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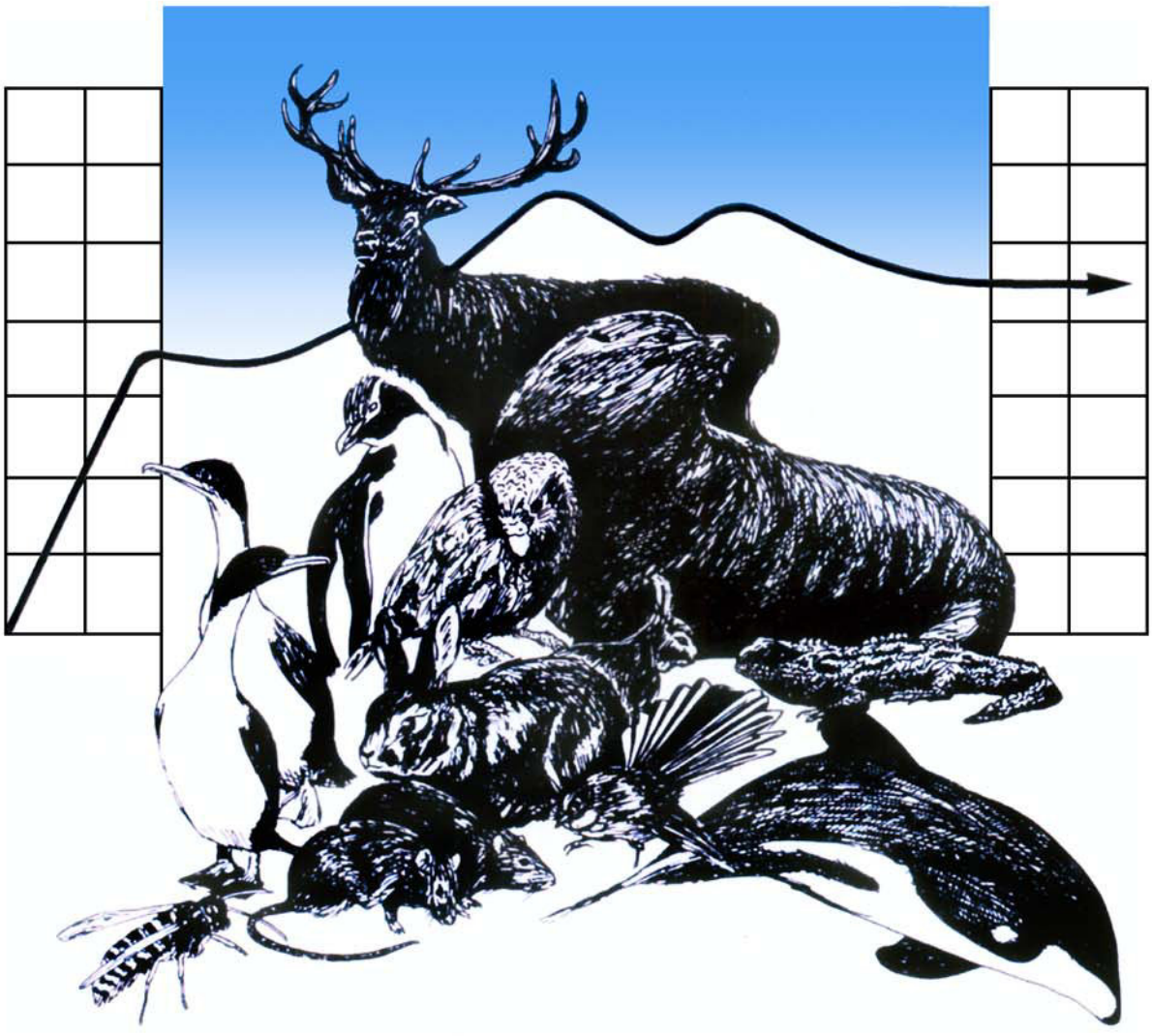

WILDLIFE MANAGEMENT

Advocating improved community environmental monitoring: applying lessons from the past to guide future participatory monitoring toolkits

Franziska Ina Landesberger

A report submitted in partial fulfilment of the
Post-graduate Diploma in Wildlife Management

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Contents

Summary

In the 1970s a new paradigm emerged in environmental conservation, calling for a more inclusive and participatory strategy to nature conservation. However, including local communities in participatory monitoring schemes has not always been successful, with the monitoring terminating early. Thus, this report analyses past participatory monitoring projects to guide the development of future community monitoring toolkits.

For this task, seven criteria were developed, using per-reviewed papers: long-term incentive and funding for monitoring, costs and benefits to the local community, locally developed indicators, trade-off between scientific rigour and simple monitoring methods, transparent information sharing and ownership of the process, achievable objectives and use of information gained, and management opportunity and local ownership. These criteria were used when analysing fifteen participatory monitoring toolkits, found through an online search. It was also analysed whether the community initiated the monitoring or an external agency and whether the monitoring was part of an environmental or natural resource management project.

The following limitations have to be considered: Only fifteen toolkits were included in the report and the information given on the documents found online was not in all cases sufficient to state whether a toolkit met a certain criteria or not. However, using the information given on the documents it was found that one community monitoring toolkit fulfilled all criteria: the toolkit working with communities in the Pacific and Indian Ocean on locally-managed marine areas (LMMA). No significant correlation was found between the number of criteria a toolkit meets and who initiated the monitoring. However, community monitoring toolkits which were part of environmental management projects fulfilled significantly more criteria than participatory monitoring which was not associated with other projects.

Additionally to the seven criteria it was found that sustainability of the the monitoring scheme and local ownership can be enhanced with building on informal monitoring systems already in place. Also, facilitation can contribute greatly to the success of community monitoring. Facilitators sensitive to power unbalances between different groups and diverse cultural backgrounds and knowledge systems are important for good monitoring toolkits.

Introduction

For most part of the 20th century, environmental conservation had been centred exclusively around preservationist values and been driven by governments and external organisations. Only in the late 1970s a new paradigm concerning biodiversity conservation emerged which called for community involvement and participation (Jones 2006). This new paradigm was promoted through conferences such as the 'Forest and People' World Forestry Congress in 1978 and projects like the UNESCO Man and Biosphere programme (Garcia and Lecuyer 2008). Conservation management is divided by these two divergent views on how much local people should be involved and how much weight should be given to their perspectives. On the one hand, there are practitioners who argue for a scientific, top-down approach, including no-take reserves and on the other hand there are advocates of community-based, bottom-up approaches to conservation which are centred around environmental sustainability (Voyer et al. 2012). According to Voyer et al. (2012) conservation management has to face the challenge of finding a middle ground between scientific and socio-economic objectives. Yet, it has become more and more apparent that social factors contribute to a great extent to the success of protected areas (Voyer et al. 2012). If local people are involved in and benefit from managing resources they depend on, it could increase their motivation to sustainably use these resources and conserve their environment (Holck 2008, van Rijsoort et al. 2005).

Conservation management decision-making heavily relies on adequate knowledge of trends in habitats and species. Yet, scientific monitoring of these trends can be hard to coordinate and may be expensive, thus is not carried out enough (Danielsen et al. 2009). Until recently, monitoring has focused on answering set research questions and was performed by scientists or professional managers (Evans and Guariguata 2008). However, according to Danielsen et al. (2009) involving local communities in monitoring, may enhance sustainability by making monitoring locally relevant and may reduce monitoring costs in the long-term. Participatory monitoring can increase local commitment to natural resource conservation by raising awareness and pride of local community members. Along with these benefits, threats can be identified more rapidly, and action taken faster, since local communities are constantly present in the monitored area (Holck 2008). However, studies of the effectiveness of participatory monitoring have also shown that data which has been collected by non-scientists, without sufficient training, can have higher variation and less precision than data collected by educated scientists, sometimes creating biased results (Holck 2008). Also, participatory monitoring projects have failed in the past,

because the local communities often bear the monitoring costs, which can be higher than expected and lead to a termination of the monitoring after the external funding agency leaves (Evans and Guariguata 2008).

"Sustainability for any conservation effort in developing countries can only be ensured if the local communities play a central role" (Holck 2008: 2033). Thus, it is essential for future environmental management and sustainable resource use to understand the shortcomings of current community monitoring toolkits and develop more successful ones. Yet, to date no comprehensive analysis has been undertaken to understand why so many community monitoring toolkits have failed to sustainably include local communities in monitoring their environmental resources. This report aims at analysing past community monitoring projects to guide the development of future participatory monitoring toolkits. For this task seven criteria were developed and compared to whether the toolkit was part of a management project and who initiated the monitoring.

Methods

The first step for the development of this analysis was a search for peer-reviewed publications through 'Scopus', 'Web of Knowledge' and 'Science Direct' web-based search engines. These publications were synthesised to develop seven criteria for successful community monitoring toolkits: periodic reassessment, costs and benefits to the local community, selection of indicators, trade-off between scientific rigour and simple monitoring tools, transparency and information sharing, achievable objectives and use of information gained, and local ownership or management opportunity (Garcia and Lecuyer 2008, Holck 2008, Setty et al. 2008, Fraser et al. 2006, Andrianandrasana et al. 2005, van Rijsoort et al. 2005, Abbot and Guijt 1998). These indicators will be explained in greater detail in the results section.

In the second step 'grey' literature, including conference presentations, guidebooks, project reports and modules, was searched for on the web. These toolkits were then filtered and selected according to three criteria. Firstly, only documents available in English were considered. Secondly, only those toolkits were used which complied with Danielsen et al.'s (2009) definition of monitoring as a systematic and regular measurement of variables and collection of data over time. Thirdly, toolkits were not used for the analysis if they did not fit in category two, three or four of Danielsen et al.'s (2009) typology of monitoring schemes. Danielsen et al. (2009) developed a five-category typology of monitoring projects, ranging from professionally undertaken and externally driven

monitoring (category 1), externally-driven monitoring but involvement of local people for data collection (category 2), collaborative monitoring scheme with external analysis (category 3), collaborative monitoring scheme with local data interpretation (category 4) to monitoring projects, carried out by the community, without any external assistance (category 5). Monitoring toolkits belonging to the first and the last category were excluded from the analysis since in the first category the community is not involved, and in the last category no external assistance, such as training to use scientific monitoring tools, is provided. Training is considered extremely important for successful monitoring (Holck 2008), thus category five toolkits were excluded from the analysis.

In total fifteen community monitoring toolkits were included in the report. These were analysed using the seven criteria stated above. Also, correlation between the number of criteria a toolkit fulfils and whether the monitoring was initiated by the community or by an external agency was analysed. It was further analysed whether a correlation exists between the monitoring process being part of an environmental management project and the number of criteria the toolkit meets (see table1, appendix). For this mean and standard deviation were calculated and a two-sample t-test conducted, using Microsoft Excel.

Results

Criteria for success drawn from past projects

The following seven criteria or questions were developed to distinguish whether community monitoring toolkits were successful: (1) Does the toolkit manage to ensure that the monitoring continues after the initial set-up phase? Monitoring needs to be frequently enough and over a long enough period of time in order to detect real change as opposed to stochastic, dynamic variations (Wagner 2005, Abbot and Guijt 1998). For example van Rijsoort et al. (2005) report of a participatory resource monitoring from Yunnan, China which only had enough funding for one year of monitoring. After the funding agency left the monitoring significantly decreased, diminishing the usefulness of the monitoring (Garcia and Lecuyer 2008). In contrast the Durrell Wildlife Conservation Trust set up an annual participatory ecological monitoring in the Aloota Wetlands in Madagascar, involving local residents. The annual budget for the monitoring was only $5000, ensuring sustainable funding over years by the Trust and positive change in resource extraction by the community (Garcia and Lecuyer 2008, Andrianandrasana et al. 2005). Sustainable monitoring by local communities can be ensured by guaranteeing continuos funding

through an external agency or the project or through short and long-term benefits to the community, outweighing the costs of monitoring.

(2) Are costs and benefits clear to the communities and do the benefits outweigh the costs? According to Garcia and Lecuyer (2008) it is essential for successful and sustainable participatory monitoring schemes that advantages of monitoring are obvious to the community and that these are higher than the costs the local residents have to bear. Often these benefits are long-term and do not become immediately apparent (Andrianandrasana et al. 2005, Bennun et al. 2005). Yet, Setty et al. (2008) state that when monitoring provides the most immediate benefits, participation appears to be highest. Thus it is also important to ensure short-term incentives for the monitoring, along with the benefits being felt throughout the community (Andrianandrasana et al. 2005, Bennun et al. 2005). Besides these considerations, participatory monitoring toolkits should also emphasise the importance of good facilitation throughout the process, ensuring participation of different groups and encourage minority perspectives to be expressed (Stringer et al. 2006, Andrianandrasana et al. 2005). Benefits and costs should be equally distributed amongst the community and clearly stated at the beginning of the monitoring scheme, with the benefits outweighing the costs to create an incentive for participation.

(3) Does the community contribute to indicator selection and are the selected indicators locally relevant? Selecting indicators for a monitoring scheme is most difficult since this process highlights the different point of views and objectives of the different stakeholders involved. Garcia and Lecuyer (2008) state that most of the criteria and indicator toolsets are driven by external agencies, without great local relevance, becoming dysfunctional quickly after the funding eases. It is important to make indicators locally relevant, thus community contribution when developing indicators is essential for successful participatory monitoring toolkits. Fraser et al. (2006) for example describe a case study from the Kalahari Rangelands, Botswana, where locally meaningful indicators on environmental degradation were developed in group discussion. However, establishing monitoring indicators requires considering the trade-offs between locally developed indicators and indicators comparable between different sites.

(4) Were trade-offs between scientific rigour and simple monitoring methods for non-trained scientists acknowledged? Monitoring is influenced by individual world views, with the task always providing a particular view of reality (Abbot and Guijt 1998). For example, the linear world view of Western science is reflected in the continuous refinement of methodologies, whereas most traditional knowledge systems rely on a cyclical world

view of interdependence of human beings and their environment (Abbot and Guijt 1998). Yet, protected area management tools rarely provide guidance on how to work with different parties who have different perspectives (Izurieta et al. 2011). Along with the consideration of different perspectives of groups involved in monitoring, participatory monitoring toolkits also have to consider the trade-off between scientific methods and simple monitoring techniques for non-trained volunteers. One of the critiques of participatory monitoring, most often stated, is that this process produces biased results, not useful for scientific research (Granderson 2011, Evans and Guariguata 2008, Holck 2008). Several studies have been conducted to compare the monitoring results of professional scientists and community participants. According to Holck (2008) and Verheij et al. (2004) bias in data generated by volunteers can be significantly reduced by providing sufficient training and supervision. Thus, participatory monitoring toolkits need to provide guidance for facilitators on how to incorporate different perspectives and work in a culturally sensitive way along with offering methodologies, both simple and inexpensive but scientifically sound and suggest enough training for the community to use these methodologies effectively.

(5) Is the information gained shared transparently amongst all community members and does the community feel ownership over the monitoring process? Training for the community is not only essential for data collection but also for the interpretation of the results, enabling the community to share and use the information obtained and gain ownership over the monitoring process (Fraser et al. 2006, Andrianandrasana et al. 2005). Bennun et al. (2005) and Garcia and Lecuyer (2008) agree with saying that it is essential for the community to feel ownership of the monitoring process and the data in order to ensure successful participatory monitoring schemes. For this not only involvement in all stages, but also ensuring that the terminology which is used is clear for all participants is essential (Abbot and Guijt 1998). Thus, giving communities the opportunity and the means to participate in all stages of the monitoring process, enabling them to share the information gained in a way everybody can understand it and ensuring that decisions are made in a transparent matter, contributes to successful community monitoring toolkits.

(6) Is the information gained from the monitoring used and are the objectives for the monitoring achievable with the funding available and within the set time-frame? Without realistic and achievable objectives participatory monitoring may not be able to keep communities interested and the monitoring may terminate early. For example, Fraser et al. (2006) report from a forestry planning project in Western Canada aiming at engaging

communities. However, the assessment took almost one year longer than originally expected, leading to higher costs. Combined with skewed results and unwieldy data the delay diminished the usefulness of the assessment. Along with achievable objectives, van Rijsoort et al. (2005) state that it is essential for successful participatory monitoring schemes to work towards using the results gained in order to achieve the stated objectives.

(7) Are the rights over natural resources/areas clear and has the community the opportunity to manage these resources/areas? If the local participants have no rights over the resources or uncertain tenure over the area they are asked to monitor they often lack motivation to do so. For example Andrianandrasana et al. (2005) show that the management control given to the local communities, living in the Aloota Wetlands in Madagascar, enabled these communities to enforce rules and regulations. However, even though they were able to exclude outsiders from resource use and had the right to charge fines if people did not respect the rules, they lacked sufficient authority and welcomed the presence of governmental officials. Similarly, Setty et al (2008) state that uncertain tenure over non-timber forest products resulted in a lack of interest in long-term monitoring in the Biligiri Rangaswamy Temple Wildlife Sanctuary in India. With the Indian government passing an act in 2006 which gave the community ownership over these forest products, along with harvesting rights Setty et al. (2008) are confident that the situation will change. Thus, Setty et al. (2008) conclude that tenure is essential for long-term monitoring interest. Similarly, van Rijsoort et al. (2005) state that sustainability of monitoring projects depend on the legislation allowing villagers to use and access resources in the protected area. Thus, participatory monitoring toolkits are most successful if the land tenure of the area monitored and the rights over the natural resources are clear, or co-management schemes/shared responsibility is established.

Applying the criteria to the toolkit analysis

For many of the analysed toolkits it could not be established whether they fulfilled certain criteria since the information given in the documents was not specific enough. Due to a lack in time no personal contact was established to clarify these points. However, the aim of this report was not solely to judge past community monitoring toolkits but to learn from these experiences and establish criteria which are necessary to produce better participatory monitoring toolkits in the future.

Using the information given on the toolkit documents it was found that only one of the fifteen analysed toolkits fulfils all of the above explained criteria: The toolkit developed for locally managed marine area networks (LMMA) in the Pacific and Indian Ocean (number 10 in table1, appendix). In this toolkit the monitoring is part of a near shore or coastal environmental management initiative and is initiated by the community. The toolkit which applies all, but one of the above stated criteria is also part of an environmental project and is also initiated by the community itself: The toolkit provides assistance for communities to establish a bushland regeneration project in Australia (number 11 in table1, appendix). However, one of the third most successful toolkits, monitoring seagrass in Thailand (number 9 in table1, appendix), is initiated by non-governmental organisations (NGOs) and development agencies and is not part of an environmental management project.

Apart from these three examples, most other toolkits fulfil between one and four of the seven criteria. Toolkits intended for use by different communities, mostly do not work with locally developed and locally relevant indicators (criteria 3), but rely on pre-selected indicators the local community cannot modify (e.g. toolkit 1, 5, 7 and 8 in table1, appendix). Ten of the sixteen analysed toolkits provide a good balance between scientific rigour and simple monitoring tools (criteria 4).

No significant correlation was found between the number of criteria a toolkit fulfils and whether the monitoring was initiated by the community itself (mean: 3.55, sd: 1.94) or an external agency (mean: 3.57, sd: 1.51; two-sample t-test, p-value: 0.9535). However, the difference in mean number of criteria a community monitoring toolkit meets and whether it was part of an environmental management project (mean: 4.71, sd: 1.41) or not (mean: 2.66, sd: 1.38) is statistically significant (two sample t-test, p-value: 0.0168).

Discussion

From the documents available online, it could not be established for all of the toolkits whether they fulfilled all of the seven criteria. However, these seven criteria were found to be a good indicator for the analysis and can therefore be used to guide the development of future participatory monitoring toolkits. Using the information available on the fifteen toolkit documents it was found that, whether the monitoring was initiated by the community or by an external organisation did not influence the number of criteria the toolkit met. However, monitoring toolkits which were part of an environmental management project fulfilled

significantly more of the criteria, compared to community monitoring toolkits which were not associated with other projects.

Locally developed or internationally comparable indicators?

Most of the analysed participatory monitoring toolkits intended for different communities to use, rely on an indicator list which has been developed by scientists. This indicator list does not allow the local communities to modify or adjust indicators to their local needs. For example, the Reef Check instruction manual (toolkit 7, table1, appendix), developed in the United States, has been used by communities in more than sixty countries to monitor the health of coral reefs. In order to be able to compare these different monitoring sites indicators have to follow a standard framework (Wagner 2005, Bennun et al. 2005). For Bennun et al. (2005: 2578) it is important, that indicators "work at different spatial scales so that the results for individual sites can be put together to demonstrate trends over larger areas". However, often local communities do not receive any returns (Bennun et al. 2005). For example, the Reef Check team does analyse the data sent to them by the communities and produces a global health report, but does not encourage or instigate local environmental action or benefits. Participatory monitoring toolkits "are usually first developed by external organisations in keeping with their global priorities and later have local practices crafted on them, so they are often inappropriate and stand little chances of being consequently put to use" (Garcia and Lecuyer 2008: 1305). Externally driven monitoring programmes often fail at linking the monitoring process to local concerns and the monitoring often ceases after the funding agency leaves (Garcia and Lescuyer 2008). In order to be sustainable, indicators not only have to be a tool that can be used on a daily basis by people improving environmental and natural resource management, but these people also have to be closely associated with the development of these indicators. Without this the toolset may be outside their decision-making process (Garcia and Lecuyer 2008). When local people develop their monitoring programme they are able to suggest indicators that reflect their interests and perspectives and these can be adapted to changing circumstances (Reed et al. 2006, Bennun et al. 2005). Thus. Garcia and Lecuyer (2008) see the role of external experts less in developing indicators and ensuring scientific rigour as more in providing guidance and verifying local monitoring techniques already in place.

Between these two extreme opinions of globally comparable, indicators developed by scientists and locally adapted and developed indicator sets Evans and Guariguata

(2008) suggest that scaling-up of locally relevant indicators with significant training could result in a compromise. “Modular programs allowing for local adaptation can ensure information is comparable and useful between communities, and from local to national scales” (Evans and Guariguata 2008: 31). However, it should be ensured that mechanisms are in place which guarantee the return of results to the communities. The toolkit looking at biodiversity monitoring in community managed forests, developed by the Asia Network for Sustainable Agriculture and Bioresources (ANSAB; toolkit 16, table 1, appendix), gives local communities the opportunity to redefine and confirm externally developed indicators. However it is not flexible enough to incorporate local knowledge and pre-existing informal systems of data collection as much as Garcia and Lecuyer (2008) consider necessary. This was achieved by the seagrass monitoring toolkit in Thailand (toolkit 9, table 1, appendix) which incorporates both scientific and local knowledge for data collection.

Training and guidance for scientific rigour

A balance between achieving scientific rigour and using simple and inexpensive monitoring tools to include local participants in all stages of the monitoring regime was attempted by most of the analysed toolkits. Yet, several authors such as Bennun et al. (2005) conclude that along with the methods sometimes being too simple to gather meaningful data, the likelihood of bias in the collected data is especially high if the sampling regime was designed by the community. Also Evans and Guariguata (2008: 21) doubt that “local monitoring on its own has the ability to detect changes in populations, habitats or patterns of resource use of sufficient accuracy and precision to serve for scientific decision-making”.

However, Holck (2008) found that if participants received sufficient training they were able to produce as accurate results as scientists. For example, Danielsen et al. (2007) compared two monitoring schemes in the Philippines, the first was implemented in a participatory manner whereas the second was only undertaken by scientists. They found that both schemes came to the same conclusion and a workshop was planned to develop a pasture management plan for the local area. The educated scientists discovered eroded hillsides using fix point photography, whereas the local community participants reported overgrazing by goats of the same area using their local knowledge. Wagner (2005) reporting from a comparison of scientific monitoring and participatory monitoring of mangrove forests and coral reefs in Tanzania, conclude similarly, that the community participants produced compatible results. After significant training, the community

volunteers identified areas which required restoration, providing valuable information for environmental management. Thus, Wagner (2005) conclude that as long as external experts provide significant supervision and training the results can be considered reliable and accurate. Most of the analysed toolkits emphasise on the importance of training and supervision in order to reduce bias and produce meaningful results. For example the starter's guide to community science concerned with coastal and inshore marine resources (toolkit 8, table 1, appendix) emphasises on the importance of training and supervision, ensuring theoretical and practical instructions, with every participant practicing all stages of the monitoring.

Initiation of the community monitoring

Whether the monitoring was initiated by the community itself or an external agency was not found to influence the number of criteria a toolkit satisfies. However, literature suggests that if the community starts the monitoring scheme, their incentive to continue may be higher than when the scheme is suggested by an external party (Evans and Guariguata 2008). "Repeated studies in different parts of the world have shown that when the users of a common-pool resource organise themselves to devise and enforce some of their own basic rules, they tend to manage local resources more efficiently than when rules are externally imposed on them" (Rucha and Harini 2012: 511). For example Rucha and Harini (2012) compared two case studies of forest monitoring in India. The Deulgaon community initiated the forest management themselves, whereas the monitoring involving the community living in the Ranvahi forest was initiated by Amhi Amchya Arogya Sathi (AAA), a local NGO. The first case revealed very successfully implied restrictions on resource use, both for the local community and external users. The community sanctioned rule breakers, monitored the compliance with daytime patrolling and succeeded in improving the biodiversity in their local forest. In contrast, in the second case, only external harvesting was successfully prevented, whereas excessive harvesting of natural resources by the local community continued. It was found that the local NGO did not deal with the rule breakers as harshly and did not punish all infractions, since the NGO had planned on initiating more projects in the community in future and was reluctant to antagonise local people. This lenient behaviour led to increased infraction of the rules and a less significant improvement of the local biodiversity. External parties and local communities often have multiple and contradicting interests and needs, shaping protected areas in different ways (Granderson 2011).

When starting a participatory monitoring scheme, Sekher (2001) advocates building on traditional systems of data collection as much as possible. These systems often have existed for several years and enjoy community support, thus new rules and new tools can be added by building on the legitimacy and acceptance of the local population. Similarly, the toolkit working with communities in the Pacific and Indian Ocean on locally-managed marine areas (LMMA; toolkit 10, table 1, appendix) builds on traditional techniques to preserve marine resources. For example, seasonal bans and no-take areas have long been practiced in Fiji. When a chief or special person for the community died, areas of coral reefs were temporarily closed off for fishing. Blending these customary practices with modern techniques might positively contribute to the effectiveness of the management of these areas.

Monitoring as part of an environmental management project

The coral reef monitoring toolkit for communities in the Pacific and Indian Ocean (toolkit 10, table 1, appendix) was the only toolkit that was found to meet all seven criteria. In this toolkit, the community initiates and drives the nearshore and coastal management process, with guidance provided by external agencies. This ensures both long-term commitment and scientifically sound results. Annual meetings with the external partners provide forums for discussion and also contribute to the long-term commitment. In these forums of discussion and all other phases of the coastal management scheme different groups of the communities, including women, are encouraged to participate. It is also ensured that benefits and costs are equally shared amongst all community members and disadvantaged groups are specifically included in socio-economic activities related to the project. The communities feel ownership over their management and monitoring process, not only because they select their own indicators, with external guidance, but also because they follow their own objectives and interests. The community participates in all stages of the monitoring process and uses the information gained to create 'no-take' areas in order to restore marine biodiversity.

This monitoring toolkit, intended for locally-managed marine areas (LMMA), is initiated by the community and the monitoring is part of an adaptive management process to protect the local marine biodiversity. Similarly, the toolkit on recovering bushland in Australia (toolkit 11, table 1, appendix), which fulfils all but one of the seven criteria, is initiated by the community and the monitoring results are used for a local restoration project.

The positive correlation between community monitoring toolkits being part of an environmental or resource management project and the number of criteria they meet was found to be significant. This correlation might be explained through the fact that some criteria are fulfilled with the monitoring being part of a project. For example, the information gained from the environmental monitoring is often used for management decision making (criteria six). Also, often management projects work together with local governmental officials, contributing to clear rights over the use of natural resources and local management opportunity (criteria seven). For example, Verheij et al. (2004) show with a study of community monitoring of coral reef health and mangrove forests in Tanga, Tanzania, that joint management between local governmental institutions and the community contribute to long-term monitoring interest. This collaboration also enhanced rule compliance and contributed to positive ecological trends. The community, including women, monitored the local coral reef and mangrove forest, analysed the results, identified priority issues and developed an action plan with the district council having advisory and supervisory role. Joint patrolling of community members, governmental officials and the navy was initiated to enforce compliance with fishing restrictions. This joint management successfully increased the mangrove cover and rapidly enhanced reef recovery after the 1998 El Nino bleaching event (Verheij et al. 2004).

However, Granderson (2011) state that different stakeholders have a different view of protected areas. For example, Axford et al. (2008) show with a study in the Pacific Islands that local stakeholders were more interested in impacts on local people and the working of the protected areas, whereas external agencies were focused on sustainability and scientific criteria. These external agencies are often more powerful and thus shape the monitoring process of protected areas. Yet, for a sustainable monitoring process a balance of power, and assets sharing between different stakeholders, who bring different sets of knowledge and values into the process, has to be achieved (Granderson 2011, Danielsen et al. 2009). This might be possible with the careful integration of different knowledge systems (Weaver and Cousins 2004). Yet, Weaver and Cousins (2004) state that knowledge and information sharing has not always contributed to promote shared understanding between different parties and empower marginalised stakeholders.

Conclusion

Especially in developing countries, local communities often depend on natural resources and their environment. Thus, successfully involving these local stakeholders can enhance environmental protection and sustainable monitoring (Maguire et al. 2011, Holck 2008). To include local communities in environmental monitoring schemes participatory monitoring toolkits are often used. However, these were found to be unsuccessful in many cases.

Thus, in this report, seven criteria were developed to guide and improve future community monitoring toolkits: Incentive and funding for the community to commit to long-term monitoring, equal cost and benefit sharing amongst all community members along with the benefits outweighing the costs, locally relevant indicator selection, training and guidance for scientifically sound monitoring results while using simple techniques, local ownership over the monitoring process through inclusion of the community in all monitoring steps, using monitoring results to achieve objectives, and clear land tenure/ rights over natural resources for local management.

Along with these seven criteria it was found that local ownership and sustainability of the monitoring scheme can be enhanced with building on informal monitoring systems already in place. Also, facilitation sensitive to different cultural backgrounds, diverse knowledge systems, and power relationships between stakeholders was found to be important for good community monitoring toolkits.

To improve the management of our natural resources, monitoring which makes a real contribution is essential (Danielsen et al. 2009). Often this contribution can be achieved with truly engaging local communities not only in the monitoring but also in the management process. However, current toolkits used for participatory environmental monitoring are not perfect. Thus, more research is needed to determine whether the criteria developed for this analysis are sufficient for successful community monitoring toolkits and whether they can be applied in different contexts around the world.

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Appendix

Table 1: Shows all community monitoring toolkits used for the analysis with their title, monitoring topic, location, which criteria the toolkits did meet, who initiated them (C = community initiated; N = initiated by an NGO/governmental organisation) and whether the monitoring was part of an environmental management project.

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
Air and Water Pollution, and Waste Monitoring				
(1) Citizen participatory dioxin monitoring campaign by pine-needles as bio-monitor of ambient air dioxin pollution (Ikeda et al. 2004)	Japan; The needles of Japanese black pine trees were used as bio-monitors for ambient air pollution.	The analysis took place for five consecutive years; indicators were developed by scientists; communities only participated in the data collection, without the opportunity to take influence; the data was analysed in a scientific laboratory and the results handed back to the community in a way for them to be able to understand; the results were used by the communities to protest against air polluters	N	No
(2) Local environmental monitoring project for forward Scotland (McLeod and Airlie 2003) - community EcoCal	Scotland/ England; Pilot study to test two monitoring tools (community EcoCal and Neighbourhood Environment Action Teams (NEAT)) with two communities in Fife	community decided on frequency of data collection, and the indicators (problem: different for different groups) - feeling of ownership; emphasis on locally relevant indicators; insufficient training for the community to analyse the data	C	No

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
(3) Local environmental monitoring project for forward Scotland (McLeod and Airlie 2003) - Neighbourhood Environment Action Teams (NEAT)	Scotland/ England; Pilot study to test two monitoring tools (community EcoCal and Neighbourhood Environment Action Teams (NEAT)) with two communities in Fife	baseline survey undertaken once, re-survey to measure success; pre-selected indicators; emphasis on locally relevant indicators; information is used for the development of an action plan; insufficient training for the community to analyse the data; the monitoring committee is working on obtaining legal status;	C	No
(4) Participatory environmental monitoring, Guatemala (2005)	Guatemala; Environmental impacts of a goldmine are monitored	different groups in the community are involved; training from external experts;	N	No
(5) Global community monitor. Celebrating a decade of breathing new life into communities (Global Community Monitor (GCM) 2011)	Globally; Communities around the world can order training and equipment to monitor the air quality in their area.	it is not stated whether periodic reassessment of the air is planned; indicators are pre-selected but are compatible between different places around the world; a simple tool is used (“air bucket”) and cases of successful action against air polluters are shown; no information is provided on how easily the results can be interpreted by the community	C	No

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
Coastal and Marine Monitoring				
(6) Turning the tide. An estuarine toolkit for New Zealand communities (Robertson and Peters 2006)	New Zealand; Estuarine monitoring	no emphasis on periodic reassessment; diverse groups are invited to participate; community contributes to monitoring/indicator selection; balance between scientific rigour and simple methods; it is up to the community to take further action and use their results;	C	No
(7) Reef check instruction manual. A guide to reef check coral reef monitoring (Hodgson et al. 2004)	Globally; Coral Reef monitoring, using economic and ecologically valuable fish species, which are easy to recognise by non-specialists	balance between scientific rigour and simple monitoring; information is used by the Reef Check organisation for annual reports; community is trained for data collection, but analysis is done by Reef Check	C	No
(8) Coastal and inshore marine resources monitoring. A starter's guide to community science. Manual for the coordinator (2010)	Globally; Improve management of community resources to ensure sustainable use	pre-selected indicators are used; monthly monitoring, in the beginning assisted by a coordinator; diverse groups are encouraged to participate; training for analysis is provided	N	No

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
(9) Participatory seagrass monitoring using an integrated approach that combines scientific and local knowledge: An example from Southern Thailand (Sukpong et al. 2010)	Thailand; Seagrass monitoring by local communities	seagrass ecosystems provide habitats for fish species contributing significantly to the livelihoods of the participating communities - creation of incentive; indicators were established using traditional and scientific knowledge; a conservation zone was created;	N	No
(10) Locally-managed marine areas: A guide to supporting community-based adaptive management (Govan et al. 2008)	Southeast Asia, Melanesia,Micronesia, Polynesia and the Americas; Locally-Managed Marine Area (LMMA) Network; Monitoring of local management efforts of near shore or coastal areas	external assistance over a long time frame, but communities drive the process and are involved in all stages; different local groups contribute to indicator and objective selection; benefits and costs are intended to be equally shared between all members of the community; balance between scientific rigour and simple monitoring; the community feels ownership over the management process; the information is used for adaptive management;	C	Yes

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
Monitoring of Restoration Efforts				
(11) Recovering bushland on the Cumberland Plain - best practice guidelines for the management and restoration of bushland (2005)	Australia; Assistance for community groups to establish a bushland regeneration project	modification is possible/ not all guidelines have to be used; periodic reassessment; meant to meet grant requirements/ demonstrate success of restoration work; very scientific indicators - but well explained and referred to more information online; explained how to develop achievable objectives;	C	Yes
(12) Monitoring revegetation projects for biodiversity in rainforest landscapes. Toolkit version 1, revision 1(Kanowski and Catterall 2007)	Australia; Revegetation projects in rainforests or recovery from disturbance events are monitored	the community has to obtain funding in order to purchase the necessary equipment; indicators are pre-selected; the community also seems to have to organise training themselves, if instructions in the toolkit appear to be unclear;	C	Yes
(13) Monitoring revegetation projects for biodiversity in rainforest landscapes. Toolkit version 3 (Kanowski and Catterall 2010)	Australia; The toolkit is to assist community groups in monitoring their revegetation projects	monitoring over long timeframe is suggested; pre-selected indicators; simple and rapid methodology; objectives and information used is tied to the revegetation project the monitoring is intended for; information and data sheets for analysis is provided, given computer literacy	C	Yes

Toolkit Title, Year and Author(s)	Monitoring Topic and Location	Fulfilment of Criteria?	Initiative	Part of project
Monitoring of Livelihood Practices				
(14) Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program SANREM CRSP annual report (Foglia and Roncoli 1995)	Philippines; Growing concern for environmental degradation - members of the Lantapan community volunteered to monitor water quality in their major rivers	different groups in the community are integrated (also possibly marginalised ones such as women, poor people...); collective agreement on research question and indicators; use of indigenous and scientific knowledge; information is used to improve farming techniques; data is analysed with community	N	Yes
Forest Monitoring				
(15) Participatory biodiversity monitoring in community managed forests (Asia Network for Sustainable Agriculture and Bioresources ANSAB 2010)	Globally; Biodiversity monitoring in community managed forests	emphasis on regular assessment; community is consulted when selecting indicators; the toolkit aims at justifying and adjusting community forest management; community is involved in most steps;	N	Yes