

## The extinction of experience in a biodiversity hotspot: rural school children's knowledge of animals in the Western Ghats, India

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**Lack of environmental awareness or ignorance regarding the ecological role of animals among children has long-term negative consequences for the biodiversity of a nation. We conducted a study in a biodiversity hotspot in southern India to examine the knowledge level of rural school children regarding the mammalian species in their region. The results of the study showed that school children were able to recognize regional mammalian species that are publicized by media sources, but had little knowledge about their conservation status or more significant information about them. Environmental education programmes must focus on making children more aware of the importance of various animals sharing their habitat, so that they have greater knowledge regarding the ecological roles of animals in the ecosystem.**

**Keywords:** Biodiversity hotspot, environmental education, mammals, school children.

CHILDREN exhibit great interest in learning about the behaviour and habits of wild animals, and attitudes formed about a species during childhood may have long-lasting effects on the nature of their relationships with diverse types of animals sharing their habitat<sup>1-3</sup>. Some scholars have drawn attention to 'children's extinction of experience', pointing out that in the current age, children spend less time outdoors and that 'spontaneous contact with nature is a vanishing experience of childhood'<sup>4-6</sup>. Other studies also caution that children's increasing dependence on secondary sources such as television and the internet for information about the environment results in them being more familiar with exotic or charismatic wildlife species promoted by the media than those living in their backyards<sup>7,8</sup>. This alienation of children and young adults from regional/local biodiversity could negatively impact attempts to conserve indigenous biodiversity, as citizens unaware of the importance of indigenous species cannot appreciate, support or actively take part in activities devoted to conserving them<sup>1,9</sup>.

Studies on children's attitudes or knowledge regarding wildlife suggest that they prefer domestic and exotic fauna over native wildlife<sup>10,11</sup> and that school children from

rural areas are more knowledgeable about wildlife species and have a more positive attitude about them than their counterparts from urban and semi-urban regions<sup>11-13</sup>. However, such knowledge may not extend to specific information about particular species or even make children more empathetic regarding the conservation of wildlife species<sup>14</sup>. Studies also attest that media sources, particularly the television, play an important role in influencing children's attitudes towards animals<sup>7,15,16</sup>.

In a developing, biodiversity-rich country like India, wildlife conservation can only be sustained by nurturing conservation-positive attitudes in children<sup>12,17</sup>. However, except for a handful of studies that have examined the awareness of students regarding environmental and biodiversity issues<sup>18-20</sup>, little is known about children's attitudes towards wildlife and its conservation. We conducted a study in a biodiversity hotspot region in southern India – Valanchery, (11.03°N, 76.03°E), Malappuram district, Kerala, to analyse rural school children's knowledge and attitudes towards the wildlife inhabiting their region. We hypothesized that study children would be more knowledgeable about animals that are publicized by media sources than animals that are ignored/non-publicized, and that their primary source of information would be the media.

Malappuram is well-forested with a cover of 758.86 km<sup>2</sup> (ref. 21). Many houses in the study area have large backyards that form extended habitats for small animals. Hence, living in this region provides the scope for close interactions with many wild animal species. Additionally, environmental education for school children is strongly promoted in the region through the National Green Corps (NGC) programme initiated by the Government of India, and other environmental awareness activities coordinated by several non-governmental organizations (e.g. the SEED (Student Empowerment for Environmental Development) initiative by the regional newspaper *Mathrubhumi*)<sup>22</sup>. We chose mammals as the focal animal group to test the knowledge of school children, as some studies have shown that children are most familiar with mammals than other animal groups<sup>23-25</sup>. Furthermore, some mammals are involved in human-wildlife conflict issues and therefore tend to appear in media reports<sup>26</sup>.

We used a questionnaire survey to test study children's knowledge of mammal species reported from the Western Ghats mountain range that runs through Kerala. The questionnaire ([Supplementary Table 1](#)) listed 46 wild mammals found in the Western Ghats ([Supplementary Table 2](#)). Images of the species, in addition to their common names in English and Malayalam, the regional language of the state, were provided in the questionnaire. The local names of mammal species were validated through conversations with teachers and village elders in the area. The questionnaire was administered to a total of 496 students – 340 girls and 156 boys in the age group of

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12–15 years (from 18 schools in the region), and the respondents were asked to indicate if he/she could recognize the mammal species. Students were also asked to indicate their source of knowledge regarding the animal species, i.e. whether they had seen the animal in their home surroundings or learned about it from secondary sources such as television, radio, magazines, newspapers, books, etc. We also questioned children regarding the hunting/killing of the focal species and the reasons behind it. Parental consent was obtained prior to the administration of the questionnaire.

We classified the mammalian species listed in the questionnaire into four categories according to their presence/absence in the study area and prominence in media reports and environmental awareness programmes, either because they are flagship species, or conflict animals or pest animals. The four categories were: publicized mammalian species absent in study region (PA), publicized species that are present in the study region (PP), non-publicized mammalian species not reported from the study region (NPA) and non-publicized species present in the study region (NPP; Table 1). We used *F* test and ANOVA for testing inter-category variation in the ability of children to identify the mammals, knowledge of killing pressure faced and reasons behind it, and Tukey's test for the post-hoc analysis since the data followed normal distribution.

Our results showed that children were more familiar with certain kinds of mammal species than others described in the questionnaire. They readily identified common and pest animals such as the bandicoot rat, striped squirrel and house shrew (>90%), but were less familiar with the forest cousins of the same species: bush rat (23%), flying squirrel (19%) and tree shrew (19%) respectively. Participants showed poor awareness of elusive forest animals that are rarely discussed in environmental outreach programmes, such as fishing cat (35%), Nilgiri marten (27%) and brown palm civet (20%). Children

identified publicized species significantly more often than non-publicized species (both present and absent combined; *F* test,  $F_{1,44} = 8.63$ ,  $P = 0.005$ ). There was a significant inter-group difference in the ability of children to recognize mammalian species from the four categories – PP, PA, NPP and NPA (ANOVA  $F_{3,40} = 4.77$ ,  $P = 0.006$ ; Table 1). Post-hoc analysis (Tukey's test) revealed that significantly more children recognized publicized species reported from their habitat in comparison to non-publicized absent species ( $t_{ij} = -3.02$ ;  $P < 0.05$ ). However, there were no significant differences between the other categories (Table 1).

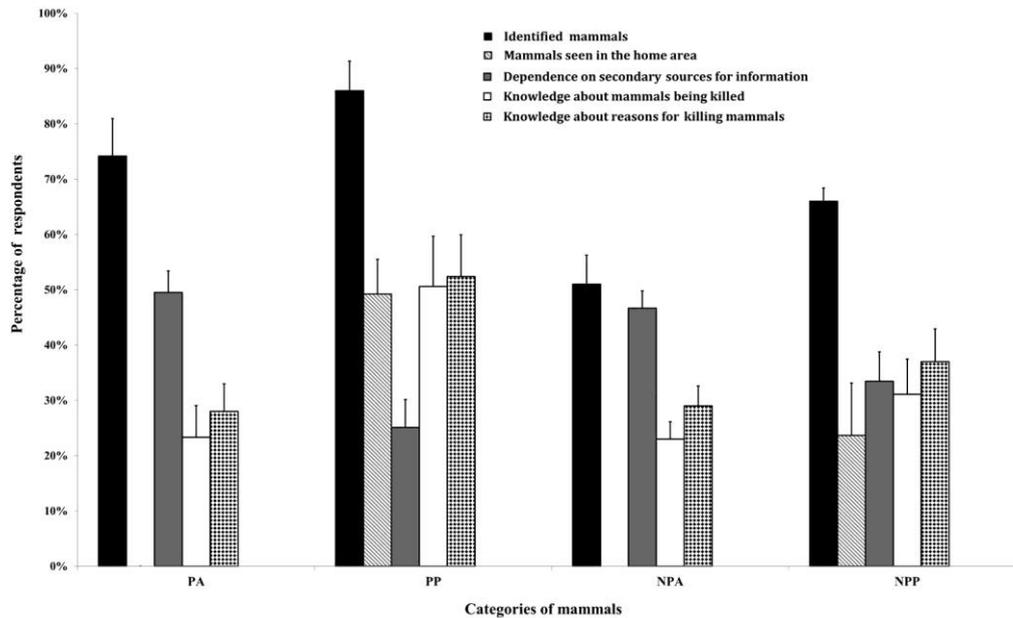
Discussions with participants revealed that they were confused while identifying certain species belonging to the NPA category. For instance, many students complained that it was difficult for them to differentiate between golden jackal and fox since they were unaware of the former and hence, they misidentified the golden jackal as fox in the questionnaire. To avoid any potential bias caused by such misinformation, we only considered those animals which were identified by more than 25% of the participants in all four groups (Supplementary Table 2) while analysing the cross-category variation in 'source of information', 'hunting pressure faced' and 'causes for killing'. Additionally, we conducted an inter-category comparison of the ability of children to recognize mammals, after removing the above-mentioned species from the list; however, this did not reveal any significant variation (ANOVA  $F_{3,22} = 1.21$ ;  $P = 0.33$ ).

The greater familiarity with publicized and present species was also reflected in children's reliance on information sources for data about animals. The cross-category analysis of respondents' dependency on secondary resources for information about the focal species revealed a significant difference (ANOVA  $F_{3,22} = 4.36$ ;  $P = 0.013$ ; Figure 1). Post-hoc analysis showed that PP was significantly different from PA ( $t_{ij} = -2.95$ ;  $P < 0.05$ ) and NPA ( $t_{ij} = -2.77$ ;  $P < 0.05$ ). In other words, children from Valanchery were less dependent on media sources for information about publicized species living in their surroundings in comparison to publicized and non-publicized mammals that were absent in their surroundings. This result indicates that students may be obtaining information about PP species (which includes rodent pests and conflict species such as wild boar and elephant) from other sources such as parents and peers. However, cross-category comparison of hunting pressure faced by mammals (ANOVA  $F_{3,22} = 27.54$ ;  $P = 0.33$ ) and the reasons behind it (ANOVA  $F_{3,22} = 27.54$ ;  $P = 0.33$ ) revealed no influence of either animal prioritization or its presence in the study region. This suggests that participant children generally had little interest in actively obtaining first-hand information about animals or through media sources. Although most of the children were able to recognize the mammals reported from their home area, about half of them had never seen the publicized animals directly

**Table 1.** Cross-category comparison (post-hoc analysis) of respondent responses regarding different mammal categories

	PP	NPA	NPP
Recognition of mammalian species			
PA	0.41	-2.50	-0.81
PP		-3.03*	-1.30
NPA			2.33
NPP			
Dependency on secondary resources for information			
PA	-2.96*	-0.39	-2.32
PP		2.77*	1.14
NPA			-2.09
NPP			

PA, Publicized mammalian species absent in the study region; PP, Publicized species present in the study region; NPA, Non-publicized mammalian species not reported from the study region; NPP, Non-publicized species present in the study region; \* $P < 0.05$ .



**Figure 1.** Student responses regarding identification of mammals and information about them. PA, Publicized mammalian species absent in the study region; PP, Publicized species present in the study region; NPA, Non-publicized mammalian species not reported from the study region; NPP, Non-publicized species present in the study region.

(PP: 51%) and less than a quarter had seen the non-publicized species reported from their area (NPP: 24%). It is interesting to note that although the PP category includes common mammalian pests (rat, mouse) and a charismatic species (Asian elephant), very few respondents reported observing these animals in their home surroundings (Figure 1). The basic science textbook followed in the eighth standard (our respondents were mainly from the eighth and ninth standard) includes a small segment on threats to biodiversity in the Western Ghats in the chapter on biodiversity. Although the textbook does provide information on wild animals; examples of threatened species are publicized ones such as Nilgiri tahr, lion-tailed macaque, Malabar civet, etc.

The lack of awareness in respondent children regarding less publicized species, and the hunting pressures faced by them and their confusion about such animals raises serious ecological concerns. Reduced awareness about local/regional species may result in children failing to appreciate the ecological value of species that exists in their backyard<sup>27</sup>. Children potentially have the chance to interact with various kinds of animals in their surroundings and their negative response arising from poor awareness or ignorance may lead to the eradication of animals in their surroundings. For instance, in the far-western lowlands of Nepal, children were more responsible than adults for killing the yellow monitor (*Varanus flavescens*), a wild reptile, due to lack of awareness and fear regarding this species<sup>27</sup>.

The results of the present study underscore the need to make children aware of the value of various animals shar-

ing their habitat and appreciating that coexistence is essential to preserve wild animals in the subcontinent. Environmental education programmes aimed at school children should focus on local species, the ecological role of common and less publicized species and equitable human–animal relations. Establishment of citizen science projects in rural areas involving students and local population, and promoting joint knowledge production can also help in increasing environmental awareness in children<sup>12,28</sup>. The conversion of natural ecosystems into human-dominated areas and its adverse impacts, both direct<sup>29,30</sup> and indirect<sup>31</sup>, on different animal species is expected to increase in the future. The lack of information regarding indigenous species among children and adults can only accelerate species loss and leave us ill-equipped to protect and conserve even the flora and fauna present in our backyards<sup>32</sup>.

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## Energy production and its emission generation impact on the environment

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**Energy contributes greatly to every aspect of life and other activities, and is the main source of economic development of any country. Globally, the demand for electrical power has increased in recent times, causing a major increase in the price of various fuels. Energy production from various renewable and non-renewable resources is not new. However, its impact on the environment is a major concern. Several power plants from large hydro, wind, thermal and others are being used for energy generation, nevertheless the depletion of the environment is the major global concern. The challenges posed to the environment need to be tackled to protect our environment. This study evaluates the state of energy generation and distribution, and its potential environmental impacts on biodiversity, climate change, aquatic life, land use, emission**

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