Results of the GEF Biodiversity Portfolio Monitoring and Learning Review Mission, India

Enhancing Outcomes and Impact through Improved Understanding of Protected Area Management Effectiveness

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Executive Summary

The objective of the mission was to improve understanding of the correlation and causal relationship between protected area management effectiveness as measured by the Management Effectiveness Tracking Tool (METT), and the Management Effectiveness Evaluation (MEE) developed for use in India and biodiversity outcomes and impacts.

The mission to India built on the initial findings from a similar mission conducted in Zambia in November 2010. In addition, the mission spent considerable time analyzing the evolution of the METT to the India-specific MEE (Management Effectiveness Evaluation) as applied to the country's Tiger Reserves and the broader PA network in India with the objective of learning from the refinements and advances India has made in assessing Protected Area Management Effectiveness (PAME).

The following question guided the identification and analysis of the causal relationship between management effectiveness and conservation outcomes:

a. *Does protected area management effectiveness accurately reflect biodiversity status and project impact in protected areas?*

b. *Are increases in protected area management effectiveness scores attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool (METT)/Management Effectiveness Evaluation (MEE)?*

c. *Is achievement of project outcomes and impact attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool/Management Effectiveness Evaluation?*

d. *What are the strengths and weaknesses of the METT/MEE based on the Indian experience?*

e. *How might the METT/MEE be improved for use by the GEF based on the Indian experience?*

A selection of the key findings from the mission is summarized below:

1. An increase in the METT performance measure is positively correlated with changes in biodiversity condition and a reduction in threat profile.

2. Initial donor investments, by virtue of focusing on inputs, will almost always push METT/MEE scores up.

3. The METT/MEE does not fully assess the park's external environment from both a biological and socio-economic perspective and these external factors can impact the PAME scores in a positive or negative way.

4. Protected Area Management Effectiveness tools (PAME), whether it be the initial METT applied in the GEF Ecodevelopment Project that or the more refined MEE now being applied in India, is simple to apply, easy to understand, and allows for easy aggregation and analysis.

5. Most experts interviewed agreed that the key elements of protected area management effectiveness at site level were indeed being tracked in the METT and that the tool was a valid performance metric. However, the fact that authorities in India chose to use the METT as the jumping off point to develop a more robust METT is an indication of the limitations of the METT as currently constructed.

6. The strengths in how PAME is assessed in India are: 1) the refinements made to the METT questions which are more sophisticated and context-specific in the India MEE; and 2) the approach developed for its implementation including:

    a) training and orientation and detailed guidelines for all participants in the process which ensured a consistent technical rigor on the part of all stakeholders;

    b) an agreed protocol established and applied ensuring uniformity of application of the scorecard;

    c) technically qualified biologists were trained as independent evaluators to apply the MEE; and this is likely the most critical ingredient to reducing strategic incentives to alter or rig the scores;

    d) park staff were also trained and received an orientation on the process and their expected contributions as key informants; and

    e) altering the MEE slightly to be more robust in terms of quantitative analysis and emphasizing the support of qualitative scores with quantitative data.

    With the introduction of this strategy for its application, India eliminated the possibility of strategic incentives to alter the MEE scores to meet goals other than to provide an objective view of management effectiveness. It is worth noting that MEE data are reported to parliament thus a rigorous process was required.

7. The GEF needs to identify an approach, analogous to what was observed in India, which would allow for more independent completion of the METT and all GEF tracking tools for that matter. The current system is fraught with conflict-of-interest. Prior to this recommendation becoming reality, the METT—and all GEF tracking tools for biodiversity—must be revised to ensure that qualitative scoring is supported by quantitative data or supporting documentation in order to limit the current subjectivity implicit in a scorecard approach. This new methodology should also draw on the "adversarial collaboration" approach first recommended after the Zambia mission/case study and try to apply it within the GEF context. This kind of adversarial collaboration may increase PA performance across the entire PA system if the METT is systematically applied as it increases competition and provides strong social incentives for increased performance. If linked with performance incentives for staff it could prove a powerful tool for improving PAME. Finally, for GEF-6,

consideration must be given to supporting countries to systematically apply the METT country-wide in order to derive the maximum potential benefit from the METT as described herein. [1]

8. The Indian MEE improves the analysis of outcomes and threats when compared to the METT currently in use by the GEF, however, one could actually go further in terms of PAME scorecard improvement. In the GEF context and in our work to improve the METT, we will examine the inclusion of one additional data sheet that focuses on biodiversity status (building on a finding from the Zambia mission/case study) but that also requires reporting on pressure and response indicators as not only are these data easier to monitor and record we have consistently observed that it has been shown to particularly critical in enhancing PAME and correlates directly with biodiversity outcomes. We found considerable supporting evidence for our conclusions in Zambia that we need to improve the analysis of biodiversity values and conservation outcomes within the METT to be more precise and require that biodiversity status be justified by biodiversity data being collected by the project along with threat/pressure and response data. Thus, we must reiterate to GEF project developers that even at PIF stage, pressure, state and response measures should be part of each project logframe for protected area projects that are seeking to improve management effectiveness and that these indicators must be seen as required complements to the METT scorecard. Some projects are now taking this approach as evidenced by PIF project frameworks in GEF-5, but it must be more uniform across the portfolio.

9. Outputs and outcomes from the India Ecodevelopment project in the two parks we visited appear to be sustained due to the persistence of the EDCs that were established during the project and also due to adequate budget being provided to the two parks post-project. The value of the EDCs as "social fences" for the Tiger Reserves was mentioned as part of the reason for this success and this should be more carefully analyzed and documented, but was beyond the scope of this case study. The term "social fences" refers to the function that EDCs play in protected area management. The EDCs come from local communities surrounding the parks and are engaged in biodiversity-friendly activities supportive of protected area objectives and often have stopped engaging in extractive activities that were negatively impacting biodiversity. Furthermore, protected area staff have often engaged the EDCs as champions of the protected area. All of these functions of the EDCs result in their functioning as "social fences" that serve to protect biodiversity through their social commitment to the conservation goals of the protected areas.

10. Particularly in parks where wildlife is the component of biodiversity that is the conservation objective of the park, the park's design (size, siting, surrounding habitat, etc.) and the ecosystem's carrying capacity can have a marked impact on the ability of the PA staff to "improve" biodiversity condition if measured by sheer numbers. Hence, maintenance of population densities of certain species (as opposed to pure numbers) and even small reductions in densities may actually be a successful performance, thus additional data sheets may be able to account for these nuances in interpreting METT scores. GEF needs to

[1] Adversarial collaboration refers to the peer review process employed in Zambia where protected area managers throughout the country were brought together to assess the PAME scores across the entire system and discuss and analyze the veracity of the scoring based on expert opinion.

take note of this in the PIF stage and onward when analyzing biodiversity condition indicators in the project logframes.

11. We observed that in the case of tiger reserves, that there may be a delay in measuring the response of management efforts to tiger populations/density, thus in the GEF context, over the course of a 5-year project, the role of pressure and response indicators become ever more important in wildlife-focused protected areas.

12. Analysis of MODIS data for forest and vegetation cover requires careful ground-truthing in order to ensure that remote interpretation is reliable. Without ground-truthing of the MODIS data for Pench and Periyar, it would have been easy to mistakenly conclude extensive unplanned fire and deforestation within the parks. As GEF considers using satellite imagery for measuring portfolio impacts (eg., habitat fragmentation within and outside of protected areas) of the GEF-4 and 5 portfolios, a viable methodology will have to be developed to ground-truth satellite imagery in a large enough sample for assessing portfolio impact and measuring impact indicators developed for the biodiversity strategy.

13. In sum, the GEF must refine the METT, taking the best of both the Zambia and India experiences to date with the aim of making the GEF METT more robust overall as a measure of PAME. This is necessary to strengthen its use as a reliable proxy of biodiversity outcomes within the context of GEF protected area projects. This will include all of the recommendations highlighted in the missions/case studies in Zambia and India, and perhaps more that are identified in future missions.

Crested Serpent Eagle, Pench Tiger Reserve, Credit: Anupam Joshi

Mission Context and Rationale

1. The GEF RBM approach focuses on improving portfolio monitoring and learning. It gives attention to using monitoring information for accountability, internal management, learning and knowledge management. In support of the RBM, the GEFSEC has introduced a portfolio monitoring and learning review process to address specific thematic and portfolio monitoring issues within the respective focal areas.

2. Based on a review of evaluations and OPS 4 results, extensive internal discussions, and focal area-led discussions with the task forces and with STAP, a select number of learning questions were identified for the biodiversity focal area and these were included in the GEF-5 biodiversity strategy to be implemented and lead by the GEF Secretariat in collaboration with the GEF Agencies. As part of the replenishment process, the GEF Council approved the biodiversity learning objectives to be implemented during GEF-5 as part of the GEF-5 biodiversity strategy.

3. The GEF Secretariat, the GEF network of agencies, partner executing agencies and country-based staff of the GEF agencies and Government partners will be the main users of findings coming from the learning review process. Analysis and lessons derived from the learning missions will be used to improve focal area strategies and policies, and inform project design and implementation.

4. Given the extensive investment that the GEF has made in protected areas over the course of its existence ($1.89 billion of GEF resources which supported 2,302 protected areas spanning 634 million hectares and 700 globally threatened species), priority has been placed on first implementing learning objective one, “Enhancing Impacts and Outcomes through Improved Understanding of Protected Area Management Effectiveness”, through five country case studies during the first three years GEF-5. The first learning mission was undertaken in Zambia from November 23-December 3, 2010. The second learning mission was undertaken between April 2-14, 2012 and this report summarizes the results and findings from that mission.

5. Midway through the third phase of GEF (GEF3, FY 02-06), the GEF began tracking the impact of its investment in protected areas systematically through the application of the Management Effectiveness Tracking Tool (METT) which assesses progress in improvement in protected area management effectiveness. The METT is comprised of 30 questions that assess the key elements of protected area management based on a management framework developed by the IUCN World Commission on Protected Areas. At both the project and portfolio level, the GEF is using protected area management effectiveness as assessed through the METT as one proxy for biodiversity status and condition and as a measure of one key contributing factor towards ensuring the sustainability of a protected area system, i.e., effectively managed individual protected areas are a cornerstone of a sustainable protected area system.

6. While the METT has positive attributes as a monitoring tool in terms of its ease of application, and the calculation and aggregation of scores, the tool is largely made up of

inputs that are *hypothesized* to matter for conservation outcomes but for which there has been little empirical analysis of the hypothesized links. In addition, the scores are aggregated in a way that may not actually correlate with effectiveness (i.e., we hope that the score is an indicator for a continuous latent underlying variable of effectiveness that we cannot observe). The METT can only be considered an effective performance metric, and thus a tool to assist learning and the delivery of project results, if a correlation between the METT scores and conservation outcomes exists.

7. The mission to India built on the initial findings from the Zambia mission and further assessed whether and how that correlation may exist and sought to add to the existing evidence base on the correlation between the METT score of a protected area and conservation outcomes. The mission team also spent considerable time analyzing the evolution of the METT to the India-specific MEE (Management Effectiveness Evaluation) as applied to Tiger Reserves and the broader PA network in India with the objective of learning from the refinements and advances India has made in assessing Protected Area Management Effectiveness (PAME).

Mission Objective

8. The objective of the mission was to improve understanding of the causal relationship between protected area management effectiveness as measured by the Management Effectiveness Tracking Tool (METT), and the Management Effectiveness Evaluation (MEE) developed for use in India and biodiversity outcomes and impacts. Current understanding of this relationship is quite low, undeveloped, and largely anecdotal. Results from the India mission will also help provide methodological guidance for other project interventions or thematic areas in the GEF that are currently using or contemplating using scorecard approaches for performance monitoring.

Mission Approach

9. The mission to India assessed the correlation between the METT/MEE of protected areas and conservation outcomes and the mission results add to the emerging evidence base developed as a result of the Zambia case study.

10. The project and protected areas identified in India for this analysis were selected because they met the following necessary criteria to allow for an analysis of management effectiveness and conservation outcomes:

    a. Project intervention is focused on improving the management effectiveness of individual protected areas and/or the sustainability of the protected area system.

    b. The METT (or equivalent) for protected areas has been systematically applied more than one time to protected area sites that have received GEF and/or other investment thereby providing at least two data points.

    c. The protected area sites and the protected area system administration are able to provide data on pressure, biodiversity status, and response (threat reduction) for the protected area sites for the same time period as the METT (or equivalent) has

been applied. This kind of data allows for an analysis and comparison between the METT (or equivalent) score (a performance metric) and conservation outcomes (what the GEF aims to positively influence.)

11. In India, GEF has invested in a number of protected areas through traditional protected area as well as biodiversity mainstreaming projects. Of particular note in terms of GEF investment in protected areas in India and systematic application of the METT/MEE was the India Ecodevelopment Project (The project was implemented from 1996-2004 and the METT was applied from 2001-2004). The main objective of the project was to conserve biodiversity by implementing the ecodevelopment strategy of the Government of India in and around seven protected areas (PAs). Three primary objectives of the project were to: (a) improve capacity of PA management to conserve biodiversity and increase opportunities for local participation in PA management activities and decisions; (b) reduce negative effects of local people on biodiversity, reduce negative impacts of PAs on local people and increase collaboration of local people in conservation efforts; (c) develop more effective and extensive support for ecodevelopment. The project objectives were consistent with the Bank's Country Assistance Strategy (CAS) and government priorities and the priorities of the GEF at the time of approval.

12. The project was implemented in seven Protected Areas, namely: Palamau Tiger Reserve (Jharkhand), Buxa Tiger Reserve, (West Bengal), Nagarhole Tiger Reserve (Karnataka), Periyar Tiger Reserve (Kerala), Pench Tiger Reserve (Madhya Pradesh), Gir National Park (Gujarat) and Ranthambhore Tiger Reserve (Rajasthan). At the initiative of the World Bank, the project applied the METT to all of these protected areas.

13. Based on the experience of applying the METT to these project sites and the authorities interest in assessing management performance of the country's Tiger Reserves, India subsequently developed and applied the MEE (a version of the METT designed specifically for Tiger Reserves) systematically throughout the system of Tiger Reserves, thus providing multiple PAME (Protected Area Management Effectiveness) scores over time. In addition, India has developed a MEE for application in all of its other protected areas that are not part of the Tiger Reserve network. Thus, even though India offered only one GEF project that applied the METT systematically during after the project when more projects as part of the case study "sample" would have been preferable, India still provided an excellent opportunity for the implementation of the case study given that the country has a unique experience in the application and development of PAME tools.

14. Prior to the mission, the team was informed that the key required data were available at numerous Tiger Reserves namely: a) threat reduction data; b) enforcement data; and c) wildlife data (numbers and density of tiger and prey). However, recovering this data for five Tiger Reserves that were identified (Buxa, Kanha, Palamau, Pench, and Periyar) as the focus of this mission proved challenging. Given the limited time in country the mission team decided to focus on an in-depth analysis of Pench and Periyar and dedicate scarce time and resources to developing a robust data set for each of these reserves. *The trade-off with this decision was the inability to assess a larger sample size and a more diverse set of Tiger Reserves (high scoring and low scoring) and the impact that this has had on our ability to run correlation analysis (see paragraphs 20-33) .* Forest/vegetative cover data from MODIS

were analyzed for these two reserves in preparation for the mission and ground-truthed at the two sites as is discussed in Annex 4 and in the findings section of the mission report.

15. The following questions were selected to guide the mission as they have been identified as most relevant to begin to draw out the causal relationship between management effectiveness and conservation outcomes:

    a. *Does protected area management effectiveness accurately reflect biodiversity status and project impact in protected areas?*
    b. *Are increases in protected area management effectiveness scores attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool (METT)/Management Effectiveness Evaluation (MEE)?*
    c. *Is achievement of project outcomes and impact attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool/Management Effectiveness Evaluation?*
    d. *What are the strengths and weaknesses of the METT/MEE based on the Indian experience?*
    e. *How might the METT/MEE be improved for use by the GEF based on the Indian experience?*

16. These questions framed the interaction at each site with the protected area staff (See Annex 1 for informants interviewed). A structured interview process was conducted that revolved around understanding each site's PAME score and its relationship to the threat, reduction and biodiversity status data. Given the nature of the sites that were analyzed and their PAME performance, the majority of findings responded to questions (a), (d), (e), and to a lesser degree questions (b) and (c).

Landscape Pench Tiger Reserve, Credit: Mark Zimsky

Summary of Mission Results and Discussion

17. We were able to obtain comparable METT and MEE scores between 2001 and 2011 for Buxa, Palamau, Pench, and Periyar Tiger Reserves. The 2001-2004 scores come from the GEF Ecodevelopment Project. The 2006 scores are taken from a 45-question scorecard that was a transition monitoring tool between the application of the METT and the Indian MEE. This tool allocates points in a ratio that is consistent with the METT and the MEE. Within the 45 question tool, inputs account for 70% of the score, outputs for 24% of the score, and outcomes 6% of the score which is comparable to the METT and the MEE (70%, 23% and 7% respectively for inputs, outputs and outcomes). The 2011 score comes from the India MEE, a 30-question, 300 point PAME tool that is equivalent to the METT in use by the GEF.

18. The mean increase in the PAME performance measure was 26.4 percentage points between 2001 and 2011, but there is a lot of variability. See Table 1 below. Three of the four of protected areas experienced an increase in the PAME performance measure. For those protected areas that experienced an increase, the mean increase was 35 percentage points.

Fishers at Periyar Tiger Reserve, Credit: Anupam Joshi

Gaur at Pench Tiger Reserve, Credit: Anupam Joshi

Gaur crossing river at Pench Tiger Reserve, Credit: Anupam Joshi

Table 1: Changes in METT Scores as Percentage of Total Possible Points and Biodiversity Condition[2]

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011	Project?	Qualitative Trend of Biodiversity Condition	Source for Biodiversity Condition	Threat reduction	Source for threat reduction
Periyar Tiger Reserve	36.8%	41.05%	69.5%	63.2%	69%	80.0%	43.2%	Y	1	Data sheet, all sourced, see Annex 3	1	Data sheet, all sourced, See Annex 3
Pench Tiger Reserve	35.8%	46.3%	63.2%	63.2%	77.8%	88.3%	52.5%	Y	1	Data sheet, all sourced, see Annex 3	1	Data sheet, all sourced, See Annex 3
Buxa Tiger Reserve	53.1%	45.8%	47.9%	83.3%	67.0%	63.3%	10.2%	Y	1	MEE 2006 and 2011 and Status of Tigers, Co-predators and Prey in India, 2010	-1	MEE 2006 and 2011
Palamau Tiger Reserve	38.5%	45.8%	69.8%	76.0%	76.2%	38.3%	-0.2%	Y	-1	MEE 2006 and 2011 and Status of Tigers, Co-predators and Prey in India, 2010	-1	MEE 2006 and 2011
MEAN SCORES	41.1%	44.8%	62.6%	71.4%	72.4%	67.5%	26.4%					

[2] Using quantitative data (tiger and prey data, canopy cover and extent of vegetative cover, fire, enforcement, threat reduction) we categorized for each protected area the change in biodiversity condition from the early 2000s to 2011 as follows: “decrease” (-1), “increase” (+1) or “stable” (0). We also categorized the threat reduction data as follows: “threat increased” (-1), threat decreased (+1) or threat “stable” (0).

19. Table Description and Explanation (Please also see Annex 2)

19. All values are percentage of total points available that the protected area scores on tracking tool (96 for METT (2001-2004), 185 for transition MEE (2006) and 300 for MEE India (2011).

20. We categorized the METT questions during the previous mission to Zambia as measuring either an input, output, or outcome as these categories are more useful in the GEF context than the categories used in the METT as all GEF projects are designed following an input, output, and outcome logic. We applied a similar approach in India as we implemented in Zambia and observed that:

    a. The value of the input questions from the three PAME scorecards ranges from 64 to 70 %: 61/96 (64%) for METT and, 128/185 (69%) for the transition MEE, and 210/300 (70%) for the final version of the MEE that is currently in use in India for all Tiger Reserves. Thus, the majority of the PAME score is derived from the input score which is an observation that is consistent with the findings from Zambia and the comparison that was made in Zambia between the METT and the Zambia-specific METTPAZ. Thus, in both instances of a revised METT being developed for specific country contexts, inputs still drive scores.
    b. Outputs from the three PAME scorecards ranges from 23 to 33 %; 32/96 for METT (33%), 45/185 (24%) for transition MEE, and 70/300 (23%) for MEE.
    c. The outcome question for the three PAME scorecards was of a similar low weighting across the three tools, ranging from 3-6%: 1 question for METT or 3/96 points (3%), 4 questions for 2006 transition MEE or 12/185 (6%), 2 questions or 20/300 (6%) for MEE. Although the India MEE has four outcome questions, only two directly address biodiversity status and those are the two we refer to here.

    Therefore, we concluded that the comparison between scores derived from these three PAME tools remained valid given the consistency and similarity of the weighting and because, for the most part, the nature of the input, output, and outcome questions are similar.

21. The mean input score increase of the four protected areas is 34.6%. All four inputs scores increased with Pench and Periyar enjoying increases of 53% and 59%, respectively.

22. The mean output score increase of the four protected areas is 6.7%. Pench and Periyar increased by 49.6% and 9.4% respectively. Buxa and Palamau outputs scores dropped, 9% and 23% respectively.

23. The mean outcome score increase for the four protected areas is 62.5%. All four protected area outcome scores increased from the baseline score in 2001.

24. Using available quantitative and qualitative data (tiger and prey data, canopy cover and extent of vegetative cover, METT and MEE written analysis), we categorized for each protected area the change in biodiversity condition from the early 2000s to 2011 as follows: “decrease” (-1), “increase” (+1) or “stable” (0). Not all variables were available for each protected area. We gave equal weight to each variable and determined trend by using the 2011 value and the earliest observed value.

25. Using available quantitative and qualitative data we also categorized the threat reduction data (fire, enforcement, threat reduction and response, METT and MEE written analysis) as follows: "threat increased" (-1), threat decreased (+1) or threat "stable" (0). Not all variables were available for each protected area. We gave equal weight to each variable and determined trend by using the 2011 value and the earliest observed value.

26. For Pench and Periyar, we observed a steady increase in species population numbers (Figure 1 and Annex 3) with a simultaneous slow and steady reduction in threats and in Pench an increase in tourism pressure (Figure 2a and 2b). Thus, Pench and Periyar scored a "+1" for biodiversity condition and "+1" for threat decreased. These trends are consistent with the slow steady increase in the PAME scores we noted in the METT and the MEE for both reserves as management was able to reduce threats and manage increasing pressures.

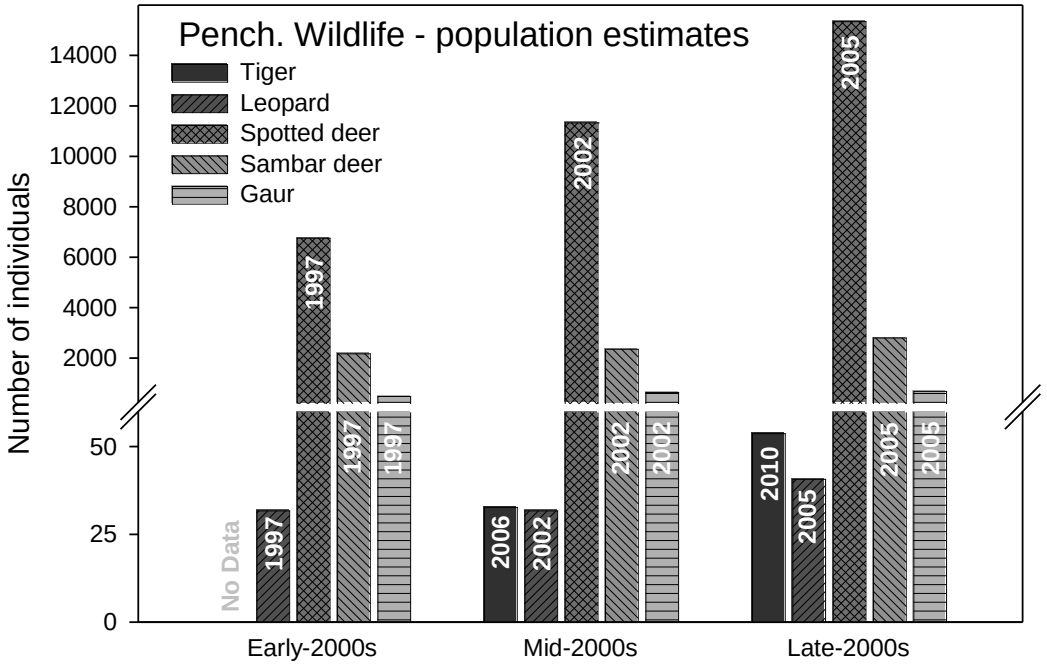


Figure 1a. Species population numbers in Pench Tiger Reserve.

Tiger Tourism, Pench Tiger Reserve, Credit: Mark Zimsky

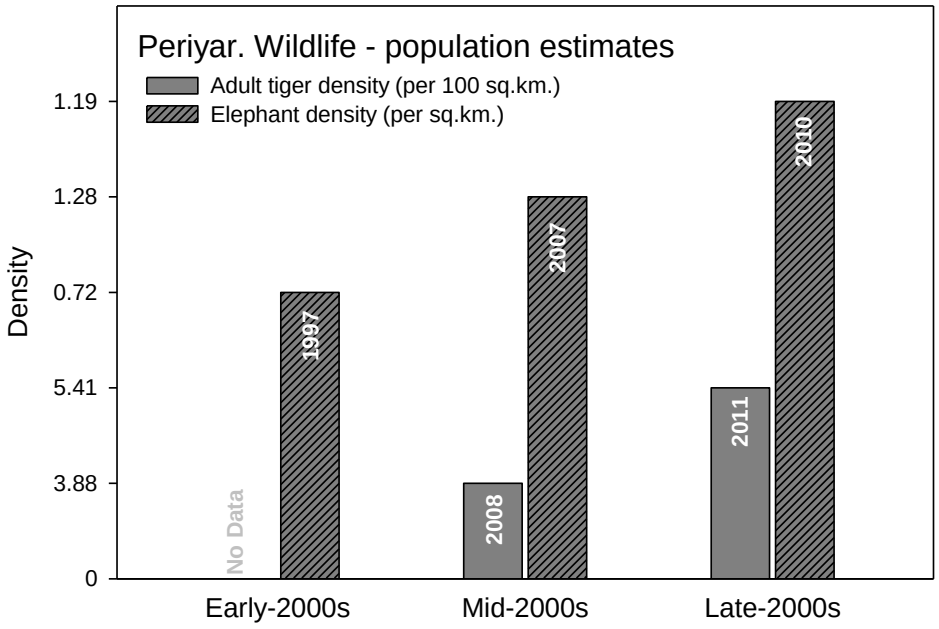


Figure 1a. Species population numbers in Periyar Tiger Reserve.

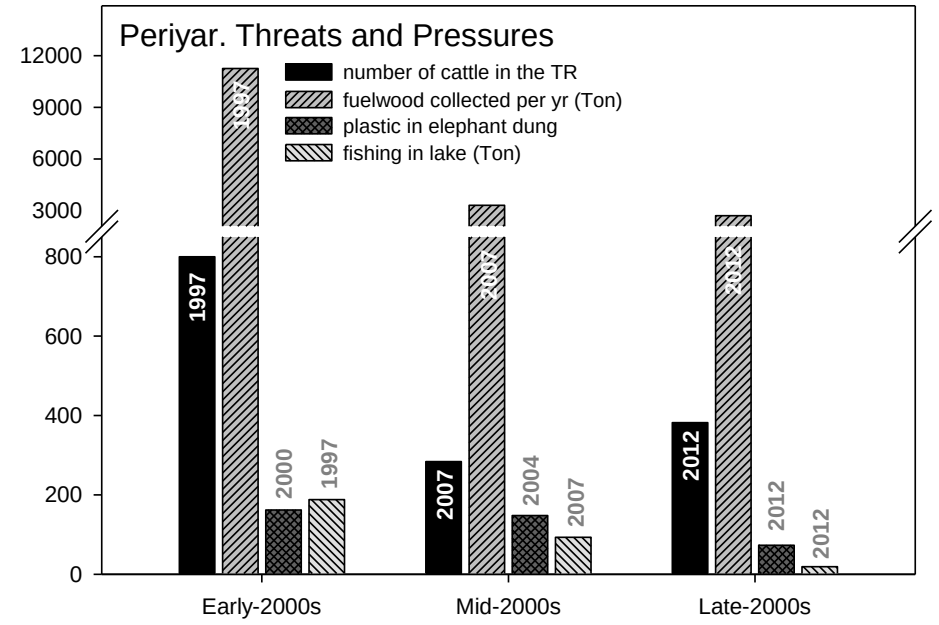


Figure 2a. Threats and pressures in Periyar Tiger Reserve.

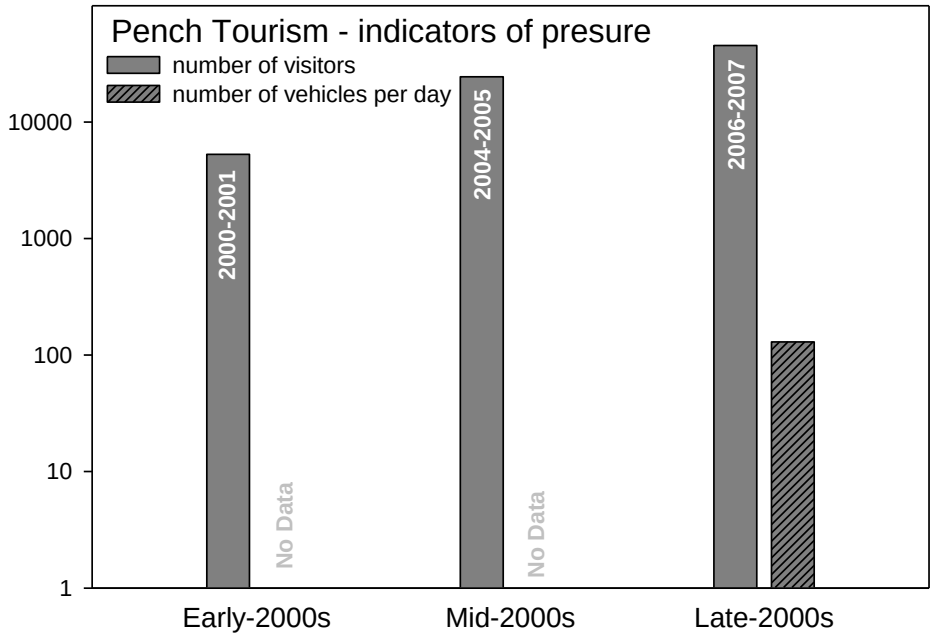


Figure 2b. Threats and pressures in Pench Tiger Reserve.

Data analysis and discussion at Pench Tiger Reserve, Credit: Mark Zimsky

27. For Buxa and Palamau, we did not have as comprehensive of a data set but we were still able to assess, in a limited manner, data on species populations and threat reductions and pressures using the available data primarily through the MEE 2006 and 2011 and the publication "Status of Tigers, Co-predators and Prey in India, 2010".

28. For Buxa, we observed an increase in the trend of biodiversity condition (+1), with an increased threat profile (-1). This trend was inferred from the PAME scores provided in the MEE on threats, biodiversity conditions and the associated explanations provided by the independent evaluators. We also noted a significant drop of 20% in PAME scores for Buxa since the close of the GEF project, from 83% to 63%. We noted that in Buxa, the last MEE undertaken in 2011 indicated that 80% of its management costs were covered by the State. Thus, the increased threat profile is likely not due in this case to insufficient budget (and reduced inputs), but rather, as noted in the MEE, intense population pressure by surrounding villages and tea gardens.

29. For Palamau, we observed a decrease in biodiversity condition (-1) and an increased threat profile (-1). This trend was inferred from the PAME scores provided in the MEE on threats, biodiversity conditions and the associated explanations provided by the independent evaluators. We also noted an accompanying drop in PAME score from 76% at the end of the GEF project to 38% in 2011. This drop is largely due to the geographical location of the Palamau Tiger Reserve where naxalism is a key threat resulting in 40% of the management area being out of control of the PA management authority as noted in the MEE 2011. In this case, PAME scores appear to be an accurate assessment of biodiversity status and threat condition.

30. In the Zambia Mission, we had 11 observations, which was sufficient to run correlations and a regression analysis using the ordered outcome of increase, stable, decrease. But in the India Mission we only have 4 observations, which makes detecting a true correlation separate from sampling error more difficult. The estimated Spearman correlation between change in METT scores and biodiversity trends over the period 2001 to 2011 is positive and large at 0.78, but we cannot estimate it very precisely (in other words we cannot say that it's statistically different from zero at conventional statistical significance levels like $p<0.10$ ➔ the p-value is 0.23). The estimated Spearman correlation between changes in METT scores and threat reduction over the same period is also positive and large at 0.89 ($p=0.11$).

31. In the Zambia Mission, we observed a strong positive correlation between the score from the outcome question and the cumulative scores from the input and output questions. A positive correlation is consistent with the hypothesis that the input and output questions are identifying inputs and outputs that are relevant to achieving outcomes. If we discard 2001 and 2002 data from the India data, which are zeroes for the outcomes for all parks, we see the same pattern: there is a strong positive correlation between the score from the outcome question and the cumulative scores from the input and output questions (0.61); which is statistically different from zero at $p=0.012$.

32. In the Zambia Mission we noted that there is a negative correlation between the change in the METT performance values and the starting METT score (i.e. the higher the starting score, the less increase in score observed.) We note the same phenomenon in India. There is a negative correlation (-.054) between the 2001-2011 change in the METT score and the 2001 METT score (i.e., the higher the starting score, the less increase in score observed). However, with only four

observations, we cannot estimate this correlation with much precision (i.e., we are not able to reject the null hypothesis of zero correlation at conventional levels of statistical significance).

33. Our results suggest correlations, but cannot be interpreted as causal relationships. However, observations and interviews conducted in Pench and Periyar Tiger Reserve indicate that the investments and subsequent maintenance of park budgets after the GEF-Ecodevelopment Project resulted in consistent staffing, patrolling, and community engagement necessary for the management of each reserve thus suggesting a causal relationship between improvements in biodiversity condition and status and increasing effort at anti-poaching patrols and constructive engagement with the Ecodevelopment Committees (EDCs) even when the EDCs occasionally have suffered income loss. The value of the EDCs as "social fences" for the Tiger Reserves was mentioned as part of the reason for this success and this should be more carefully analyzed and documented, but was beyond the scope of this case study. The term "social fences" refers to the function that EDCs play in protected area management. The EDCs come from local communities surrounding the parks and are engaged in biodiversity-friendly activities supportive of protected area objectives and EDCs often have stopped engaging in extractive activities that were negatively impacting biodiversity. Furthermore, protected area staff have often engaged the EDCs as champions of the protected area. All of these functions of the EDCs result in their functioning as "social fences" that serve to protect biodiversity through their social commitment to the conservation goals of the protected areas.

34. The suggested correlation is supported by our analysis of threat and pressure reduction data in both reserves and the arrest trends in the patrol data (Figure 3a and 3b, and Annex 3), which would be affected by the inputs that have changed over time. For both Pench and Periyar, extensive staff resources have been invested in improving all aspects of management, including patrolling, over the decade that was analyzed. Data provided demonstrates a steady reduction in the threat profile in each reserve and a stable or increasing tiger population (whether by number or density) and associated prey numbers and density.

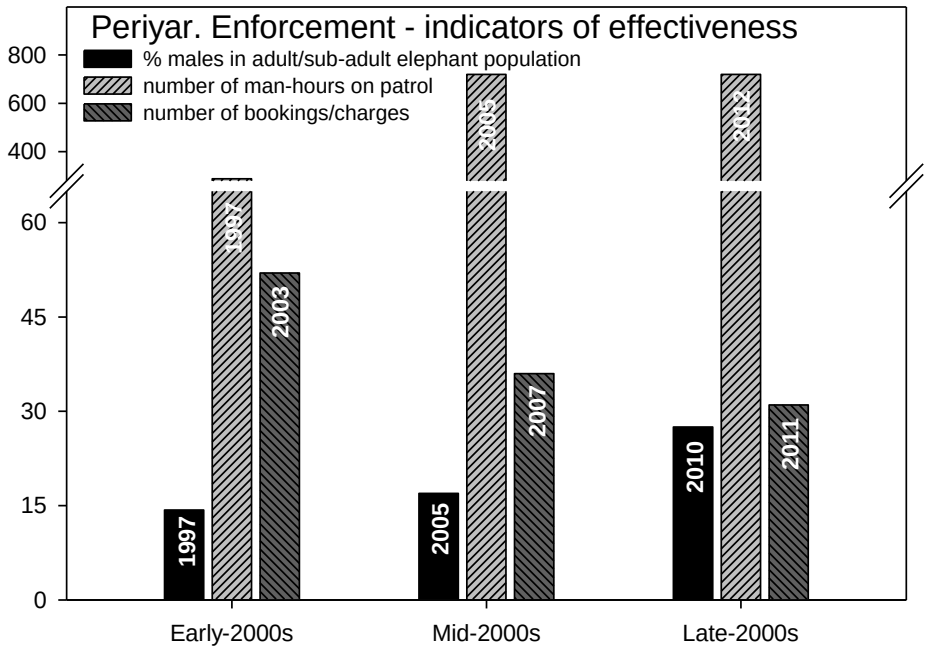


Figure 3a. Selected indicators of enforcement and enforcement-effectiveness in Periyar Tiger Reserve.

Indian Otter, Periyar Tiger Reserve, Credit: Anupam Joshi

Hanuman Langur, Pench Tiger Reserve, Credit: Anupam Joshi

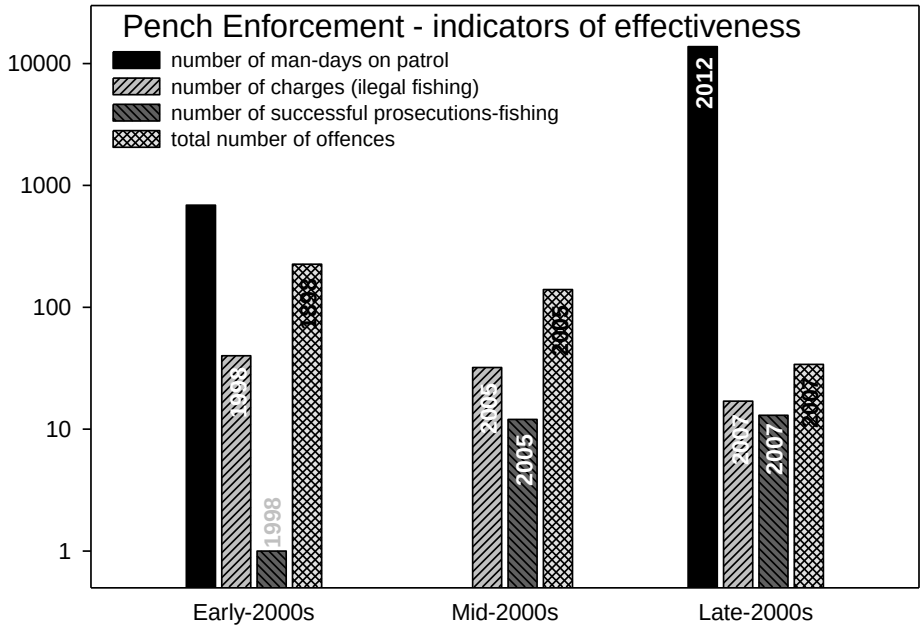


Figure 3b. Selected indicators of enforcement and enforcement-effectiveness in Pench Tiger Reserve.

Summary of Mission Findings and Discussion

35. The mission findings are presented below and grouped under each of the guiding questions of the mission:

    - Question One: Does protected area management effectiveness accurately reflect biodiversity status and project impact in protected areas?

    - Question Two: Are increases in protected area management effectiveness scores attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool (METT)/Management Effectiveness Evaluation (MEE)?

    - Question Three: Is achievement of project outcomes and impact attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool/Management Effectiveness Evaluation?

36. Finding One: An increase in the METT performance measure is positively correlated with changes in biodiversity condition and a reduction in threat profile. This finding is consistent with the findings from the Zambia case study.

37. The data we gathered (an exhaustive set of data on biodiversity status, pressure and management response) for the two reserves we visited demonstrated that the METT and MEE scores and the condition of biodiversity was trending upward while threats and pressures were being reduced. (See Annex 3).

38. Within Pench and Periyar Tiger Reserves (see Annex 4), the extent of canopy cover (a presumably positive biodiversity condition and a sign of effective management) and the number of fire events and extent of burnt areas (a presumably negative indicator of biodiversity condition and a sign of poor management) were analyzed as quantitative proxy indicators of biodiversity condition and compared against management effectiveness scores recorded in Pench and Periyar Tiger Reserves between 2000-2010.

39. Canopy cover, as measured by MODIS, in Pench National Park was stable between 2000 and 2005 (PAME scores increased from 37% to 63% in this time period), and then canopy cover as measured by MODIS "decreased" during the second half of the decade (PAME scores increased from 63% to 88% during this time period). The decrease in canopy cover occurred not only inside the Park but across the region due to a significant reduction in annual rainfall. Hence the reduction in canopy cover as reported in MODIS was *not* attributable to a reduction in forest cover (increased deforestation) as a result of illegal logging and ineffective management (as could be mistakenly interpreted without ground-truthing) but, rather, a measurement of drought stress that trees in the region were undergoing due to the dry conditions during the second half of the decade. This drought stress manifested in standing deciduous trees not leafing out when they normally would have which resulted in a reading by MODIS of decreased canopy cover. However, the biodiversity data during this period demonstrated stability in some

components of biodiversity and increases in others (see Annex 3). Overall, PAME scores over the ten-year period increased 51%, from 37 to 88%.

40. Canopy cover, as measured by MODIS, remained stable in Periyar Tiger Reserve between 2000 and 2010. This stability was consistent with management effectiveness scores over the same ten-year period which increased 43%, from 37% to 80%.

41. Overall, the PAME scores in these two Tiger Reserves were an accurate reflection of biodiversity condition of the forests within each Tiger Reserve as forest cover remained stable, given environmental conditions in the respective region where each reserve is located.

42. Fire events occurred in both Pench and Periyar. Ground-truthing of the MODIS images showed that many of the fires detected remotely were in fact induced as part of reserve management. Protected area managers seek to maintain grasslands that provide habitat for small and large herbivores (ungulates mainly), some of which are key prey species for tigers. Burnt areas were larger in Periyar than in Pench, because open grasslands and degraded deciduous forests where the fires take place occupy a larger area in Periyar than in Pench. Fires in Pench are restricted to the "fire breaks" along the extensive road network within the Park. Hence, given that inducing fires was a PA management policy, the presence of fires can be eliminated as an indicator of ineffective management. (See Annex 4 for full explanation.)

43. Finding Two: Initial donor investments, by virtue of focusing on inputs, will almost always push METT/MEE scores up. This finding is consistent with the findings from the Zambia case study.

44. The India Ecodevelopment Project provided an increase in funding in Buxa, Palamau, Pench and Periyar, and since the METT/MEE score is so dependent on inputs (between 64% to 70% of the total PAME score) the scores rose. Our analysis at Pench with regards to annual budget showed a steady flow of resources to the reserve which maintained and sometimes increased the management budget above what was provided during the GEF Ecodevelopment project (See Annex 5). In Periyar, the role of EDCs as part of an ongoing input to management was also observed to be critical to maintain high METT scores. With regards to budget in Periyar after the GEF project closed, we did not observe as linear of a relationship in terms of a budget increase as we saw in Pench (See Annex 5), and in fact we observed a sharp drop and then an increase in the reserve budget to levels almost equivalent to the end of the GEF project. Although EDCs were active in both reserves, we observed a particularly dynamic and economically productive set of EDCs in Periyar. However, written documentation of the EDCs activities in Pench indicates an equally robust participation by EDCs around that reserve. Future missions should more closely analyze post-GEF project budget inputs to better assess how stable METT scores are post-GEF investment and to identify the strategies that protected areas employ to maintain PAME performance. In India, the engagement of EDCs by park management reduced a driver of biodiversity loss thus likely reducing management costs over time as the EDCs became an ally for park management. However, a more rigorous analysis beyond the scope of this mission would have to be conducted to assess the economic benefit the engagement of the EDCs provided directly with regards to increasing or reducing park management expenditure.

45. Noticably, MEE scores in Buxa and Palamau dropped considerably after the GEF project closed. Detailed data on budget allocations to these two parks after the GEF project closed were not available. However, we noted that in Buxa budget for reserve management is currently not an

issue as 80% of the reserve's management budget is being provided by the state per the 2011 MEE analysis. The drop in the Buxa PAME score was attributed to intense resource use pressures exhibited by surrounding villages and tea gardens.

46. Finding Three: The METT/MEE does not fully assess the park's external environment from both a biological and socio-economic perspective and these external factors can impact the PAME scores in a positive or negative way. This finding is consistent with the findings from the Zambia case study.

47. This was particularly important in India given the smaller size of the protected areas and the intense land-use pressure external to many parks and the need for PA managers to think about management from the outside-in to maintain biodiversity values. EDCs obviously play a key role in this regard in India. Although this was noted as important in both Pench and Periyar, it was particularly noticeable during the Periyar site visit. In addition, the socio-economic backdrop within which the protected area is situated is not picked up the METT/MEE and this can have a positive influence in reducing threats. In India, some of these external factors included the increased GDP nationally and locally, growth of service sector and other livelihood options, government subsidy schemes for energy, welfare schemes etc. In addition, pressures created by infrastructure developments may bring additional threats to the PA beyond the control of the manager, and negatively impact PAME but not be recorded in the METT/MEE. While trying to balance the objective of having a simple performance metric for PAME and the need to present an accurate picture of the management context, GEF will have to consider if there is a way to uncover this context and monitor it through the METT or at least reflect its existence and influence on the PAME score.

Sambar in Pench Tiger Reserve, Credit: Anupam Joshi

- *What are the strengths and weaknesses of the METT based on the Indian experience?*

48. The following strengths and weaknesses were identified during the mission. (Note: For the most part strengths and weaknesses identified in Zambia held true for the India mission. In this section, we aim to focus on the rationale of the confirmation of some of the most important findings that were consistent with the Zambia mission.)

Strengths

49. Finding Four: Consistent with our finding in Zambia, the tool (whether it be the initial METT applied in the Ecodevelopment Project or the more refined MEE now being applied in India) is simple to apply, easy to understand, and allows for easy aggregation and analysis.

50. Finding Five: Consistent with our finding in Zambia, most experts interviewed agreed that the key elements of protected area management effectiveness at site level were indeed being tracked in the METT and that the tool was a valid performance metric. However, the fact that authorities in India – as we noted in Zambia—chose to use the METT as the jumping off point to develop a more robust METT is an acknowledgement of the inherent weaknesses of the METT.

51. Finding Six: The strength in how PAME is assessed in India are: 1) the refinements made to the METT questions which are more sophisticated and context-specific in the India MEE; and 2) the approach developed for its implementation including:
    a) training and orientation and detailed guidelines for all participants in the process which ensured a consistent technical rigor on the part of all stakeholders;
    b) an agreed protocol established and applied ensuring uniformity of application of the scorecard;
    c) technically qualified biologists were trained as independent evaluators to apply the MEE; and
    d) altering the METT to be more robust in terms of quantitative analysis and emphasizing the support of qualitative scores with quantitative data.

Weaknesses

52. Finding Seven: In the Indian context, given the fact that Tiger Reserves and protected areas existing within intensively used landscape mosaics, the failure of the METT to capture land-use activities and pressures outside the protected area as well as economic development in general was identified as a weakness of the METT. The team noted the importance of not burdening the METT to deliver more than can be expected from a basic performance management scorecard while recognizing the need to contextualize the METT score within the external reality of the PA, particularly in the PA management context in India.

53. Finding Eight: Although the Indian MEE is an improvement on the METT with regards to specific outcome questions and threat responses, the area of quantitative analysis or data support for qualitative scoring remains a potential weakness. The team noted that in some MEE data sheets, data support for qualitative questions was quite robust but for other MEE data sheets, it could be absent or anecdotal in nature. Ensuring consistency of application of an improved and more robust METT will remain a challenge.

Tiger sleeping at Pench Tiger Reserve, Credit: Anupam Joshi

- *How might the METT be improved for use by the GEF?*

54. Finding Nine: The utility of providing more concrete guidance in completing the METT, along with orientation and training on how to complete the METT and GEF Tracking Tools in general was made apparent during the India mission and the methodological approach for implementation that was observed. By the start of GEF-5, GEFSEC should develop more detailed guidance and assess the options for training agency staff on how to complete the tools through a webinar or some other means.

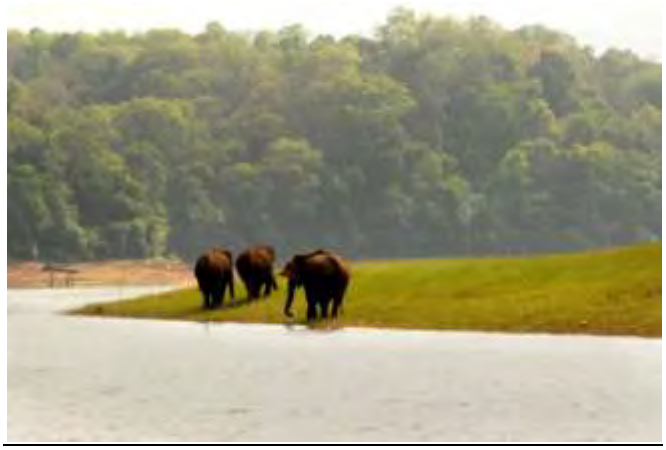
55. Finding Ten: The GEF needs to identify an approach, analogous to what was observed in India, which would allow for more independent completion of the METT and all GEF tracking tools for that matter. The current system is fraught with conflict-of-interest. Prior to this recommendation becoming reality, the METT—and all GEF tracking tools for biodiversity—must be edited to ensure that qualitative scoring is supported by quantitative data or supporting documentation in order to limit the current subjectivity implicit in a scorecard approach. This new methodology should also draw on the "adversarial collaboration" approach first recommended after the Zambia mission and try to apply it within the GEF context. This kind of adversarial collaboration may increase PA performance across the entire PA system if the METT is systematically applied as it increases competition and provides strong social incentives for increased performance. If linked with performance incentives for staff it could prove a powerful tool for improving PAME. Finally, for GEF-6, consideration must be given to supporting countries to systematically apply the METT country-wide in order to derive the maximum potential benefit from the METT as described herein. [3]

56. Finding Eleven: The Indian MEE improves the analysis of outcomes and threats when compared to the METT currently in use by the GEF, however, our experience in Pench and Periyar indicates that one could actually go further in terms of PAME scorecard improvement. In the GEF context

[3] Adversarial collaboration refers to the peer review process employed in Zambia where protected area managers throughout the country were brought together to assess the PAME scores across the entire system and discuss and analyze the veracity of the scoring based on expert opinion.

and in our work to improve the METT, we will examine the inclusion of one additional data sheet that focuses on biodiversity status (building on Zambia finding) but that also requires reporting on pressure and response indicators as not only is this data easier to monitor and record we have consistently observed that it has been shown to particularly critical in enhancing PAME and correlates directly with biodiversity outcomes. Both Pench and Periyar, had considerable amounts of reliable data on these elements of the reserves respective management frameworks. Hence, a revised METT would require targeted objective data on pressure-response that most Protected Areas should be monitoring. Thus we found considerable supporting evidence for our conclusions in Zambia that we need to improve the analysis of biodiversity values and conservation outcomes within the METT to be more precise and require that biodiversity status be justified by biodiversity data being collected by the project along with threat/pressure and response data.

Elephants at Periyar Tiger Reserve, Credit: Anupam Joshi



Spotted Dear, Pench Tiger Reserve, Credit: Anupam Joshi

Other Key Findings Consistent With the Zambia Mission

57. Finding Twelve: Monitoring biodiversity status in terms of species populations and trends may not be a cost-effective way to measure the outcomes and impact of a GEF project over its lifetime given population variability between sampling dates and other sampling challenges. In India, tiger sampling techniques changed from the pugmark method to more sophisticated sampling techniques relying on camera traps. Thus tiger population data are considered more reliable when the new techniques are applied. From 2006 onward this agreed and improved methodology is in place and a baseline established for both tiger populations and prey populations. Hence, as part of our analysis, we complemented the wildlife data with an analysis of pressure reduction on biodiversity and response measures of management to reduce threats. For Pench and Periyar in particular, data on threats and their status over time, enforcement data with regards to patrolling and preventing poaching, were both available and were quite detailed and came with no methodological issues. In addition, data on vegetation cover and fires and extent of fires were also easily available with reasonable costs for analysis.

58. These proxy indicators and the collection of data related to them were more reliable and this supports findings that we made during our mission to Zambia. As noted previously, although it is easy to imagine how threats could decline in the absence of a change in biodiversity status, it's harder to imagine how biodiversity outcomes could improve without a decline in threats. Thus, we must reiterate to GEF project developers that even at PIF stage, pressure, state and response measures should be part of each project logframe for protected area projects that are seeking to improve management effectiveness and that these indicators must be seen as required complements to the METT scorecard. Some projects are now taking this approach as evidenced by PIF project frameworks in GEF-5, but it must be more uniform across the portfolio.

Additional Findings Not Specific to the Mission Guiding Questions

59. Finding Thirteen: With the introduction of the MEE and the strategy for its application, India eliminated the possibility of strategic incentives to alter the MEE scores to meet goals other than to provide an objective view of management effectiveness. It is worth noting that MEE data is reported to parliament thus a rigorous process was required. The approach developed and its elements were key:
    a) training manuals were developed for all participants in the process;
    b) an agreed protocol was established and applied ensuring uniformity of application;
    c) technically qualified biologists were trained as independent evaluators to apply the MEE and this is likely the most critical ingredient to reducing strategic incentives to alter or rig the scores;
    d) park staff were also trained and received an orientation on the process and their expected contributions as key informants; and
    e) altering the MEE slightly to be more robust in terms of quantitative analysis and emphasizing the support of qualitative scores with quantitative data.

    These elements are critical to the usefulness of the MEE in India and the GEF will carefully review their application and suggest adoption of a similar approach with some amendment for the GEF context. Although not perfect, this systematic approach to the MEE application is quite

robust, although the additional cost implied with this methodology may be too large of a burden for widespread application. We think a combination of the Zambia implementation approach (particularly adversarial collaboration) with the approach used in India will improve the utility of the tool in the GEF context dramatically. We noted, however, that the use of supporting data for the qualitative scores varied considerably between the reserves with some evaluators very specifically citing source documentation and objective data as the rationale for their scoring in the MEE. Other evaluators were more anecdotal in their approach. This aspect will likely be the biggest challenge for the GEF in the application of an enhanced METT as part of project and portfolio monitoring.

60. Finding Fourteen: Outputs and outcomes from the India Ecodevelopment project in the two parks we visited appear to be sustained due to the persistence of the EDCs that were established during the project and also due to adequate budget being provided to the two parks post-project. This was particularly evident in Periyar, where members of some EDCs have accepted income reductions as the economic contribution to household incomes through harvesting of forest resources has been reduced given the efforts of the project to redirect their economic activity towards more biodiversity-friendly economic activities. These EDCs have maintained a pro-conservation outlook towards the reserve and voluntarily reduced their dependency on its forest resources in favor of conservation. It remains to be seen how long this will be maintained without the development of other household revenue streams but it was a startling observation that runs counter to much of the development literature. Clearly, the EDCs maintain a high interest in receiving an increased flow of financial resources from the protected area through sharing of tourism benefits, employment in the park, etc and some examples of this were noted during the field visit. In addition, for many EDCs engagement in illegal activities (such as forest resources extraction) also carries a negative social stigma and is extremely arduous thus providing additional incentive to seek more acceptable means of income generation. We also observed one EDC that was engaged in economically viable organic agriculture demonstrating the potential of the parks to maintain engagement with EDCs in a positive manner, post-project. These are both anecdotal findings and observations that merit more in-depth study and analysis on the conditions that have been necessary for the successful engagement of the EDCs after the GEF project has ended.

61. Finding Fifteen: Particularly in parks where wildlife is the component of biodiversity that is the conservation objective of the park, the park's design (size, siting, surrounding habitat, etc.) and the ecosystem's carrying capacity can have a marked impact on the ability of the PA staff to "improve" biodiversity condition if measured by sheer numbers. Hence, maintenance of population densities of certain species (as opposed to pure numbers) and even small reductions in densities may actually be a successful performance, thus additional data sheets may be able to account for these nuances in interpreting METT scores. GEF needs to take note of this in the PIF stage and onward when analyzing biodiversity condition indicators in the project logframes.

62. Finding Sixteen: We observed that in the case of tiger reserves, that there may be a delay in measuring the response of management efforts to tiger populations/density, thus in the GEF context, over the course of a 5-year project, the role of pressure and response indicators become ever more important in wildlife-focused protected areas.

63. Finding Seventeen: Analysis of MODIS data for forest and vegetation cover requires careful ground-truthing in order to ensure that remote interpretation is reliable. Without ground-

truthing of the MODIS data for Pench and Periyar, it would have been easy to mistakenly conclude extensive unplanned fire and deforestation within the parks. As GEF considers using satellite imagery for measuring portfolio impacts (eg., habitat fragmentation within and outside of protected areas) of the GEF-4 and 5 portfolios, a viable methodology will have to be developed to ground-truth satellite imagery in a large enough sample for assessing portfolio impact and measuring impact indicators developed for the biodiversity strategy.

64. Finding Eighteen: In Periyar, the Periyar Foundation proved to be an important source of supporting technical capacity and resources to maintain some of the alternative-income initiatives that were started under the Ecodevelopment project and which have resulted in positive contributions to the MEE scores.

65. Finding Nineteen: As GEF has seen in other regions, India has invested considerable effort into managing protected areas from the "outside-in" through creative engagement with the EDCs as "social fences"—a conceptualization that was introduced to the mission by our Indian counterparts. A key challenge for sustainability is ensuring that the "fences" do not collapse post-project investment. This approach is analogous to the mosaic approach to PA management being implemented by the WB through a GEF project in Colombia, where PA authorities are spending considerable effort on managing the protected areas from outside-in.

Meeting with EDC that guides tourists at Periyar Tiger Reserve, Credit: Mark Zimsky

Annex 1. Key Informant Interviews

4th April: Project Tiger

1. Dr.Rajesh Gopal, Member Secretary, National Tiger Conservation Authority
2. Mr.H.S.Negi, Deputy Inspector General of Forests, National Tiger Conservation Authority
3. Mr.S.P.Yadav, Deputy Inspector General of Forests, National Tiger Conservation Authority

4th April: MoEF

1. Mr.Hem Pande, Joint Secretary and GEF OFP
2. Dr.Nayanika Singh, GEF Consultant

5th April: Wildlife Institute of India, Dehradun

1. Mr.P.R.Sinha, Director, WII
2. Dr.V.B.Mathur, Dean, WII
3. Mr.V.K.Uniyal, Faculty, WII,
4. Dr.Asha Rajamanshi, Faculty, WII
5. Dr.Sathya Kumar, Faculty, WII
6. Mr.Bilal, Faculty, WII

6-8th April: Pench Tiger Reserve

1. Mr.Alok Kumar, Field Director, Pench
2. Mr.Tiwari, Deputy Director, Pench

9-11th April: Periyar Tiger Reserve

1. Mr.V.Gopinathan, Chief Wildlife Warden, Kerala,
2. Mr.Subramanyam, Field Director, Periyar
3. Mr.Sanajyan Kumar, Deputy Director, Periyar East
4. Mr.B.Joseph, Assistant Field Director, Periyar
5. Mr.Suresh, Deputy Director, Periyar West
6. Mr.Abdul Bashir, Divisional Manager, KFDC
7. Dr.Balasubramanyam, Conservation Biologist, Periyar Foundation

ANNEX 2. METT and MEE Data Analysis

All values are percentage of total points available that the protected area scores on tracking tool (96 for METT, 185 for 2006 MEE, and 300 for 2011 MEE India)
GEF Project refers to whether this was a site of WB GEF India Ecodevelopment Project

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011	Project?	Qualitative Trend of Biodiversity Condition	Source for Biodiversity Condition	Threat reduction	Source for threat reduction
Periyar Tiger Reserve	36.8%	41.05%	69.5%	63.2%	69%	80.0%	43.2%	Y	1	Data sheet, all sourced, see Annex 3	1	Data sheet, all sourced, See Annex 3
Pench Tiger Reserve	35.8%	46.3%	63.2%	63.2%	77.8%	88.3%	52.5%	Y	1	Data sheet, all sourced, see Annex 3	1	Data sheet, all sourced, See Annex 3
Buxa Tiger Reserve	53.1%	45.8%	47.9%	83.3%	67.0%	63.3%	10.2%	Y	1	MEE 2006 and 2011 and Status of Tigers, Co-predators and Prey in India, 2010	-1	MEE 2006 and 2011
Palamau Tiger Reserve	38.5%	45.8%	69.8%	76.0%	76.2%	38.3%	-0.2%	Y	-1	MEE 2006 and 2011 and Status of Tigers, Co-predators and Prey in India, 2010	-1	MEE 2006 and 2011
MEAN SCORES	41.1%	44.8%	62.6%	71.4%	72.4%	67.5%	26.4%					

NOTES:
Note: Key--BD condition of 1 is increase, 0 is stable, -1 is decrease. Threat reduction of 1 is threat reduced, 0 is stable, -1 is threat increased.
Intensive field visits were carried out in Pench TR and Periyar TR.
All scores from 2001, 2002, 2003 and 2004 are from World Bank/GEF Ecodevelopment project exercise using METT
Buxa Reserve first score is from 2000
Blanks in the scorecards from 2001 and 2002 were assumed to be zeros unless logically this was not possible. This was a minor issue overall in terms of impact on scoring.
2006 data is taken from a 45-question scorecard that was a transtion monitoring tool between the application of the METT and the Indian MEE. This tool allocates points in a ratio that is consistent with the METT and the MEE. Within the 45 question tool, inputs account for 70% of the score, outputs for 24% of the score, and outcomes 6% of the score.

75%	of protected areas increased score by averag	26.4%	percentage points

All values are scores on the outcome question from the tracking tool (1 question for METT or 3/96 points, 4 questions for 2006 transition MEE or 12/185, 2 questions or 20/300 for India MEE). Although the India MEE has four outcome questions, only two deal directly with biodiversity status. Since the METT score rank is 0-3 and the India MEE is 2.5-10 we have entered this as a percentage.

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011	Key Outcome and Threat Data per METT forms
Periyar Tiger Reserve	0.0%	0.0%	66.7%	66.7%	83.3%	75.0%	75.0%	Key Species: "rare, endangedered and endemic plants and animals", key threat: incursions, mega projects--damns and roads"
Pench Tiger Reserve	0.0%	0.0%	100.0%	100.0%	75.0%	100.0%	100.0%	Key Species: "ecosystem conservation", key threat: IAS-Lantana and Parthenium threatening habitat of large predator-prey
Buxa Tiger Reserve	0.0%	0.0%	0.0%	66.7%	50.0%	50.0%	50.0%	Key Species: "tiger and prey base", Key threats: humans and cattle residing in south of PA
Palamau Tiger Reserve	0.0%	0.0%	66.7%	66.7%	91.7%	25.0%	25.0%	Key Species: "tiger and other wildlife", Key threats: humans and cattle
MEAN SCORES	0.0	0.0	58.3%	75.0%	75.0%	62.5%	62.5%	

100%	of protected areas increased score by average	62.5%	percentage points

All values are percentage of total points available that the protected area scores on INPUTS from tracking tool (61/96 for METT and, 128/185 for transition MEE, and 210/300 for India MEE-Zimsky assigned input classification to MEE).

"Inputs" as defined by Nik Sekhran and Mark Zimsky, not by METT categories. You can think of this as METT scores with Outputs and Outcomes set to zero.

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011
Periyar Tiger Reserve	23.0%	51.6%	68.9%	73.8%	**66.4%**	82.1%	**59.2%**
Pench Tiger Reserve	31.1%	27.9%	60.7%	60.7%	77.3%	84.5%	53.4%
Buxa Tiger Reserve	47.5%	44.3%	45.9%	80.3%	67.6%	66.7%	19.1%
Palamau Tiger Reserve	27.9%	36.1%	65.6%	67.2%	72.7%	34.5%	6.7%
MEAN SCORES	32.4%	40.0%	60.2%	70.5%	71.0%	67.0%	34.6%

100% of protected areas increased score by average 34.6% percentage points

All values are percentage of total points generated that arise from INPUTS from tracking tool.

"Inputs" as defined by Nik Sekhran and Mark Zimsky, not by METT categories. So 50% for a PA would mean that 50% of its score comes from input questions.

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011
Periyar Tiger Reserve	14.6%	16.7%	43.8%	46.9%	**45.9%**	57.5%	**42.9%**
Pench Tiger Reserve	19.8%	17.7%	38.5%	38.5%	53.5%	59.2%	39.4%
Buxa Tiger Reserve	30.2%	28.1%	29.2%	51.0%	46.8%	46.7%	20.8%
Palamau Tiger Reserve	17.7%	22.9%	41.7%	42.7%	50.3%	24.2%	25.0%
MEAN SCORES	20.6%	21.4%	38.3%	44.8%	49.1%	46.9%	32.0%

0% of protected areas decreased contrib from inputs

All values are percentage of total points available that the protected area scores on Outputs from tracking tool (32 for METT, 45 for transition MEE, and 70 for MEE-Zimsky assigned output classification for the MEE).
"Outputs" as defined by Nik Sekhran and Mark Zimsky, not by METT categories. You can think of this as METT scores with Inputs and Outcomes set to zero.

Protected Area	2001	2002	2003	2004	2006	2011	2001-2011	Populations	Source of Population Status Assessment (Expert opinion and/or data)
Periyar Tiger Reserve	**65.6%**	**68.8%**	**71.9%**	**75.0%**	**71.1%**	**75.0%**	**9.4%**	Increase	Data
Pench Tiger Reserve	46.9%	53.1%	62.5%	62.5%	75.6%	96.4%	49.6%	Increase	Data
Buxa Tiger Reserve	62.5%	53.1%	56.3%	84.4%	70.0%	53.6%	-8.9%	Increase	Data
Palamau Tiger Reserve	62.5%	68.8%	78.1%	84.4%	77.8%	39.3%	-23.2%	Decrease	Data
MEAN SCORES	59.4%	60.9%	67.2%	76.6%	73.6%	66.1%	6.7%		

Change in output score	Populations
75.0%	Increase
49.6%	Increase
-8.9%	Increase
-23.2%	Decrease

50% of protected areas increased score by average 6.7% percentage points

Annex 3. Periyar and Pench Data Tables: Biodiversity Condition, Threat Reduction, Response and Enforcement Data

Periyar Tiger Reserve			
Basic Information			
Name	Periyar Tiger Reserve		
Total Size (ha)	92,500		
Core (ha)	88,100		
Buffer (ha)	4,400		
Location	Kerala State; Idukki, Kottayam and Pathanamthitta Districts		
Longitude	76° 56' 12.12" to 77° 25' 5.52" E		
Latitude	9° 17' 56.04" to 9° 37' 10.2" N		
Year of Establishment	1978-1979		
Management Authority	Forests and Wildlife Department		
Number of Permanent Staff	245		
Ecosystem Type(s)	lake, marshes, grasslands, moist deciduous and evergreen forests		
Indicator and Description	**early 2000s**	**mid-2000s**	**late 2000s**
Forest Cover - density at the landscape level as indicator of PA connectivity (ha) [2003[1] and 2009[2]]			
Idukki District (total forest cover)	**371,900**		**393,200**
10% - 40% cover	124,000		142,200
40% - 70% cover	244,200		216,000
> 70% cover	3,700		35,000
Kottayam District (total forest)	**29,500**		**89,500**
10% - 40% cover	11,000		33,600
40% - 70% cover	18,500		54,600
> 70% cover	0		1,300
Pathanamthitta District (total forest)	**154,300**		**175,800**
10% - 40% cover	37,100		46,500
40% - 70% cover	117,200		114,900
> 70% cover	0		14,400
Forest Degradation - relevant indicators, defined below, of pressures internal to PA			
number of cattle in the TR[3]	800 [1997]	284 [2007]	382 [2012]
fuelwood collected per yr (kg)[3]	11,250,250 [1997]	3,314,510 [2007]	2,710,150 [2012]
self-use per yr (kg)	8,601,770 [1997]	2,672,520 [2007]	2,185,150 [2012]
sale per yr (kg)	2,648,480 [1997]	641,990 [2007]	525,000 [2012]
thatching grass (kg) [3]	345,890 [1997]	633,470 [2007]	497,400 [2012]
collection of cinnamon bark (kg) [3]	30,140 [1997]	0 [2007]	0 [2012]
collection of black dammar (kg) [3]	57,070 [1997]	3,050 [2007]	0 [2012]

Wildlife - population estimates			
Tiger [4], [5]	[data not accurate]	23 [2006]	30 [2010]
Adult tiger density (per 100 sq.km.) [6], [7]	[data not accurate]	3.88 [2008]	5.41 [2011]
Elephant density (per sq.km.) [8] [9] [10]	0.72 [1997]	1.28 [2007]	1.19 [2010]
Tourism, Waste and Other Pressures			
number of visitors [11]	340,933 [2000-01]	440,929 [2005-06]	534,553 [2009-10]
to core [12]	8,000	12,000	10,000
to Sabarimala temple [12]	4,500,000	5,500,000	1,000,000
firewood (kg) collected by pilgrims [3]	2,012,000 [1997]	946,000 [2007]	825,000 [2012]
plastic in elephant dung (nos.)[3]	162 [2000]	148 [2004]	73 [2012]
honey collection (kg)[3]	10,300 [1997]	910 [2007]	920 [2012]
fishing in lake (tonnes)[3]	188.24 [1997]	93.70 [2007]	19.7 [2012]
self-use per yr (tonnes)	53.02 [1997]	15.30 [2007]	6.40 [2012]
sale per yr (tonnes)	135.22 [1997]	78.40 [2007]	13.30 [2012]
Enforcement - indicators of effectiveness			
% males in adult/sub-adult elephant population (indicates poaching) [8] [9] [10]	14.3 [1997]	16.95 [2005]	27.4 [2010]
number of man-hours on patrol	288,000 [1997]	720,000 [2005]	720,000 [2012]
number of bookings/charges [13]	52 [2003]	36 [2007]	31 [2011]
rate of successful prosecutions (%) [14]	40	66	30*

[1] Forest Survey of India's "State of Forest Report 2003" http://www.fsi.org.in/sfr_2003.htm

[2] Forest Survey of India's "State of Forest Report 2009" http://www.fsi.org.in/sfr_2009.htm

[3] Balasubramanian, M. and Veeramani, A. 2012. Ecodevelopment in Periyar Tiger Reserve: An Assessment of Resource Dependency and Ecological Impact of Local Community. A Report of Periyar Foundation.

[4] Status of Tigers, Co-Predators and Prey in India, 2008 (2006 data), p. 93

[5] Status of Tigers, Co-Predators and Prey in India, 2011 (2010 data), p. 133

[6] Balasubramanian, M. and Veeramani, A. 2009. Estimation and Monitoring of Tiger (Panthera tigris) Population in Periyar Tiger Reserve. In: the Proceedings of the National Seminar on People and Tigers: Shifting Trajectories of Ecology and Coexistence. Pp.8-15.

[7] Status of Tigers, Co-Predators and Prey in India, 2010, p. 190

[8] Anon. 1998. Population Estimation of Major Mammals in the Forests of Kerala - 1997. Kerala Forest Research Institute, Peechi and Kerala Forest Department, Thiruvananthapuram.

[9] Sivaram, M., Ramachandran, K.K., Vijayakumaran Nair, P. and Jayson, E.A. 2006. Population Estimation of Wild Elephants in the Elephant Reserves of Kerala State - 2005. Kerala Forests and Wildlife Department, Periyar Foundation and Kerala Forest Research Institute.

[10] Sivaram, M., Ramachandran, K.K., Jayson, E.A. and Vijayakumaran Nair, P. 2011. Wild Elephant Census of Kerala State - 2010. Kerala Forests and Wildlife Department, Periyar Foundation and Kerala Forest Research Institute.

[11] Tiger Conservation Plan for Periyar TR, Appendix 4.11, p. 131

[12] Tiger Conservation Plan for Periyar TR, p. 61 & 70

[13] Tiger Conservation Plan for Periyar TR, Appendix 3.4, p. 82-84 (calculations based on original data)

[14] Tiger Conservation Plan, consultations

***An additional 60% of those 10 cases are under investigation**

Pench Tiger Reserve

Basic Information

Name	Pench Tiger Reserve (MP)
Size (ha)	75,785
Core (ha)	41133, managed by Park
Buffer (ha)	34652, managed by "territorial divisions"
Location	Madhya Pradesh State; Seoni and Chhindwara Districts
Longitude	79° 08' 51" to 790 31' 55" E
Latitude	21° 38' 55" to 210 53' 52" N
Year of Establishment	1992-1993,
Management Authority	Forests and Wildlife Department
Number of Permanent Staff	126 regular forest department staff
Ecosystem Type(s)	Southern dry deciduous, dry teak, and slighly moist teak forests

Indicator and Description	early 2000s	mid-2000s	late 2000s	Comments during field visit
Forest Cover - density at the landscape level as indicator of PA connectivity (ha) [2003[1] and 2009[2]]				
Seoni District (total forest)	**303,800**		**308,400**	Total Area of District: 8750 sq km
10% - 40% cover	138,700		103,100	
40% - 70% cover	141,200		181,200	
> 70% cover	23,900		24,100	

Chhindwara District (total forest)	**440,900**		**453,900**	Chhindwara Distict--total area is 11,895 sq km Regeneration program and reforestation program of native species is reason for increase. This was outside the PA.
10% - 40% cover	183,800		192,000	
40% - 70% cover	236,800		204,400	
> 70% cover	20,300		57,500	
Forest Degradation - relevant indicators, defined below, of pressures internal to PA				
removal of forage by cattle (ton)[3]	90,000 [1998]-Tiger Reserve Management Plan, 2008	20,000 [2005], 15,000 tons removed 2004, WB Intensive Performance Project Review	Zero--source, field director, verified on site, and MEE	Core area is not under any cattle pressure, buffer zone: cattle are permitted to graze and collection of minor forest products is permitted. Drastic reduction is due to better enforcement, improved pasture management, and use of improved breeds, game proof walls.
fuelwood collected per yr (ton)[3]	18,250 [1998] [6]--estimate based on village size times per capita use	1000 tons at 2003[7]	Zero--source, field director, verified on site, and MEE	Introduction of gas, pressure cookers, some fuelwood plantations. Irrigation and improved agriculture. Most people using gas now.
Wildlife - population estimates				
Tiger [4], [5]	[data not accurate]	33, range of 27-39 [2006]	65, range of 53-78 [2010]	
Panther [6]	29 [2001]	39 [2003]	41 [2005]	

Spotted deer [6]	7,583 [2001]	14,548 [2003]	15,389 [2005]
Sambar deer [6]	2,275 [2001]	2,628 [2003]	2,844 [2005]
Gaur [6]	590 [2001]	775 [2003]	727 [2005]
Blue bull [6]	1424 [2001]	1986 [2003]	2170 [2005]
Barking deer [6]	431 [2001]	353 [2003]	202 [2005]
Wild boar [6]	3143 [2001]	3107 [2003]	3374 [2005]
Wild dog [6]	166 [2001[	264 [2003]	266 [2005]
Tourism - indicators of pressure			
number of visitors[7]	5,286 [2000-01]	24,496 [2004-05]	45,566 [2006-07]
number of vehicles	[not available]	[not available]	130 per day
Enforcement - indicators of effectiveness [6]			
number of man-days on patrol	690 man hours/day	[not available]	1380 man hours/day [2012]
number of charges (illegal fishing) [6]	40 [1998]	32 [2005]	17 [2007]
number of successful prosecutions-fishing	1 [1998]	12 [2005]	13 [2007]
total number of offenses	226 [1998]	140 [2005]	34 [2007]

[1] Forest Survey of India's "State of Forest Report 2003" http://www.fsi.org.in/sfr_2003.htm

[2] Forest Survey of India's "State of Forest Report 2009" http://www.fsi.org.in/sfr_2009.htm

[3] Field Director, Pench. From Tiger conservation management plan, 2008,

[4] Status of Tigers, Co-Predators and Prey in India, 2008 (2006 data), p. 56

[5] Status of Tigers, Co-Predators and Prey in India 2010, p. 70

[6] Tiger Conservation Plan for Pench TR and from TR manager during site visit.

[7] Tiger Conservation Plan for Pench TR, Chapter 4, p. 53

Annex 4. Forest Cover, Fire Events and Burnt Areas in Pench and Periyar Tiger Reserves

SUMMARY

Within Pench and Periyar Tiger Reserves, the extent of canopy cover (a presumably positive biodiversity condition and a sign of effective management) and the number of fire events and extent of burnt areas (a presumably negative indicator of biodiversity condition and a sign of poor management) were analyzed as quantitative proxy indicators of biodiversity condition and compared against management effectiveness scores recorded in Pench and Periyar Tiger Reserves between 2000-2010.

Canopy cover, as measured by MODIS, in Pench National Park was stable between 2000 and 2005 (PAME scores increased from 37% to 63% in this time period), and then canopy cover as measured by MODIS "decreased" during the second half of the decade (PAME scores increased from 63% to 88% during this time period). The decrease in canopy cover occurred not only inside the Park but across the region due to a significant reduction in annual rainfall. Hence the reduction in canopy cover as reported in MODIS was not attributable to increased deforestation as a result of ineffective management (as could be mistakenly interpreted without ground-truthing) but rather a measurement of drought stress that trees in the region were undergoing due to the dry conditions during the second half of the decade. This drought stress manifested in standing deciduous trees not leafing out when they normally would have which resulted in a reading by MODIS of decreased canopy cover. However, the biodiversity data during this period demonstrated stability in some components of biodiversity and increases in others. Overall, PAME scores over the ten-year period increased 51%, from 37 to 88%.

Canopy cover, as measured by MODIS, remained stable in Periyar Tiger Reserve between 2000 and 2010. This stability was consistent with management effectiveness scores over the same ten-year period which increased 43%, from 37% to 80%.

Overall, the PAME scores in these two Tiger Reserves were an accurate reflection of biodiversity condition of the forests within each Tiger Reserve as forest cover remained stable, given environmental conditions in the respective region where each reserve is located.

Fire events occurred in both Pench and Periyar. Ground-truthing of the MODIS images showed that many of the fires detected remotely were in fact induced as part of reserve management. Protected area managers seek to maintain grasslands that provide habitat for small and large herbivores (ungulates mainly), some of which are key prey species for tigers. Burnt areas were larger in Periyar than in Pench, because open grasslands and degraded deciduous forests where the fires take place occupy a larger area in Periyar than in Pench. Fires in Pench are restricted to the "fire breaks" along the extensive road network within the Park. Hence, given that inducing fires was a PA management policy, the presence of fires can be eliminated as an indicator of ineffective management.

A final conclusion of the use of this data was the necessity for intensive ground-truthing and interpretation and thus, GEF must exercise caution in the application of satellite imagery for measuring the extent of canopy cover or area burnt/fire disturbance as a proxy for biodiversity condition both at the project and portfolio level.

RESULTS

Biodiversity Indicators

Canopy Cover

In Periyar Tiger Reserve , average canopy cover did not change significantly from 2000 to 2010 (Fig 1). Most of the canopy showed coverage of 50% or more, with the mode in the 70-80% category (Fig. 2). The areas with high values correspond to the Evergreen and Semi-evergreen Forests, and the lowest to Deciduous Forests and Grasslands. The vegetation cover inside the park has remained fairly constant through time, in contrast to the surrounding areas which have been converted mostly to agricultural fields (Fig.3).

In Pench Tiger Reserve , average canopy cover did not change significantly between 2000 and 2005 (Figure 4). Most of the canopy showed low coverage with the mode in the 30-40% category. Canopy cover decreased significantly during from 2005 to 2010 (Fig. 4) with the mode in the 10-20% category (Fig. 2). This decreased in canopy cover was observed inside as well as out-side the national park (Fig. 5), and was correlated with lower annual rainfall in the second half of the decade (Fig. 6). Low values of canopy cover were attributed to the strong seasonal rainfall. In Pench the dry deciduous forests have no leaves during the 7-month dry season (November to May) and this is recorded in the MODIS images as low values.

Fire events and burnt areas

In Periyar, fire events and the associated burnt areas peaked in 2007 (Fig. 1). This was registered by MODIS as well as on the ground (Table 1). The fires are, for the most part, man-induced and part of the management plans for the protected area. There is an interest on the part of the protected area managers to maintain the grasslands that allow the maintenance of small and large herbivores, some of them key prey for tigers. The fires in Periyar occur mostly in grasslands and degraded deciduous forests.

In Pench, there are also fires and burnt areas (Fig 3). In this park the fires appear to be all along the roads as part of the management plans. Fire events and burnt areas peaked in 2009.

APPLICATIONS AND LIMITATIONS OF MODIS

MODIS can be readily used to measure vegetation cover in evergreen forests, especially in places where is there is less pronounced seasonal rainfall or no seasonal rainfall, and where there is little year-to-year variation in total annual rainfall. That would be the case of Periyar, particularly along the east flank.

Because MODIS measures “canopy cover” (green canopy) but not “forest cover” (tree cover), MODIS maps cannot be used to estimate forest cover where there is high seasonal rainfall and/or high year-to-year variation in annual rainfall. That would be the case of Pench Tiger Reserve. Because rainfall in Pench is highly seasonal (7 months with less than 100 mm), there is little canopy for most of the year and thus, the values from MODIS tend to be low (mode 30% to 40%). Further reduction of annual rainfall in these already seasonal forests, will result in even lower values of canopy cover (10% to 20%) as in the case of Pench during 2005-2010.

MATERIALS AND METHODS

Forest Cover: Satellite images of vegetation were obtained for Pench and Periyar Tiger Reserves for the years 2000 to 2011 using data from Moderate Resolution Imaging Spectroradiometer (MODIS) which is aboard the Terra (EOS AM) satellite. Images for Vegetation Continuous Fields (VCF) composites give yearly estimates of percent woody, herbaceous and bare cover. Images from 2000 to 2005 were obtained as GeoTIFF files of 1 square kilometer resolution from the (VCF) collection of images available from University of Maryland's Global Land Cover Facility at http://glcf.umiacs.umd.edu/data/vcf/. Images for 2006-2011, were not available at the Global Land Cover Facility. Raw data for these years was obtained from the Land Processes Distributed Active Archive Center (LP DAAC) https://lpdaac.usgs.gov/. The information was obtained as HDF format delivered in tiles. Eight bit tiles were imported in ArcGis 9.3 (ESRI, Redlands California), rescaled to 1 square kilometer resolution and converted to GeoTiff files. Protected area maps for Pench and Periyar Tiger Reserves were obtain from World Database on Protected Areas (WDPA) http://protectedplanet.net/ and overlapped to each year CVF image to calculate zonal statistics using the Spatial Analyst extension in ArcGis 9.3.

Fire Counts: The number of fire counts in the 6 protected areas was obtained from MODIS (Terra and Aqua). The data may include fire detections from MODAPS, the definitive version of Collection 5 (version 5.1), and from MODIS Rapid Response [MRR] (version 5.0).

Burnt Areas: Burned areas for India were obtained from the MODIS active fire and burned area products available at University of Maryland http://modis-fire.umd.edu. Those images are available as GeoTiff files with 1 square kilometer resolution for each year from 2000 to 2010. Raster data corresponded to dates of fire events, so they were transformed to fire presence (1) or absence (0). Each burned area image was overlapped with the protected area map from WDPA in ArcGis 9.3 and zonal statistics calculated for each protected area each year.

Rainfall: Rainfall data was obtained at the India Meteorological Department http://www.imd.gov.in/.

ACKNOWLEDGEMENTS

The analysis of MODIS data was carried out by Diego Lizcano Ph.D and the mission team expresses its appreciation to Mr. Lizcano for assisting this project and for providing nearly real time responses to our requests while in India.

FIGURES AND TABLES

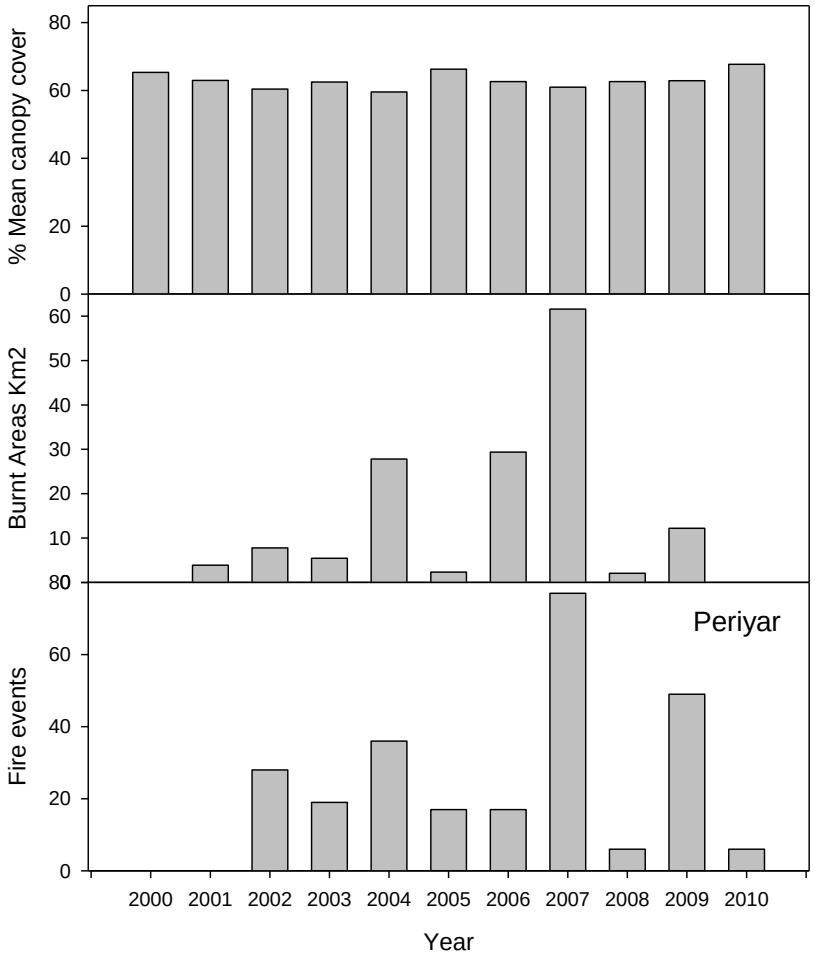


Figure 1. Mean annual forest cover (%) for Periyar(India). Values represent the average forest cover for the pixels (I km x 1 km) inside the parks. Each value is the mean of 24 values (2 per month Burnt areas (Km2) inside the Protected Areas. Data obtained from MODIS. Burnt areas (Km2) and number of fire events. Data for fire events in 2000 and 2001 were not available.

Periyar Tiger Reserve Pench Tiger Reserve

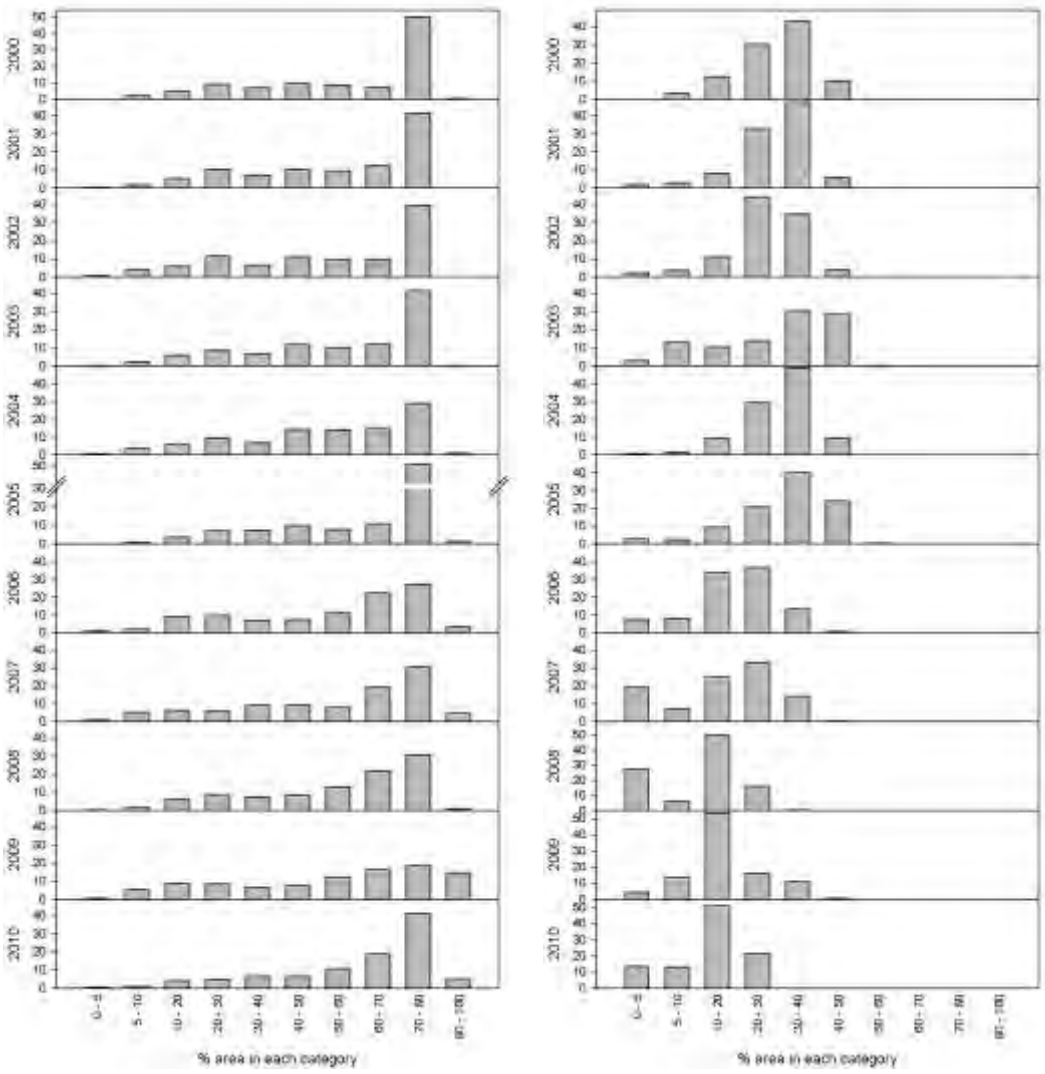


Figure 2. Frequency distribution of areas under different canopy covers categories (0-100%) in Pench and Periyar National Parks for the years 2000 to 2010. Data obtained from MODIS.

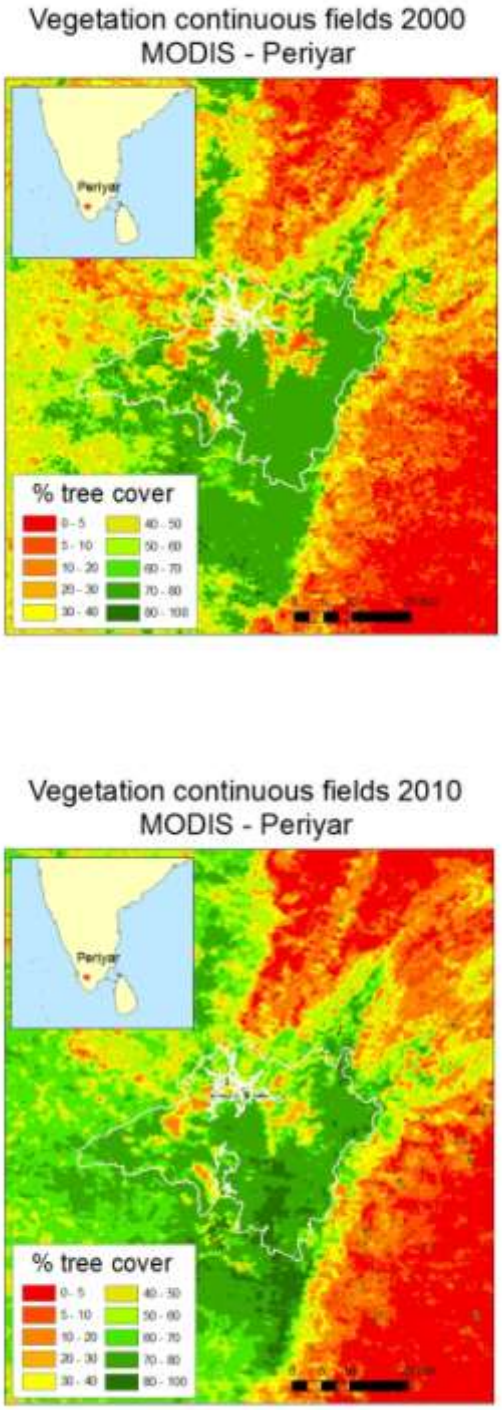


Figure 3. Canopy Cover of Periyar Tiger Reserve during 2000 and 2010.

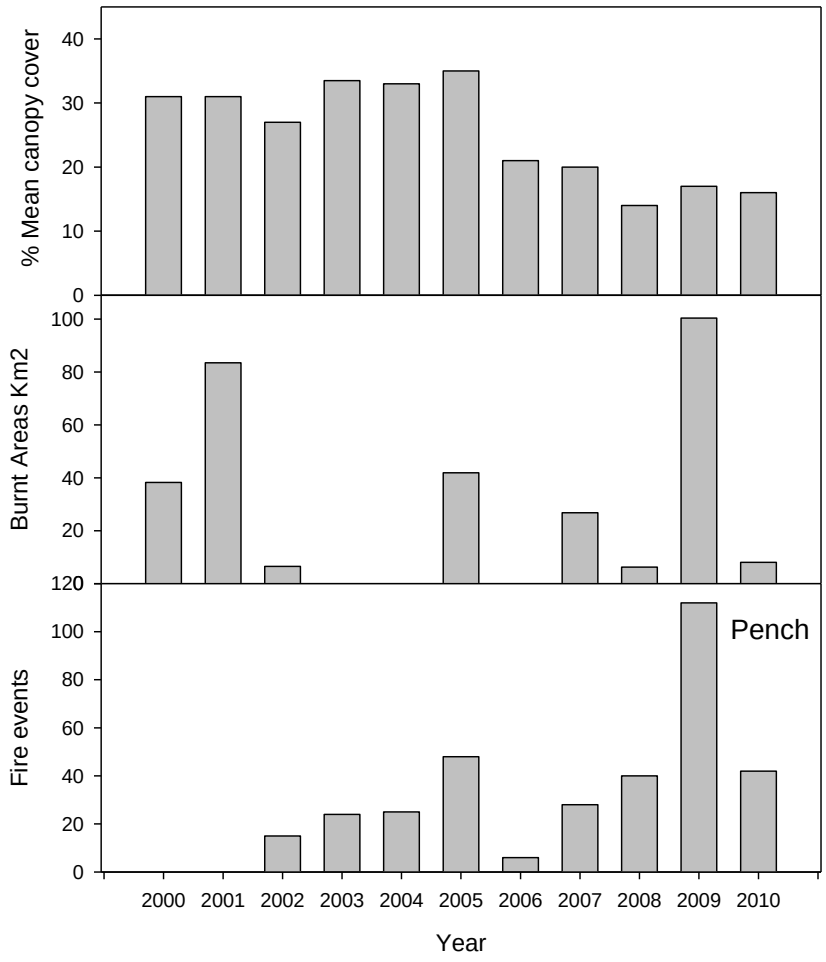


Figure 4. Mean annual forest cover (%) for Pench (India). Values represent the average forest cover for the pixels (I km x 1 km) inside the parks. Each value is the mean of 24 values (2 per month Burnt areas (Km2) inside the Protected Areas. Data obtained from MODIS. Burnt areas (Km2) and number of fire events. Data for fire events in 2000 and 2001 were not available.

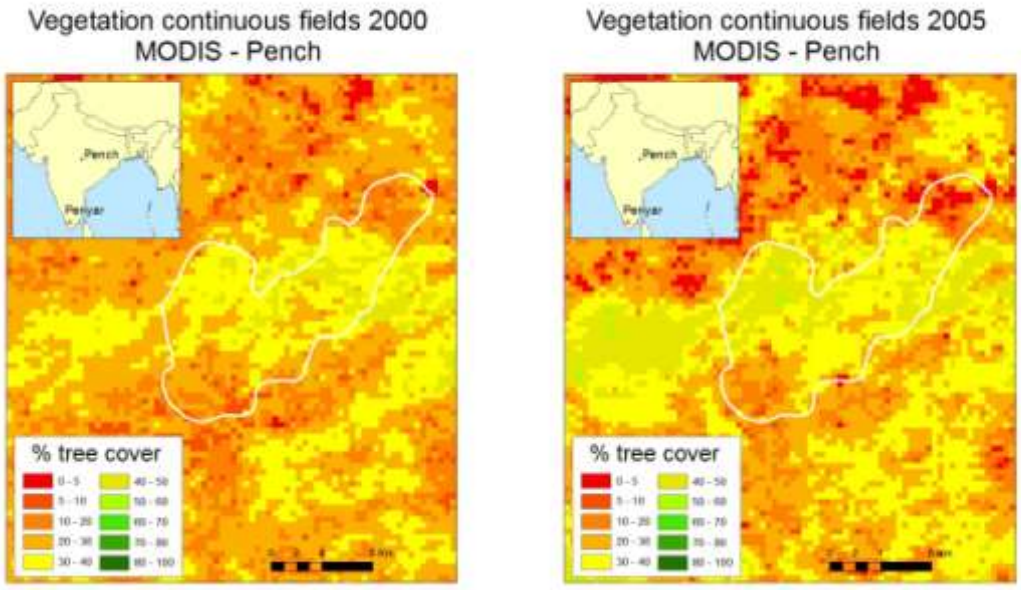


Figure 5. Canopy Cover of Pench Tiger Reserve during 2000 and 2005.

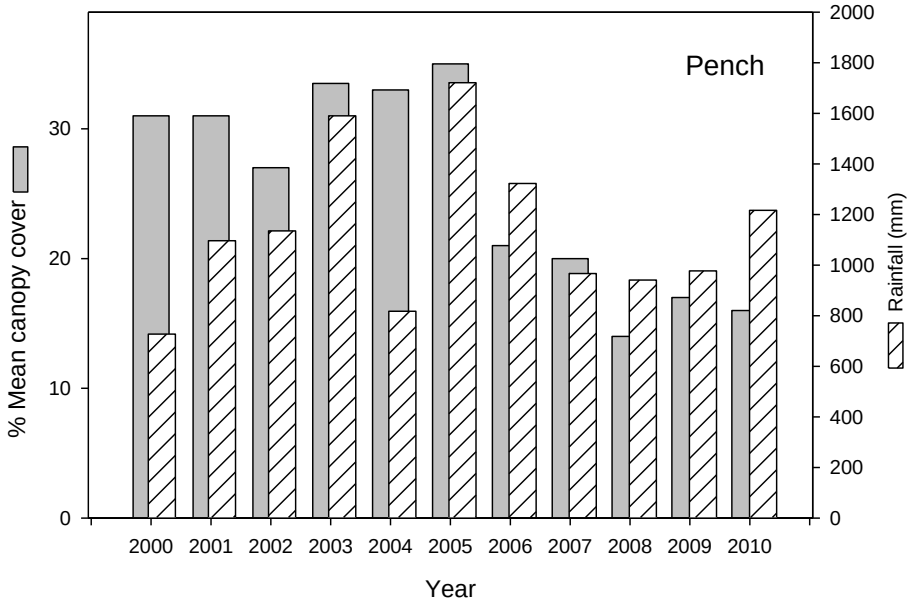


Figure 6. Mean annual canopy cover and annual rainfall in Periyar Tiger Reserve. There is a significant correlation between canopy cover and rainfall (Pearson=0.4 $P<0.05$).

Table 1. Fire events in Periyar. Data from MODIS and field data available in reports of the protected area management plan.

Year	MODIS	REPORT
2001	15	15
2002	30	879
2003	21	481
2004	107	514
2005	9	221
2006	113	193
2007	237	1151
2008	8	92
2009	47	330
2010	0	176
TOTAL	587	4052

Annex 5. Budget Data for Pench and Periyar[4]

A) Fund Utilization in Pench Tiger Reserve

Year	Funds (INR)	Funds (USD)
1999-00	42537331	1012793
2000-01	73550841	1751211
2001-02	68460779	1630018
2002-03	89867786	2139709
2003-04	84075475	2001797
2004-05	42520134	924351
2005-06	44569789	968908
2006-07	36807523	800163
2007-08	49271146	1071111
2008-09	47048410	1022791
2009-10	61014564	1220291
2010-11	74047373	1480947
2011-12	67133351	1342667

B) Fund Utilization in Periyar Tiger Reserve

Year	Funds (INR)	USD
1999-00	30850000	617000
2000-01	40000000	800000
2001-02	50579600	1011592
2002-03	30829500	616590
2003-04	20962500	419250
2004-05	35145000	702900
2005-06	30513000	610260
2006-07	21960750	439215
2007-08	20773500	415470
2008-09	33592500	671850
2009-10	39960000	799200
2010-11	30162000	603240
2011-12	31322500	626450

[4] Data provided by Tiger Reserve.

Annex 6. WB/WWF METT Re-categorized As an Inputs-Outputs-Outcome Typology

Issue	Criteria
1. Legal status OUTPUT Does the protected area have legal status (or in the case of private reserves is covered by a covenant or similar)? *Context*	The protected area is not gazetted/covenanted
	There is agreement that the protected area should be gazetted/covenanted but the process has not yet begun
	The protected area is in the process of being gazetted/covenanted but the process is still incomplete (includes sites designated under international conventions, such as Ramsar, or local/traditional law such as community conserved areas, which do not yet have national legal status or covenant)
	The protected area has been formally gazetted/covenanted
2. Protected area regulations OUTPUT Are appropriate regulations in place to control land use and activities (e.g. hunting)? *Planning*	There are no regulations for controlling land use and activities in the protected area
	Some regulations for controlling land use and activities in the protected area exist but these are major weaknesses
	Regulations for controlling land use and activities in the protected area exist but there are some weaknesses or gaps
	Regulations for controlling inappropriate land use and activities in the protected area exist and provide an excellent basis for management
3. Law enforcement OUTPUT Can staff (i.e. those with responsibility for managing the site) enforce protected area rules well enough? *Input*	The staff have no effective capacity/resources to enforce protected area legislation and regulations
	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulations (e.g. lack of skills, no patrol budget, lack of institutional support)
	The staff have acceptable capacity/resources to enforce protected area legislation and regulations but some deficiencies remain
	The staff have excellent capacity/resources to enforce protected area legislation and regulations
Issue	**Criteria**
4. Protected area objectives INPUT Is management undertaken according to agreed objectives? *Planning*	No firm objectives have been agreed for the protected area
	The protected area has agreed objectives, but is not managed according to these objectives
	The protected area has agreed objectives, but is only partially managed according to these objectives
	The protected area has agreed objectives and is managed to meet these objectives
5. Protected area design INPUT Is the protected area the right size and shape to protect species, habitats, ecological processes and water catchments of key conservation concern? *Planning*	Inadequacies in protected area design mean achieving the major objectives of the protected area is very difficult
	Inadequacies in protected area design mean that achievement of major objectives is difficult but some mitigating actions are being taken (e.g. agreements with adjacent land owners for wildlife corridors or introduction of appropriate catchment management)
	Protected area design is not significantly constraining achievement of objectives, but could be improved (e.g. with respect to larger scale ecological processes)

Issue	Criteria
	Protected area design helps achievement of objectives; it is appropriate for species and habitat conservation; and maintains ecological processes such as surface and groundwater flows at a catchment scale, natural disturbance patterns etc
6. Protected area boundary demarcation INPUT Is the boundary known and demarcated? *Process*	The boundary of the protected area is not known by the management authority or local residents/neighbouring land users
	The boundary of the protected area is known by the management authority but is not known by local residents/neighbouring land users
	The boundary of the protected area is known by both the management authority and local residents/neighbouring land users but is not appropriately demarcated
	The boundary of the protected area is known by the management authority and local residents/neighbouring land users and is appropriately demarcated
Issue	**Criteria**
7. Management plan INPUT Is there a management plan and is it being implemented? *Planning*	There is no management plan for the protected area
	A management plan is being prepared or has been prepared but is not being implemented
	A management plan exists but it is only being partially implemented because of funding constraints or other problems
	A management plan exists and is being implemented
7a. Planning process	The planning process allows adequate opportunity for key stakeholders to influence the management plan
7b. Planning process	There is an established schedule and process for periodic review and updating of the management plan
7c. Planning process	The results of monitoring, research and evaluation are routinely incorporated into planning
8. Regular work plan INPUT Is there a regular work plan and is it being implemented *Planning/Outputs*	No regular work plan exists
	A regular work plan exists but few of the activities are implemented
	A regular work plan exists and many activities are implemented
	A regular work plan exists and all activities are implemented
9. Resource inventory INPUT Do you have enough information to manage the area? *Input*	There is little or no information available on the critical habitats, species and cultural values of the protected area
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is not sufficient to support planning and decision making
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient for most key areas of planning and decision making
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient to support all areas of planning and decision making

Issue	Criteria
10. Protection systems OUTPUT Are systems in place to control access/resource use in the protected area? *Process/Outcome*	Protection systems (patrols, permits etc) do not exist or are not effective in controlling access/resource use
	Protection systems are only partially effective in controlling access/resource use
	Protection systems are moderately effective in controlling access/resource use
	Protection systems are largely or wholly effective in controlling access/ resource use
11. Research INPUT Is there a programme of management-orientated survey and research work? *Process*	There is no survey or research work taking place in the protected area
	There is a small amount of survey and research work but it is not directed towards the needs of protected area management
	There is considerable survey and research work but it is not directed towards the needs of protected area management
	There is a comprehensive, integrated programme of survey and research work, which is relevant to management needs
12. Resource management INPUT Is active resource management being undertaken? *Process*	Active resource management is not being undertaken
	Very few of the requirements for active management of critical habitats, species, ecological processes and cultural values are being implemented
	Many of the requirements for active management of critical habitats, species, ecological processes and, cultural values are being implemented but some key issues are not being addressed
	Requirements for active management of critical habitats, species, ecological processes and, cultural values are being substantially or fully implemented
13. Staff numbers INPUT Are there enough people employed to manage the protected area? *Inputs*	There are no staff
	Staff numbers are inadequate for critical management activities
	Staff numbers are below optimum level for critical management activities
	Staff numbers are adequate for the management needs of the protected area
14. Staff training INPUT Are staff adequately trained to fulfil management objectives? *Inputs/Process*	Staff lack the skills needed for protected area management
	Staff training and skills are low relative to the needs of the protected area
	Staff training and skills are adequate, but could be further improved to fully achieve the objectives of management
	Staff training and skills are aligned with the management needs of the protected area
15. Current budget INPUT Is the current budget sufficient? *Inputs*	There is no budget for management of the protected area
	The available budget is inadequate for basic management needs and presents a serious constraint to the capacity to manage
	The available budget is acceptable but could be further improved to fully achieve effective management
	The available budget is sufficient and meets the full management needs of the protected area
16. Security of budget	There is no secure budget for the protected area and management is wholly reliant on outside or highly variable funding

Issue	Criteria
INPUT Is the budget secure? *Inputs*	There is very little secure budget and the protected area could not function adequately without outside funding
	There is a reasonably secure core budget for regular operation of the protected area but many innovations and initiatives are reliant on outside funding
	There is a secure budget for the protected area and its management needs
17. Management of budget INPUT Is the budget managed to meet critical management needs? *Process*	Budget management is very poor and significantly undermines effectiveness (e.g. late release of budget in financial year)
	Budget management is poor and constrains effectiveness
	Budget management is adequate but could be improved
	Budget management is excellent and meets management needs
18. Equipment INPUT Is equipment sufficient for management needs? *Input*	There are little or no equipment and facilities for management needs
	There are some equipment and facilities but these are inadequate for most management needs
	There are equipment and facilities, but still some gaps that constrain management
	There are adequate equipment and facilities
19. Maintenance of equipment INPUT Is equipment adequately maintained? *Process*	There is little or no maintenance of equipment and facilities
	There is some *ad hoc* maintenance of equipment and facilities
	There is basic maintenance of equipment and facilities
	Equipment and facilities are well maintained
20. Education and awareness INPUT Is there a planned education programme linked to the objectives and needs? *Process*	There is no education and awareness programme
	There is a limited and *ad hoc* education and awareness programme
	There is an education and awareness programme but it only partly meets needs and could be improved
	There is an appropriate and fully implemented education and awareness programme
21. Planning for land and water use INPUT Does land and water use planning recognise the protected area and aid the achievement of objectives? *Planning*	Adjacent land and water use planning does not take into account the needs of the protected area and activities/policies are detrimental to the survival of the area
	Adjacent land and water use planning does not takes into account the long term needs of the protected area, but activities are not detrimental the area
	Adjacent land and water use planning partially takes into account the long term needs of the protected area
	Adjacent land and water use planning fully takes into account the long term needs of the protected area
21a: Land and water planning for habitat conservation	Planning and management in the catchment or landscape containing the protected area incorporates provision for adequate environmental conditions (e.g. volume, quality and timing of water flow, air pollution levels etc) to sustain relevant habitats.
21b: Land and water planning for connectivity	Management of corridors linking the protected area provides for wildlife passage to key habitats outside the protected area (e.g. to allow migratory fish to travel between freshwater spawning sites and the sea, or to allow animal migration).

Issue	Criteria
21c: Land and water planning for ecosystem services & species conservation	"Planning adresses ecosystem-specific needs and/or the needs of particular species of concern at an ecosystem scale (e.g. volume, quality and timing of freshwater flow to sustain particular species, fire management to maintain savannah habitats etc.)"
22. State and commercial neighbours OUTPUT Is there co-operation with adjacent land and water users? *Process*	There is no contact between managers and neighbouring official or corporate land and water users
	There is contact between managers and neighbouring official or corporate land and water users but little or no cooperation
	There is contact between managers and neighbouring official or corporate land and water users, but only some co-operation
	There is regular contact between managers and neighbouring official or corporate land and water users, and substantial co-operation on management
23. Indigenous people OUTPUT Do indigenous and traditional peoples resident or regularly using the protected area have input to management decisions? *Process*	Indigenous and traditional peoples have no input into decisions relating to the management of the protected area
	Indigenous and traditional peoples have some input into discussions relating to management but no direct role in management
	Indigenous and traditional peoples directly contribute to some relevant decisions relating to management but their involvement could be improved
	Indigenous and traditional peoples directly participate in all relevant decisions relating to management, e.g. co-management
24. Local communities OUTPUT Do local communities resident or near the protected area have input to management decisions? *Process*	Local communities have no input into decisions relating to the management of the protected area
	Local communities have some input into discussions relating to management but no direct role in management
	Local communities directly contribute to some relevant decisions relating to management but their involvement could be improved
	Local communities directly participate in all relevant decisions relating to management, e.g. co-management
24 a. Impact on communities	There is open communication and trust between local and/or indigenous people, stakeholders and protected area managers
24b. Impact on communities	Programmes to enhance community welfare, while conserving protected area resources, are being implemented
24c. Impact on communities	Local and/or indigenous people actively support the protected area
25. Economic benefit OUTPUT Is the protected area providing economic benefits to local communities, e.g. income, employment, payment for environmental services? *Outcomes*	The protected area does not deliver any economic benefits to local communities
	Potential economic benefits are recognised and plans to realise these are being developed
	There is some flow of economic benefits to local communities
	There is a major flow of economic benefits to local communities from activities associated with the protected area
26. Monitoring and evaluation INPUT Are management activities monitored against performance?	There is no monitoring and evaluation in the protected area
	There is some *ad hoc* monitoring and evaluation, but no overall strategy and/or no regular collection of results
	There is an agreed and implemented monitoring and evaluation system but results do not feed back into management

Issue	Criteria
Planning/Process	A good monitoring and evaluation system exists, is well implemented and used in adaptive management
27. Visitor facilities INPUT Are visitor facilities adequate? *Outputs*	There are no visitor facilities and services despite an identified need
	Visitor facilities and services are inappropriate for current levels of visitation
	Visitor facilities and services are adequate for current levels of visitation but could be improved
	Visitor facilities and services are excellent for current levels of visitation
28. Commercial tourism operators OUTPUT Do commercial tour operators contribute to protected area management? *Process*	There is little or no contact between managers and tourism operators using the protected area
	There is contact between managers and tourism operators but this is largely confined to administrative or regulatory matters
	There is limited co-operation between managers and tourism operators to enhance visitor experiences and maintain protected area values
	There is good co-operation between managers and tourism operators to enhance visitor experiences, and maintain protected area values
29. Fees INPUT If fees (i.e. entry fees or fines) are applied, do they help protected area management? *Inputs/Process*	Although fees are theoretically applied, they are not collected
	Fees are collected, but make no contribution to the protected area or its environs
	Fees are collected, and make some contribution to the protected area and its environs
	Fees are collected and make a substantial contribution to the protected area and its environs
30. Condition of values OUTCOME What is the condition of the important values of the protected area as compared to when it was first designated? *Outcomes*	Many important biodiversity, ecological or cultural values are being severely degraded
	Some biodiversity, ecological or cultural values are being severely degraded
	Some biodiversity, ecological and cultural values are being partially degraded but the most important values have not been significantly impacted
	Biodiversity, ecological and cultural values are predominantly intact
30a: Condition of values	The assessment of the condition of values is based on research and/or monitoring
30b: Condition of values	Specific management programmes are being implemented to address threats to biodiversity, ecological and cultural values
30c: Condition of values	Activities to maintain key biodiversity, ecological and cultural values are a routine part of park management