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Testing the use of interviews as a tool for monitoring trends in the harvesting of wild species

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Summary

1. Many aspects of human behaviour impact on ecological systems. Ecologists therefore need information on changes in these behaviours and are increasingly using methods more familiar to social scientists.

2. Understanding patterns of wildlife harvesting is important for assessing the sustainability of harvests. Interviews are commonly used in which informants are asked to summarize their activities over a period of time. However, few studies have investigated the reliability of such data, the usefulness of interviews for monitoring trends, and how their information content can be maximized.

3. We carried out rapid assessment interviews with villagers in Madagascar about the quantity, timing and spatial patterns of crayfish *Astacoides granulimanus* and firewood collection. We compared the results with information from daily interviews with the same informants. We used mixed models to investigate how accurately people reported their activities in the rapid assessment interviews, and estimated the probability of detecting a change in harvesting from two such interviews using a Bayesian approach.

4. The interviews provided reliable information on quantities, effort, and the spatial pattern of harvesting. Simulations suggested the interviews would detect changes in catches and harvesting effort with reasonable power; for example, a 20% change in the amount of time spent crayfish harvesting could be detected with 90% power. Power is higher when the same informants are questioned in repeat interviews.

5. *Synthesis and applications*. Ecologists are increasingly using social techniques and it is vital that they are subject to rigorous testing to ensure robustness in trend detection. This study suggests that interviews can be used to monitor changes in harvesting patterns by resource users, but whether the power is adequate will depend on the needs of the study. To maximize the power of interviews, informants should be interviewed independently and the same informants interviewed in subsequent years.

Key-words: *Astacoides*, Bayesian modelling, crayfish, firewood, inter-disciplinary, local knowledge, participatory research, participatory monitoring, power

Introduction

Many aspects of human behaviour impact on ecological systems. For example, farming practices affect biodiversity in agricultural landscapes (Robinson & Sutherland 2002), and fishing, hunting or collecting forest products can affect target and non-target populations (Milner-Gulland & Mace 1998). Ecologists often need information on changes in these behaviours and are therefore increasingly using methods more familiar to social scientists, such as interviews and social surveys (White *et al*. 2005). However, there is little quantitative information available on the reliability of these methods, which limits their usefulness as a tool for scientific management.

Quantification of local people's use of wildlife is important in assessing the sustainability of harvests (Jones *et al*. 2005), or their value to local people (Godoy *et al*. 2000). In addition, harvester behaviour and off-takes may contain information on stock status (Siren, Hamback & Machoa 2004) and therefore

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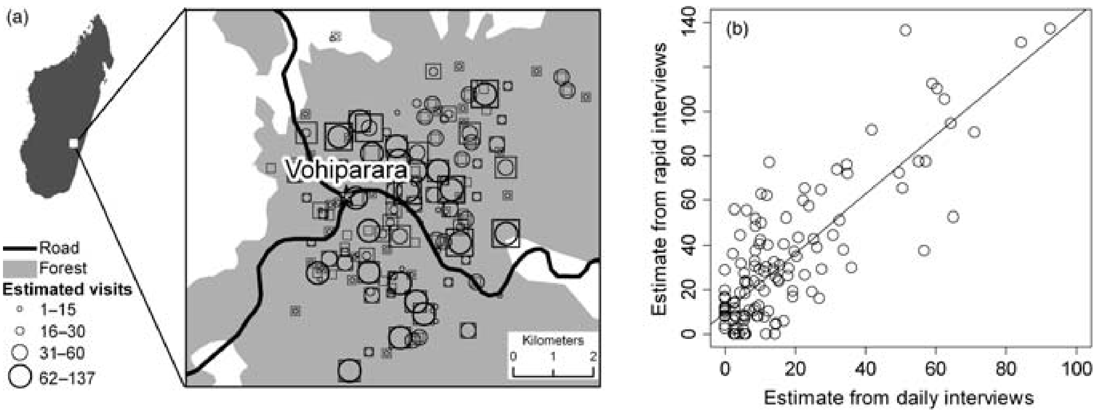

Fig. 1. (a) The location of the study area and the spatial distribution of crayfish harvesting effort estimated from the rapid interviews (squares) and daily interviews (circles). Site symbols are shown at the centroid of the relevant stream and the size of the symbol represents the estimated annual visits as shown in the legend. (b) The relationship between days crayfish harvesting at a site estimated using the two methods (slope coefficient = 1·323 ± 0·080 SE, $P < 0{\cdot}001$, $R^2 = 0{\cdot}61$).

provide cost-effective monitoring. Interviews with harvesters where informants are asked to recall extraction over a period of time are often used to quantify use of wildlife resources (e.g. Sambou *et al*. 2002; Wynne & Cote 2007), and can generate information with less effort than more intensive methods such as daily interviews (e.g. Jones *et al*. 2006). However, little is known about the quality of the information reported in interviews with long recall periods and, hence, their reliability as indicators of trends. We know of only one study that formally validates the results of rapid assessment interviews about forest product harvesting with data on true levels of harvesting over a year (Gavin & Anderson 2005).

Incorporating the understanding and knowledge of local people in a conservation project has a value beyond the potential for making quantitative assessment, for example by empowering local people to seek local solutions to environmental problems (Danielsen, Burgess & Balmford 2005). However, this study addresses only the reliability of data obtained from interviews and its use in monitoring trends. Numerous factors affect the reliability of the information reported in interviews, including misremembering and active misleading of the researcher (Bradburn, Rips & Shevell 1987). We focus specifically on people's ability to recall information, assuming that they are giving truthful answers to the best of their ability (see Methods for a justification of this important assumption). We use a detailed year-long study and rapid assessment interviews with the same informants to investigate the quality of information given in the rapid interviews on people's use of two important wildlife resources (firewood and crayfish). We use this relationship to predict how well rapid interviews would be able to detect changes in harvesting behaviour and recommend ways to maximize the quality of the information gathered.

The study was carried out in the eastern rainforests of Madagascar, an area of high biodiversity, high local reliance on wildlife resources, and extremely rapid environmental change. Conventional monitoring of many economically important wildlife products is unfeasible due to the high costs and technical capacity required (Hockley *et al*. 2005). There is, therefore, a pressing need for rapid assessment methods which can detect trends in the availability and use of wildlife resources at low cost.

Materials and methods

STUDY AREA

Vohiparara is a small village of approximately 45 households situated on the edge of Ranomafana National Park in eastern Madagascar (Fig. 1a). People in the area depend on a mixture of small-scale agriculture and harvesting forest products, including freshwater crayfish (> 95% of the harvest is *Astacoides granulimanus*) and firewood (Jones *et al*. 2006). Prior to the research described here, N.H., M.M.A. and J.P.G.J. had worked intensively in the area for 2 years and the two Europeans among them (N.H. and J.P.G.J.) were fluent in spoken Malagasy.

DAILY INTERVIEWS

Between March 2004 and March 2005, the 22 households in Vohiparara most reliant on forest products took part in a detailed study of their household economy (Jones *et al*. 2006). We interviewed households daily for eight consecutive days on a 3-week cycle with a varying start day. Informants were asked about the location and nature of each household member's activities that day. Crayfish and firewood collected were brought to the interview, the number of crayfish counted and the species and number of firewood bundles recorded.

Informants react to perceived opportunities and threats of being researched. For example, they may seek to bias their recorded uses upwards to be better recognized or downwards to hide illegal activities (Sheil & Wunder 2002). We had worked in the village for 2 years before this project, and thus, we were well-known and trusted. The direct observation of crayfish and firewood at the interview provided reliable minimum estimates, and there were many informal opportunities to check information. We are therefore confident that villagers were reporting their activities to the best of their abilities and not actively hiding information.

RAPID ASSESSMENT INTERVIEW

At the end of the study period, we carried out private semi-structured interviews with each of the 22 households. We split the year into three locally appropriate seasons: *Lohataona*, (dry and sunny, August–November, season 1), *Fahavaratra* (warm and wet, December–March, season 2), and *Ririnina* (cold, April–July, season 3). We asked informants to list the sites they had visited in the last year to harvest crayfish and to estimate how many crayfish they got from each site. We then gave 30 beans to represent a month in *Lohataona* and asked them how many days they spent crayfish harvesting. They added or removed beans to show the number of times they harvested in *Fahavaratra* and *Ririnina*. We did the same for the catch obtained from each site. We asked informants how many bundles of firewood they collected per month in *Lohataona*, and they then added or removed beans to indicate their firewood usage in the other two seasons. Finally, they separated a pile of beans representing the average number of firewood bundles harvested in a season into piles indicating the different species of firewood used. Because informants had regularly reported their day's activities, there was little incentive to actively conceal the truth. The fact that informants had been asked frequently to report their activities may have improved their ability to recall these activities at the end of the year; however, this was necessary to provide an estimate of their true resource use and therefore could not be avoided.

MODELLING RAPID ASSESSMENT INTERVIEW DATA FROM DAILY DATA

To investigate the relationship between the results from the daily and rapid assessment interviews, we fitted linear mixed models in R (R Core Development Team 2007) using the lme4 package (Bates & Darkar 2007). Separate models were fitted predicting the rapid interview results for: (a) number of crayfish harvested, (b) proportion of time spent crayfish harvesting (arcsine transformed), (c) number of bundles of firewood harvested per month, and (d) proportion of firewood bundles belonging to each of four classifications: eucalyptus (*Eucalyptus* spp., introduced), guava (*Psidium cattleianum*, also introduced), harongana (*Harungana madagascariensis*, a native pioneer) and forest species (a mixture of native forest species). In the case of (d), we summed data across all periods, including only data from the households for which more than 50 firewood bundles had been examined ($n = 19$). Because in this case there was only one value per household, a mixed model was unnecessary and linear regression was used.

Our daily interviews were only carried out approximately one-third of the time, and therefore offer only a representative sample with which to compare what people recall. We used the daily surveys as an independent variable and the rapid interview result as the dependent variable. It may seem more natural to predict the daily data from the rapid interview data. However, the rapid interviews are a response to the daily data; they are not a prediction of what *will* be harvested but an estimate of what *has* been harvested. We sought to simulate the effect of an actual decline in harvesting on the rapid assessment of harvest quantities, which is more straightforward with the rapid assessment as the dependent variable. Additional independent variables were a fixed factor for season, and random slope and intercept variables for site and person (or household). Data on firewood collection were analysed at the household level, whereas crayfish harvesting was analysed by person. We used random factors for people, households and sites because we wanted an estimate of the variance of these factors from which future surveys would be drawn. The maximal model estimated from the data was of the form:

$$Y_{ijkm} = \beta_0 + \beta_1 x_{ijkm} + b_{1i} + b_{2i} x_{ijkm} + b_{3m} + b_{4m} x_{ijkm} + C_{1k} + \varepsilon_{ijkm}$$

For example, in the specific case of predicting annual days spent crayfish harvesting from the daily interview data, the response Y represents number of days spent harvesting per year as reported in the one-off rapid interviews. x represents the same variable as estimated from the daily interviews. The indices are i individuals, m sites, k seasons and j samples within each site and individual. The coefficients are β_0, the intercept, β_1, the coefficient on number of days as estimated from the daily interviews, b_1 and b_2, the random intercept and slope for each individual i. b_3 and b_4 are the random intercept and slope for each site m, and C_1 the coefficient for each season k. Note that the number of random coefficients differs between indices; for example, a b_1 coefficient is estimated for each individual while a b_3 coefficient is estimated for each site (see Supplementary Appendix S1). Akaike Information Criterion (AIC; Burnham & Anderson 1998) was estimated for each model nested within the maximal model. In each case, the model that minimized AIC was selected.

ESTIMATING THE POWER TO DETECT CHANGES IN HARVESTING ACTIVITIES FROM RAPID ASSESSMENT INTERVIEWS

Using the most parsimonious model for each question, we used a Bayesian simulation approach (Gelman *et al.* 2004) with a diffuse non-informative prior, to estimate the probability (P) of detecting a change in household activity using rapid interview data. Our selection of a Bayesian approach was made for pragmatic rather than philosophical reasons. Simulation or prediction from mixed models is complex as it can be carried out in several ways depending on the level or 'focus' (Spiegelhalter *et al.* 2002) of interest. In this case, we wanted to include the effect of variation between households and sites in the simulation, and the Bayesian approach allowed these to be sampled directly. We used non-informative priors, that is, assuming no prior knowledge before seeing the data. The results will therefore be very similar to those estimated using a frequentist approach. In principle, rather than using the best-supported model for simulations, the Bayesian approach could be used with model averaging to make predictions based on all appropriate models. However, there are significant theoretical and technical challenges to implementing Bayesian model averaging with mixed models (Pauler, Wakefield & Kass 1999; Han & Carlin 2001; Cai & Dunson 2006), and thus, we based our inferences on the best-supported model.

For the simulation, we assumed that a rapid assessment interviewed a new set of households visiting a new set of sites but that the new households and sites were drawn from the same population as the Vohiparara data (i.e. the sites and households were sampled from the site and household distribution estimated by the model). We further assumed that the number of households and the activities remained the same as in our original data set. For each simulation, we then assumed a change of between 10% and 80% in the dependent variable (e.g. a decline of 50% in the average number of crayfish caught at a site) between the initial survey and a subsequent follow-up survey. The longer it takes to detect a decline, the less useful it is from a management perspective; thus, we chose to model two interviews separated by a single period. We modelled the follow-up survey in two ways: (i) a new sample of households, and (ii) re-interviewing the same households (a paired survey). In the former case, new random parameters were drawn for the follow-up survey;

in the latter case, the same random parameters as in the initial survey were used. Conservation managers may be unlikely to act unless they detect a change of a certain minimum size; thus, we investigated both the probability of detecting any change (P_0) and of detecting a change of at least 10% (P_{10}) in the dependent variable.

The models were implemented in OpenBUGS (Thomas *et al.* 2006). The modelling approach used was hierarchical so that random parameters for individuals or sites were drawn from a common individual or site distribution. The parameters of the common distributions, termed *hyper-parameters*, were also estimated. As is usual, random effects intercept and slope parameters were assigned multivariate normal prior distributions with zero mean and inverse-Wishart variance–covariance matrix. Hyper-parameters were assigned normal priors with zero means and 1×10^6 variances. Model error variance was assigned an inverse gamma prior with $\alpha = 0{\cdot}001$ and $\beta = 0{\cdot}001$. Two hundred thousand samples were drawn from the posterior density distributions and the first 100 000 discarded. For each survey type, the marginal posterior prediction of the mean difference between the second and first survey (both using a new sample and paired) was estimated. The location and spread of this distribution in relation to zero was then used to estimate the probability of detecting a difference between surveys; the greater the proportion of the distribution lying away from zero, the higher the probability of detecting a change. This is analogous to a *t*-test. *P* was estimated by sorting the posterior in ascending order and finding the first positive value (for P_0) or the first value above 10% of the mean (for P_{10}) with index value *i*. *P* was then calculated from $P = 1 - i/100\,000$.

HOW GOOD ARE PEOPLE AT REPORTING THE SPATIAL PATTERN OF THEIR HARVESTING?

We visited each of the place names mentioned in the interviews at least twice with different community members and recorded their coordinates with a Global Positioning System (GPS). We assigned each place name to the relevant feature on a digitized map using a combination of the GPS location and notes taken in the field. We estimated the total number of days of crayfish harvesting (summed across all informants) at each site using both the rapid and daily interview data.

Results

MODELLING RAPID ASSESSMENT INTERVIEW DATA FROM DAILY DATA

Model selection for predicting rapid interview data from daily data is summarized in Supplementary Material Table S1. Parameter estimates for the model with the best support for each category are given in Table 1. The models selected meet our a priori expectation that individual and household behaviours vary. The firewood collection model had the best model fit, followed by the number of crayfish harvested and the crayfish harvesting-effort model (Supplementary Material Fig. S2a–d). There was a clear positive linear relationship between the rapid and daily interviews for all models including random effects (Fig. 2a–c). However, there was a general tendency for informants to report effort levels and catches closer to the mean of all informants than their true personal value, that is, informants at the lower range of the population tended to overestimate and those at the higher end tended to underestimate (see intercepts and slopes for fixed effects in Table 1). There was a positive significant relationship between the proportion of firewood bundles reported in daily interviews and rapid interviews, which held for each type of firewood (see Fig. 2d).

Table 1. The parameters for the selected models relating the responses from the daily interviews to those from the rapid interviews for three questions: Model A, the number of crayfish found at a site; Model E, the proportion of days spent harvesting crayfish; Model I, the number of fire wood bundles collected per month

	Fixed effects		Random effects	
Model	Parameter	Estimate ± SE	Parameter	% of variance
A	Intercept	20·04 ± 2·82	Site (Intercept)	35
	Daily	0·46 ± 0·068	Site (slope)	< 0·5
			Person (intercept)	43
			Person (slope)	< 0·5
			Residual	22
E	Intercept	0·29 ± 0·064	Person (intercept)	50
	Daily	0·62 ± 0·10	Residual	50
	Season 2	0·15 ± 0·037		
	Season 3	0·21 ± 0·037		
I	Intercept	10·44 ± 1·30	Person (intercept)	95
	Daily	0·33 ± 0·061	Residual	5
	Season 2	–1·78 ± 0·42		
	Season 3	–0·56 ± 0·39		

THE POWER TO DETECT CHANGES IN HARVESTING ACTIVITIES USING RAPID ASSESSMENT INTERVIEWS

We estimated the posterior probability of being able to detect a change in activity on the basis of two rapid assessment interviews carried out a year apart (Fig. 3a–d). The probability was higher for the paired comparisons than when a new set of informants was picked from the population. For example, a paired analysis gives a 99% probability of detecting a 20% change in the number of crayfish caught at a site compared to a 78% probability with the unpaired test. Unsurprisingly, we found that the probability of detecting this change as being ≥ 10% is lower than the probability of detecting it simply as a change (≥ 0%).

HOW GOOD ARE PEOPLE AT REPORTING THEIR SPATIAL HARVESTING PATTERN?

The rapid interviews captured well the spatial distribution of crayfish harvesting reported in the daily interviews (Fig. 1a). Summed across all informants, 114 sites were mentioned in both data sets, 26 sites appeared only in the daily data and 34 sites only in the rapid assessment interviews. Sites which appeared in only one data set tended to be rarely visited, and overall, there was a strong positive relationship between the total number of visits to a site estimated using the rapid and the daily interview data (Fig. 1b).

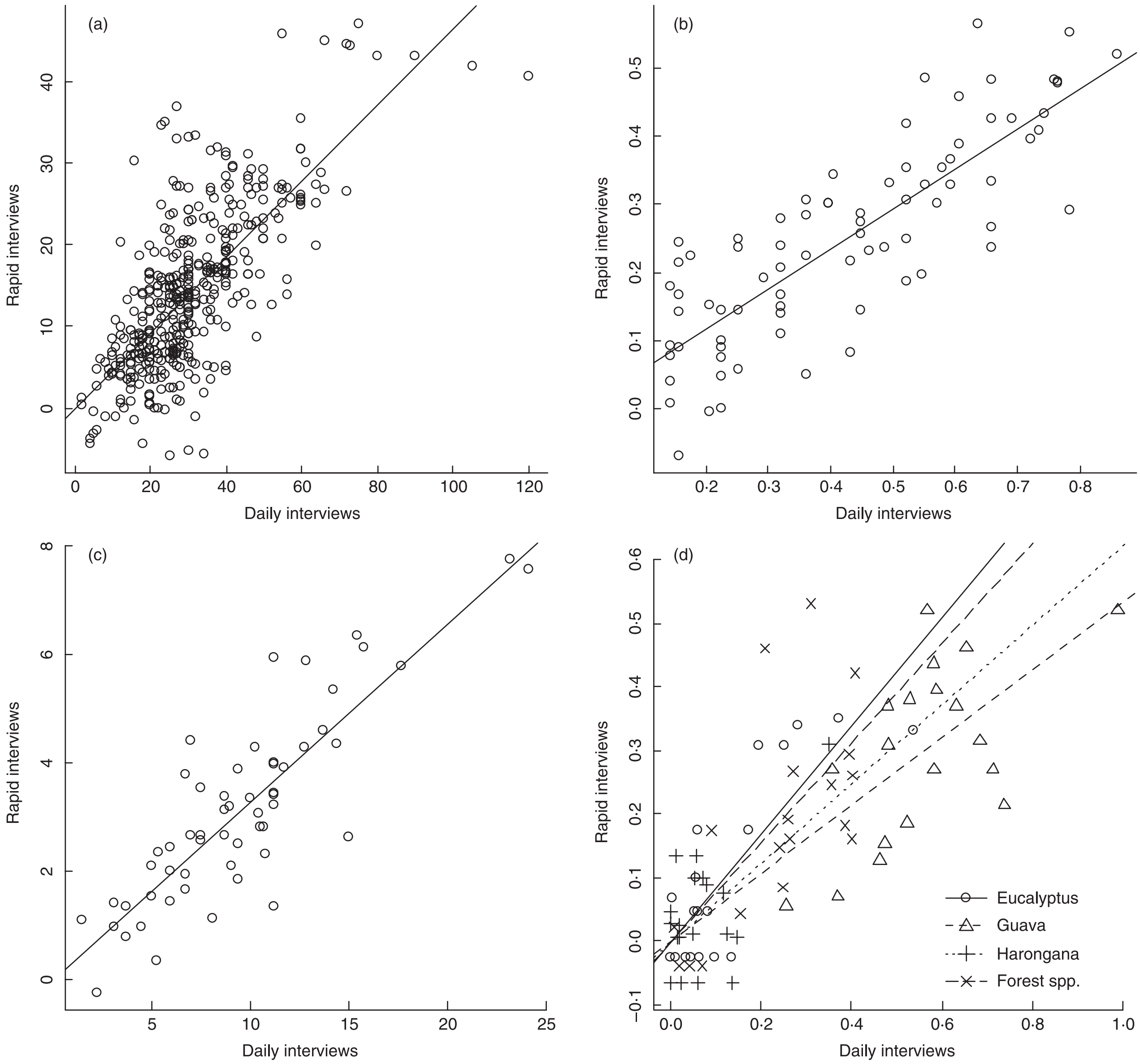

Fig. 2. (a, b and c). Partial residual plots for rapid interviews against daily interviews for the most parsimonious model (i.e. the relationship between the two interview methods given the other model variables) for (a) the number of crayfish caught per site, (b) the proportion of days spent crayfish harvesting (arcsine transformed), and (c) the number of bundles of firewood collected per month. (d) Partial residual plot for proportions of firewood in each of the four categories reported in the rapid interviews compared with the daily interviews. Eucalyptus: slope coefficient = 0·849 ± 0·143 SE, $P < 0{\cdot}001$, $R^2 = 0{\cdot}67$; guava: slope = 0·534 ± 0·165, $P < 0{\cdot}005$, $R^2 = 0{\cdot}38$; harongana: slope = 0·622 ± 0·221, $P = 0{\cdot}012$, $R^2 = 0{\cdot}31$; forest species: slope = 0·783 ± 0·212, $P = 0{\cdot}002$, $R^2 = 0{\cdot}31$. Supplementary Material Fig. S2 shows these plots separately.

Discussion

HOW GOOD ARE PEOPLE AT RECALLING THEIR RESOURCE USE BEHAVIOUR?

Our study is the only one we know of that compares the results of rapid assessment interviews with detailed information on harvesting patterns covering the same informants and time period. The rapid assessment interviews were strongly predictive of the daily interviews, albeit biased towards the mean. Gavin & Anderson (2005) compared forest product harvesting levels reported in rapid interviews with detailed data from the same informants but did not find a close relationship between the survey methods. However, the surveys covered different time periods; thus, changes over time in harvesting pattern may explain part of this difference.

A study of small-scale fishermen in Thailand (Lunn & Dearden 2006) found that fishermen tended to report larger catches and greater effort than researchers observed directly. The authors suggest that the fishing culture may encourage overestimation and warn that this may be a general issue in interviews with resource users. Rather than a tendency to overestimate, we found that informant estimates tended towards the population mean with harvesters collecting a below-average amount overestimating and those collecting an above-average amount underestimating their harvests.

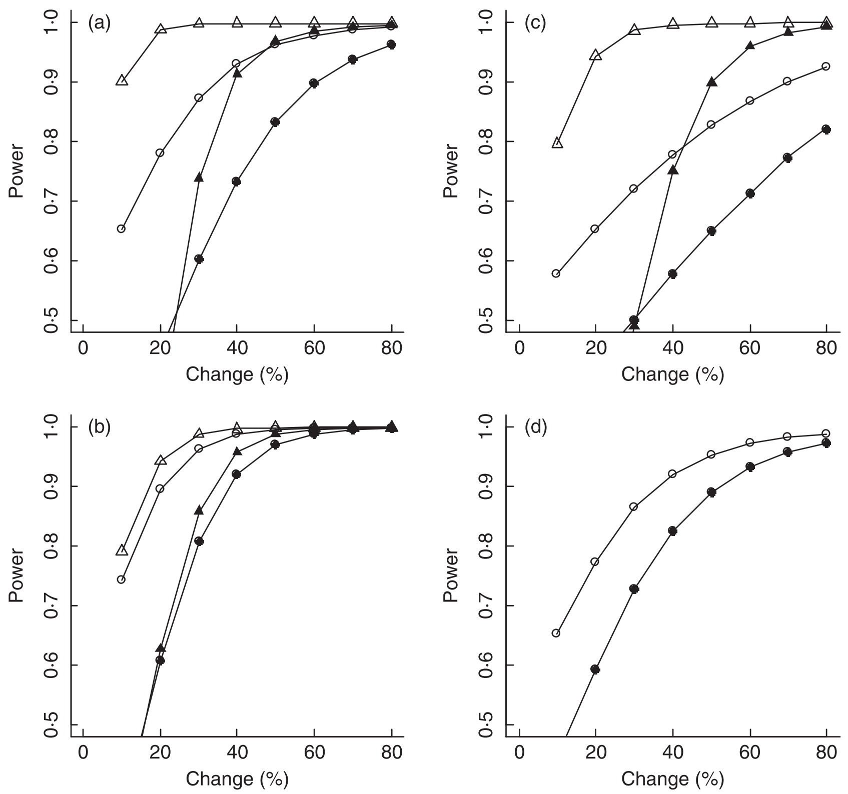

Fig. 3. The power to detect a change using the rapid interview data in (a) the number of crayfish caught at a site, (b) the proportion of days spent crayfishing per month, (c) the number of firewood bundles caught per month, and (d) the number of bundles of forest firewood caught per month. Open symbols represent the power to detect any change and closed symbols the power to detect a change of ≥ 10%; circles represent a new set of people or households interviewed; triangles show a paired analysis with the same people visited in subsequent years. There is no paired analysis in d as a mixed model was not used.

This may be a common effect, with informants either using information on general harvesting patterns to estimate their own behaviour or giving estimates of their mean over a period greater than 1 year.

Information on spatial patterns of harvesting is particularly important in studies of wildlife resource use. It is not possible to infer whether harvests are sustainable without information on the size of the harvested area. In fact, an increase in the harvested area can in itself suggest that a harvest is unsustainable (Clayton, Keeling & Milner-Gulland 1997). We found that, summed across all informants, the rapid assessment interviews reliably represented the spatial distribution of crayfish harvesting effort, albeit with considerable uncertainty at low harvesting levels. A number of studies have used interviews to establish the spatial pattern of harvesting (e.g. Smith 2003; Siren *et al.* 2004). However, we have not found any study which investigated quantitatively how well people can recall sites visited over a period of time. Our finding is therefore a useful result, suggesting that one-off interviews can be used to characterize the spatial pattern of harvesting.

HOW USEFUL ARE DATA FROM RAPID INTERVIEWS AS A BASIS FOR MONITORING TRENDS?

Conservationists are often interested not just in static assessments but in monitoring change over time. Ideally, monitoring programmes should be able to reject the null hypothesis of no change in the system with reasonable power (Forcada 2000; Maxwell & Jennings 2005).

Our study suggests that people are quite reliable when reporting how many crayfish they catch at a site per day (although with a tendency of bias towards the mean) and that rapid interviews would have a 90% power to detect a change of ≥ 10% when the true change was 40%, suggesting that interviews may be able to identify major changes in catches. Catch Per Unit Effort (CPUE) data are commonly used to infer trends in underlying stock sizes (Siren *et al.* 2004). However, interpreting this result in terms of underlying stock abundance depends on the CPUE–abundance relationship, and would require information on changes in spatial patterns of harvesting and methods used (Harley, Myers & Dunn 2001).

Crayfish harvesting in Vohiparara has previously been assessed as probably sustainable at current levels (Jones *et al.* 2005). If harvesting increased significantly, managers may wish to carry out further research. Our results suggest that the rapid interviews contain sufficient information to allow monitoring of changes in harvester behaviour. If the mean amount of time spent harvesting crayfish increased by approximately 20%, there would be a 90% probability of this change being detected with the paired analysis. The powers for detecting a change as being ≥ 10% are naturally lower but the power may still be sufficient to make a threshold-based management policy workable.

Most firewood collected in Vohiparara is guava, an introduced shrub. Forest trees are generally used only when people clear forested land for agriculture. A large increase in forest species as a proportion of firewood bundles may therefore indicate a change in rates of forest clearance, warranting further investigation. Our simulations suggest that a 90% power to detect a change in the amount of forest firewood harvested requires a change of > 35% (or > 50% to detect the change as being ≥ 10%). Whether such power is adequate depends on how urgent the need is to detect changes in firewood usage.

WHAT ARE THE IMPLICATIONS FOR THE DESIGN OF INTERVIEW STUDIES?

Although the absolute powers reported here may have little relevance outside this specific study, their relative values and our qualitative results have implications for the design of interview-based studies carried out by ecologists. Because there are differences between individuals (in their preferred activities or harvesting skill), power is improved by carrying out a paired analysis, that is, returning to the same informant in subsequent years (of course the initial sample must be randomly selected). This finding is likely to be generally applicable.

Another consideration when designing such interviews is that the power to detect change is likely to be higher when informants are interviewed independently. This is so because the inaccuracies in each individual's estimate balance out across a number of informants. However, if interviewed in groups, informants might ignore their own private information and follow the group's opinion (Janis 1972). It has been suggested (Danielsen *et al.* 2000) that focus group discussions can be useful for monitoring trends in resource use and resource status. The rationale behind focus groups is that group processes can help people to explore and clarify their views in ways not possible in a one-to-one interview (Kitzinger 1995). Monitoring which uses groups to identify and discuss trends may help build local consensus and motivate local action (Danielsen *et al.* 2005), but we suggest that they are unlikely to be the most robust way to detect trends. The most appropriate methods, therefore, depend on the researcher's objectives.

If interviews are to yield quantitative information useful for detecting trends, questions must be formulated that respondents can answer accurately. The fit of the models suggested that people were better at accurately recalling some activities (e.g. how much firewood they collected per month) than others (e.g. how often they went crayfish harvesting). This may be because number of crayfish trips per month is more variable than firewood usage, making it harder to provide an average value. The fit is better for the use of eucalyptus firewood than for other firewood species such as guava. Eucalyptus are large trees which take some effort to cut down, perhaps making this activity more memorable than cutting guava, a small shrub. Researchers using interviews for obtaining quantitative information should be aware of the well-known limitations of recall accuracy (Bradburn *et al.* 1987). Focusing questions on activities which respondents are likely to remember may make results more reliable.

Of course, the value of any interview data depends on informants being honest. If informants have reasons to under- or over-report activities, results will be biased; thus, possible incentives faced by informants should always be considered (Sheil & Wunder 2002). One of the most significant influences on the validity of responses is the perceived attitude of the researcher to behaviours (Weinhardt *et al.* 1998), and researchers must make every attempt to appear neutral.

Conclusions

Part of a researcher's skill comes in selecting the monitoring method most suited to their aims (Forcada 2000; Nichols & Williams 2006). Rapid assessment interviews with local people offer an attractive and relatively cheap method for collecting information on patterns of exploitation of wild species. However, they are only valuable if they can be used to detect true changes in behaviours. Our results are encouraging, suggesting that rapid interviews can have the power to detect meaningful changes in harvesting patterns by local people and we conclude that well-designed interviews do have a role to play in conservation monitoring. Of course, this sort of monitoring is a blunt tool and the powers reported here would not be sufficient in all cases; more intensive monitoring may be needed for species of particular conservation concern. Applied problems in ecology need people with skills from both the natural and the social sciences (Adams 2007). As ecologists increasingly use social surveys in their research (White *et al.* 2005), awareness of the potential of such approaches, and their limitations, is of growing importance.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Model selection

Fig. S1. The fit of the predictions of the most parsimonious model to the data from the rapid interviews.

Fig. S2. Partial residual plot for proportions of firewood reported in the rapid interviews compared with the daily interviews (Fig. 2d expanded).

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