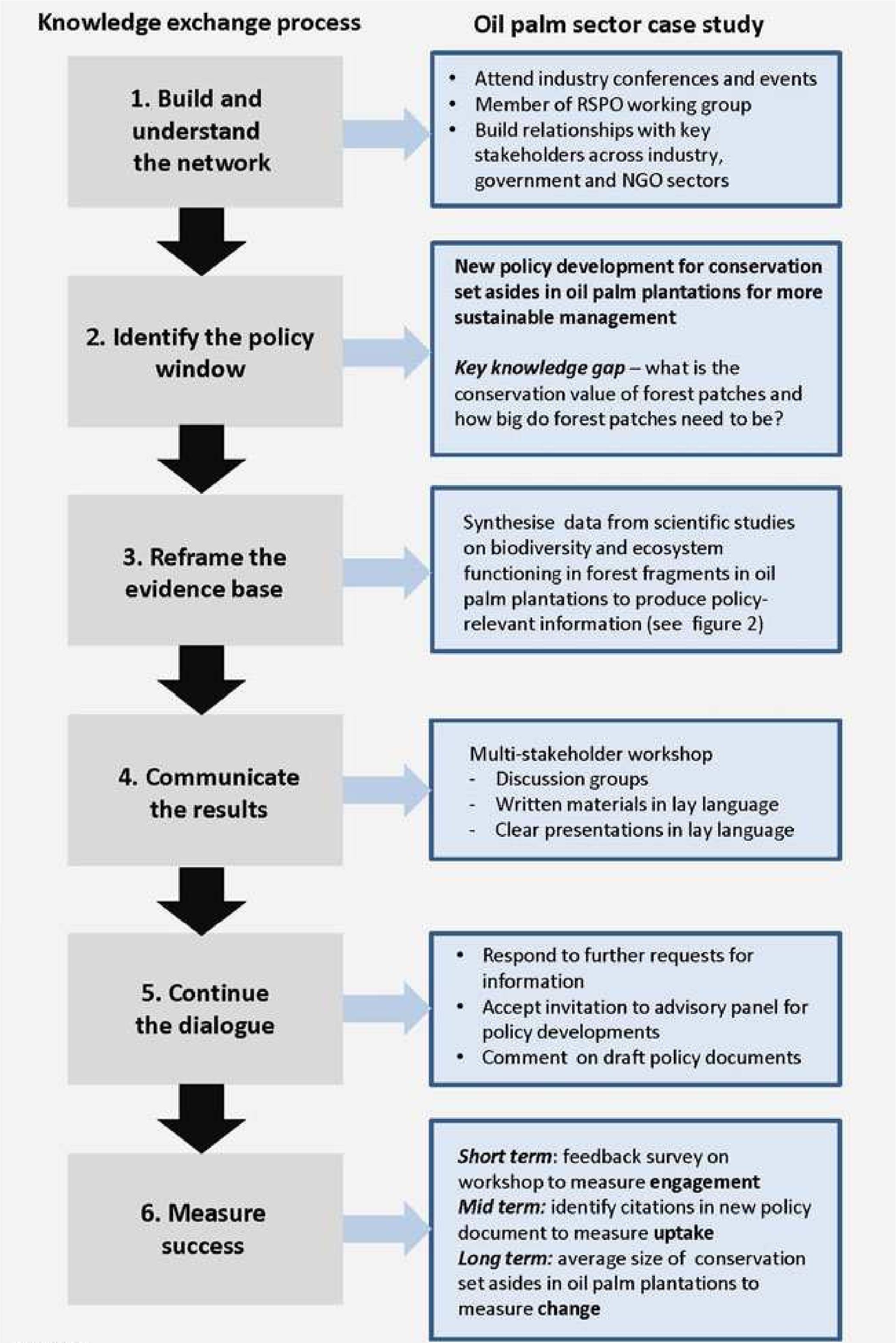
Figure 1. Flow chart of the Knowledge Exchange process indicating the generic stages of the process (left) and how we addressed them in our case study (right).

Figure 2. The relationship between species richness with core forest patch area, as presented for communication to policy makers, expressed as % of species richness reported in continuous forest. Where the line of best fit (solid black line) crosses the continuous forest equivalence threshold, this indicates the core forest area needed to support the full number of species in continuous forest, (broken black lines either side indicate 95% confidence intervals). The shaded area indicates the 95% confidence for predicted species richness for a minimum viable core area of 200ha determined by the ability for dipterocarp trees regenerate, based on Yeong *et al.* (unpublished, Appendix S1).

Supporting Information

Additional supporting information may be found in the online version of this article.

Appendix S1 Patch size synthesis methods and results
Appendix S2. Video of Powerpoint slides used at the workshop
Appendix S3 Workshop agenda
Appendix S4 List of post workshop activities



- Attend industry conferences and events
- Member of RSPO working group
- Build relationships with key stakeholders across industry, government and NGO sectors

New policy development for conservation set asides in oil palm plantations for more sustainable management

Key knowledge gap – what is the conservation value of forest patches and how big do forest patches need to be?

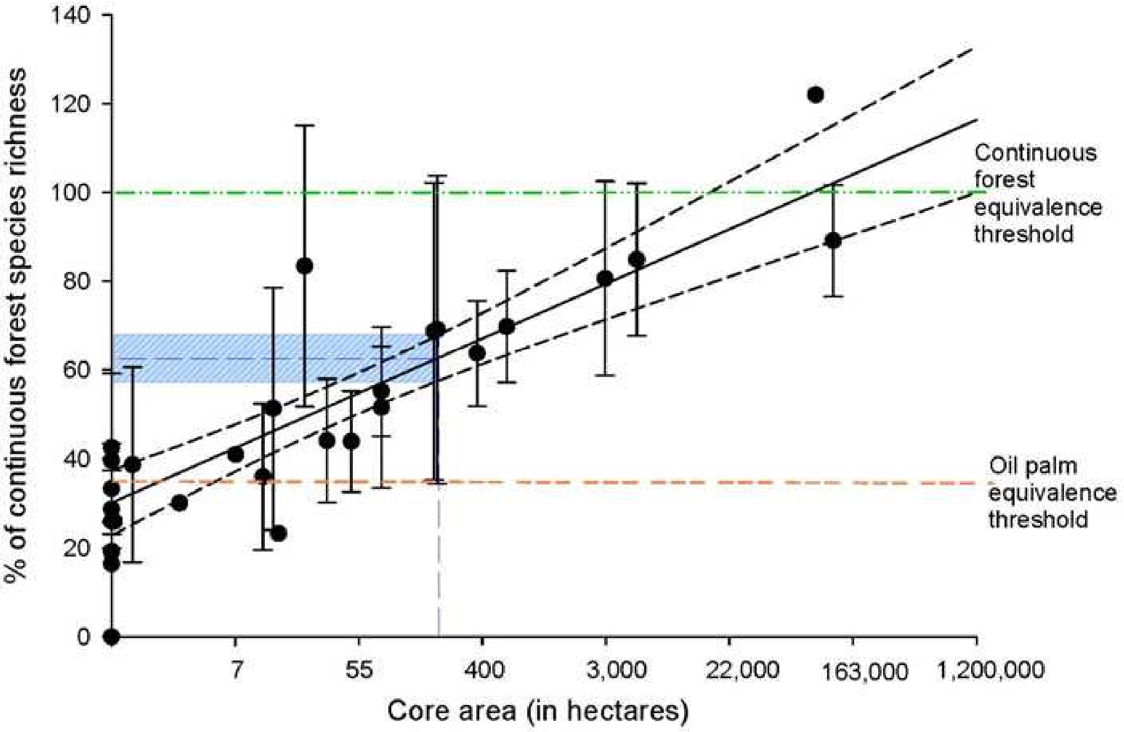
Synthesise data from scientific studies on biodiversity and ecosystem functioning in forest fragments in oil palm plantations to produce policy-relevant information (see figure 2)

Multi-stakeholder workshop
- Discussion groups
- Written materials in lay language
- Clear presentations in lay language

- Respond to further requests for information
- Accept invitation to advisory panel for policy developments
- Comment on draft policy documents

Short term: feedback survey on workshop to measure **engagement**
Mid term: identify citations in new policy document to measure **uptake**
Long term: average size of conservation set asides in oil palm plantations to measure **change**

Figure 1


140
120
100
80
60
40
20
0
% of continuous forest species richness
7
55
400
3,000
22,000
163,000
1,200,000
Core area (in hectares)
Continuous forest equivalence threshold
Oil palm equivalence threshold