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Research Article

Information Flows in Community-Based Monitoring Exercises in the Ecuadorian Amazon

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Community-based monitoring schemes provide alternatives to costly scientific monitoring projects. While evidence shows that local community inhabitants can consistently measure environmental changes, few studies have examined how learned monitoring skills get passed on within communities. Here, we trained members of indigenous Kichwa communities in the Ecuadorian Amazon to measure fern and dung beetle species richness and examined how well they could pass on the information they had learned to other members of their community. We subsequently compared locally gathered species richness data to estimates gathered by trained biologists. Our results provide further evidence that devolved monitoring protocols can provide similar data to that gathered by scientists. In addition, our results show that local inhabitants can effectively pass on learned information to other community members, which is particularly important for the longevity of community-based monitoring initiatives.

1. Introduction

Community-based monitoring schemes (CBMS) combine local traditional knowledge with existing organizational systems to measure ecological changes [1, 2]. Because CBMS can increase local understanding of environmental issues [3], they are considered capacity building exercises that provide evidence for local management decisions [4].

Evidence shows that, with appropriate training, CBMS can provide precise data on environmental processes. Danielsen et al. [5] show that trained community members are able to accurately monitor biomass and logging activities in India, Tanzania, and Madagascar. Similarly, Oldekop et al. [6] show that community inhabitants in Ecuador can use simple and cost-effective methodologies to provide fern species richness estimates that accurately reflect biodiversity patterns observed by scientists.

What has not yet been addressed, however, is how information gained by those attending training schemes is passed on to other community members. In other words, we do not know whether trained community members can train other people within their communities. This information is important for the creation of long-term and decentralized CBMS, where the majority of the collection and interpretation of data is directly managed by local communities and stakeholders [1, 2].

Here, we use a CBMS exercise with indigenous Kichwa communities in the Ecuadorian Amazon to assess the ability of locally trained community members to train other residents within their communities. Specifically, we compare species richness estimates of two biodiversity indicators, ferns [7] and dung beetles [8] (henceforth beetles), gathered by scientists, community members trained by scientists, and community members trained by the community members originally trained by scientists.

2. Methods

Exercises took place in the communities of San José de Payamino (henceforth Payamino) and Chontococha in

August and November 2008. The communities are located within the Sumaco Biosphere Reserve and are classified as areas of tropical forest [9].

Four men from each community took part in the exercises and received a typical regional day wage each ($10 per day) for the duration of each exercise (four days). Participants in each community were divided into two groups: an expert-trained group and a community-trained group. The expert-trained group received fern and dung beetle identification training from the scientist group, which was composed of two Ph.D. students (JAO, NKT) from The University of Manchester with several months experience conducting biodiversity monitoring of ferns and beetles in the region. The community-trained group received fern and dung beetle identification training from the expert-trained group. Information was therefore passed from the scientist group to the expert-trained group to the community-trained group. Expert-trained group participants were chosen on a volunteer basis, whereas the expert-trained group recruited the community-trained group participants. Preliminary results were presented during community meetings on subsequent visits in 2009.

3. Training

Evidence shows that training schemes increase the accuracy of CBMS [6]. Our study, therefore, only focused on comparisons between participants who had received training. Expert-trained groups received fern identification training for several weeks while working as field assistants with JAO and NKT, who conducted a larger regional biodiversity assessment. Expert-trained groups were taught how to differentiate beetle species during a single 30 min session. In the case of both ferns and beetles, the expert-trained groups were given information on the key physical characteristics of each taxonomic group but were not given specific information to differentiate between specific species. Once trained, the expert-trained groups were asked to recruit and train the community-trained groups using their choice of methods. While community-trained groups received training on fern identification several days after the expert-trained group had finished working with JAO and NKT, dung beetle identification training for both expert- and community-trained groups occurred during the same day. Despite having no time limit, training for each indicator lasted approximately 15 min in both communities and consisted of field visits to review ferns and sessions examining beetle specimens.

4. Sampling

In each community, the different groups (scientist, expert-trained and community-trained) sampled ferns and beetles along three 500 m transects situated in primary forest. Ferns were sampled along each transect in 10 equally spaced 5 × 5 m quadrats; groups were specifically asked not to remove ferns or break off samples for comparisons. Groups sampled transects in random order and were not allowed to sample transects before previous groups had finished.

Table 1: Matched-pairs analysis results showing differences in species richness estimates between scientist, expert-trained, and community-trained groups.

Indicator	Community	Richness estimates*
Fern richness	Payamino	Scientist: 5.8[a]
		Expert trained: 7.6[b]
		Community trained: 5.9[a]
	Chontacocha	Scientist: 5.6[a]
		Expert trained: 5.4[a]
		Community trained: 4.6[b]
Beetle richness	Payamino	Scientist: 11.2[b]
		Expert trained: 8.2[a]
		Community trained: 8.6[a]
	Chontacocha	Scientist: 10.7[a]
		Expert trained: 8.8[b]
		Community trained: 13.2[c]

*Values that are not connected with the same letter differ significantly from each other.

Beetles were sampled using dung-baited pit-fall traps placed in each quadrat. Traps were collected after 24 hrs, and beetles were stored in 95% ethanol. Expert-trained and community-trained groups were then asked to determine the species richness of each trap. An expert taxonomist (SV) confirmed beetle species richness after the exercise.

5. Analysis

Correlations were analyzed separately for each community and each indicator. The accuracy, the amount by which groups over or underestimated species richness, was analyzed using paired t-tests. All analyses were performed in JMP8 (SAS Institute Inc.).

6. Results

With the exception of beetle richness in Chontacocha (Figure 1(d)) all richness estimates between scientist and expert-trained groups correlated significantly and positively (Figure 1(a)–(c)). All correlations between expert-trained and community-trained groups were positive and significant (Figure 1(e)–(h)). Only beetle species richness estimates in Payamino (Figure 1(j)) and fern species richness estimates in Chontacocha (Figure 1(k)) were significantly and positively correlated between the scientist and community-trained groups. Both expert- and community-trained groups over and under estimated species richness but there is no discernable pattern (Table 1).

7. Discussion

Results show substantial positive and significant correlations between the different groups, suggesting that information was passed successfully between the groups. These results confirm previous findings that CBMS can show similar

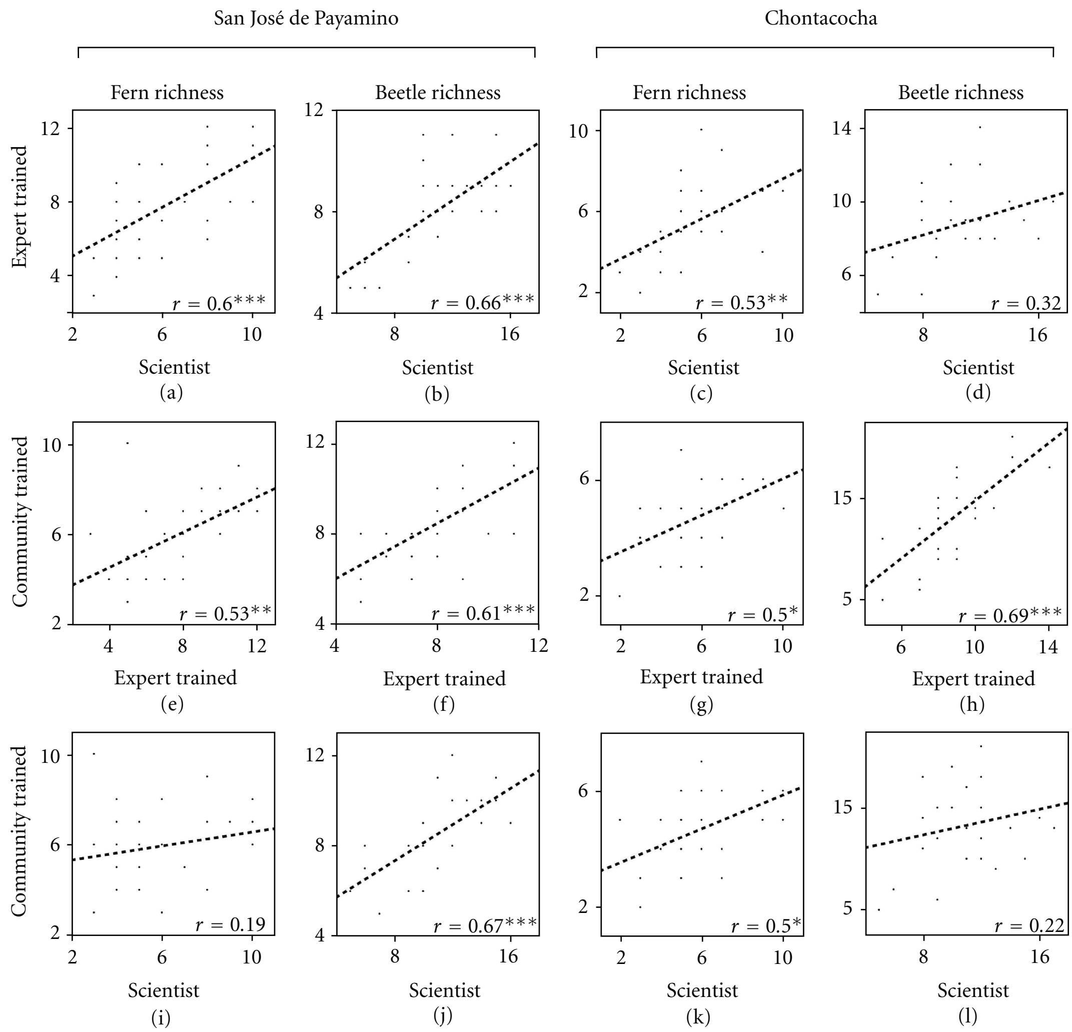

Figure 1: Correlations between scientist, expert-trained, and community-trained groups ($^{*}P < 0.05$, $^{**}P < 0.005$, and $^{***}P < 0.0005$).

trends to those found by scientists [4–6]. Beetle richness estimates between scientist and expert-trained groups showed no significant correlation in Chontacocha. Expert-trained groups, however, only received dung beetle identification training for 30 min. While Payamino's significant correlations between the scientist and expert-trained group suggest that community members have the ability to learn complex taxonomic information in a short time, a single 30 min session might not always be sufficient. Conversely, fern species identification training of the expert-trained group took place over several weeks, and the correlations between the scientist and the expert-trained group were positive and significant in both communities. While long training schemes are not always feasible, there is evidence that CBMS participants can learn taxonomic identification skills in substantially shorter periods of time [6].

Correlations between expert- and community-trained groups suggest that the information flow is particularly strong between community members. Poor beetle richness estimate correlations between the scientist and the community-trained groups in Chontacocha might be explained by a poor information flow between the scientist and the expert-trained group. The nonsignificant correlation of fern richness estimates between the scientist and the community-trained group in Payamino, however, suggest that there is a significant loss of information passed from the expert-trained to the community-trained groups. Despite the potential for information loss at these two points of communication, our data suggest that there is a large potential for community members to train other members within their communities, but that the way that information is transmitted to those individuals trained by professional scientists is critical.

Significant over- and underestimations of fern and dung beetle richness suggest significant errors in the accuracy of species richness estimates. Non-experts taking part in monitoring exercises commonly fail to recognize certain species as being either the same or different [10]. Differences between groups in our data are likely due to similar species "lumping" and "splitting" events.

The success of monitoring schemes relies on adapting methodologies to specific needs. While CBMS might not necessarily provide as detailed information as monitoring exercise performed by trained scientists [11, 12], they can lead to quicker decision making [5, 13]. An important factor influencing the longevity of CBMS is their ability to become less dependent on external expertise and resources. Although only based on a few comparisons, our data suggest that participants are remarkably good at passing on learnt information. Of key importance, however, is how initial information gets passed on from scientific experts to local practitioners and community-based monitoring initiatives. If we, the scientific community, can devise simple and accurate training methodologies that can be easily taught, learned, and implemented, then CBMS can provide a powerful and locally relevant tool to measure changes in biodiversity, natural resources, and ecosystem services.

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