Human Ecology
https://doi.org/10.1007/s10745-024-00538-w

https://link.springer.com/article/10.1007/s10745-024-00538-w

Age and Gender-Related Variation in Plant and Animal Naming Ability in the Soliga/Solega Community of Southern Karnataka, India

Aung Si[1] · Samira Agnihotri[2] · Chikkananjegowda Madegowda[3]

Accepted: 12 September 2024

Abstract

It is widely acknowledged that traditional ecological knowledge (TEK) is an endangered part of the cultural heritage of many Indigenous communities worldwide. It has also been shown that TEK can vary within a community according to variables such as the age and gender of individuals. We combine the above concepts and use intra-community variation in the ability to name local plants and animals to identify disruptions in the transmission of TEK among the Soliga/Solega community of southern Karnataka State, India. Naming ability was used as a proxy for TEK, and Soliga respondents from three ecological zones (individually, or in small gender- and age-matched groups) were shown colour pictures of 20 locally-occurring plants and birds to name. The results showed that in general, respondents were better at naming plants than birds. While there were no overall age-based differences in responses, men performed better than women in naming both plants and birds. A key finding is that in general, and separately for plants and birds, older women outperformed their younger counterparts. Several ecological and cultural reasons may be responsible for these observed patterns, which primarily indicate a disruption in TEK transmission among women, including local biodiversity loss and other hazards presented by the invasive species *Lantana camara*, plus socio-economic factors like the impacts of fortress conservation, traditional patterns of marriage, a shift towards mainstream foods and medicine, and differences in the levels of education between young men and women.

Keywords Conservation · Dravidian · Endangered language · Ethnobiology · Language documentation · Tribal · Age and gender differences · Solega · Karnataka state · India

Introduction

The traditional ecological knowledge (TEK) of non-urban and Indigenous communities worldwide is a valuable part of intangible cultural heritage. It is also a valuable resource for the communities themselves, as well as external stakeholders in the domains of health, nutrition, and conservation (Vandebroek et al., 2011). A potential breakdown in the inter-generational transmission of TEK is a cause of concern worldwide, and particularly in communities that speak endangered languages (Fernandes-Llamazares et al., 2021). The causes of TEK erosion are numerous and may include phenomena such as language loss, habitat destruction and lifestyle changes (see also Zent (2013) for a review). Lifestyle changes may be manifest in various forms, including a decline in traditional diets, access to formal education, cessation of subsistence hunting and gathering in favour of agriculture, moving to an urban area for increased job prospects, among others. The interactions between the various

✉ Aung Si
asi@uni-koeln.de

Samira Agnihotri
samira.agnihotri@tdu.edu.in

Chikkananjegowda Madegowda
cmade@atree.org

1 Institute for Linguistics, Albertus-Magnus-Platz, University of Cologne, Cologne 50923, Germany

2 University of Trans-Disciplinary Health Sciences and Technology, Post Attur via Yelahanka, Jarakabande Kaval, 74/2, Bengaluru, KA 560064, India

3 Ashoka Trust for Research in Ecology and the Environment (ATREE), Jakkur Post, Bangalore 560064, India

Published online: 26 September 2024

causes of TEK loss on the one hand, and the breakdown of language and TEK transmission to younger generations, on the other, are potentially very complex, and need to be systematically investigated in a range of language communities.

In addition to the potential of the above factors to erode TEK, socio-economic variables may also affect the distribution of TEK within a community. Numerous studies around the world have shown that age, gender and other life history traits can have a major effect on the knowledge levels of individuals (e.g., Hays, 1974; Renck et al., 2022; Sujarwo et al., 2014). Moreover, individuals' knowledge can also vary among different domains of TEK, or individuals may be equally knowledgeable across multiple domains (e.g., Si, 2020a), but it is theoretically possible for a person to be very familiar with medicinal plants, for example, but know little about birds (e.g., Ellen, 1979). Whether TEK is transmitted to younger generations or not can also depend on knowledge domain (Reyes-Garcia et al., 2013), as some may be more adaptable to changing local conditions than others.

Our study focuses on patterns of TEK in the Soliga/Solega (or People of the Bamboo) community of southern Karnataka State, India. Note that although the indigenous pronunciation of the community name is 'Solega', the term 'Soliga' is frequently used in the popular media. For the remainder of this paper, we use the spelling 'Soliga'. The Soliga are officially designated as belonging to the Scheduled Tribes, a category which refers to some of the most socio-economically disadvantaged groups in India, and are further classified as one of the Particularly Vulnerable Tribal Groups in the country. The ancestral lands of the Soliga cover the area known as the Biligiri Rangan Hills (henceforth, BR Hills); here, the community traditionally practiced small-scale shifting cultivation with crops such as finger millet and maize, while also supplementing their diet with hunting and gathering. This way of life came to an end in 1987, when their forest home was declared a wildlife sanctuary under the 1972 Wildlife Protection Act of India. Since then, they have been sedentarised in permanent hamlets in and around the protected area, which they call *podu* 'village', and they have experienced a significant decline in their traditional ways of living, including a ban on their fire management practices known as *taragu benki* or leaf-litter fire. Many households cultivate small parcels of land; they do not have legal rights over the land, but have obtained land titles through the Forest Rights Act, 2006. Most have switched from their traditional crops to cash crops like coffee and pepper due to increasing crop depredation by wildlife (Agnihotri et al., 2021; Mallegowda et al., 2017) and external market pressures (Mundoli et al., 2016). While the BR Hills are now officially the Biligiri Ranganatha Temple Tiger Reserve (henceforth, BRT), the area faces a serious ecological threat in the form of the rampant, introduced woody weed *Lantana camara*, which has covered large swaths of the hills in impenetrable thickets (Sundaram & Hiremath, 2012), and led to the endangerment or local extinction of many culturally important plants and animals (Agnihotri et al., 2021; Si, 2016). Thus, the Soliga continue to face 'in-situ displacement'(Rai et al., 2019) and their traditional knowledge is as endangered as the biodiversity of their forest home.

This study is a preliminary investigation into variation in Soliga people's knowledge of local plants and birds to highlight potential disruptions in the transmission of TEK and to determine if such disruptions manifest themselves differently among men and women and between age groups. The study forms part of a systematic, multi-sited analysis (including Australia (Si, 2020a), Myanmar (Si & Kyawphyo, 2023) and Papua New Guinea (Frye et al., 2022; Frye & Si, 2024) of TEK transmission in language communities of varying size and local conditions, using a similar methodology. Briefly, the methodology involves eliciting plant and animal names from respondents by showing them pictures of species that are relevant to the local region. It should be acknowledged that the ability to name plant and animal forms comprises just a small aspect of a person's TEK; nevertheless, naming ability is used here as an easily measured proxy to assess intra-community variation in knowledge of their local biological environment (e.g., Hunn, 2002; Pilgrim et al., 2007; Wyndham, 2010; Zarger, 2002).

Soliga represents an important part of the larger study for several reasons. It is characterised as a 'stable' language (Eberhard et al., 2023), but anecdotal evidence from community members suggests that much specialised terminology regarding plants and animals is being forgotten, or not learnt by younger people. In addition, the environmental damage caused by *Lantana* in the BR Hills and the concomitant changes in access rights within the Tiger Reserve make Soliga an interesting case study for the effect, if any, of invasive species on TEK transmission.

We designed our research based on our long experience with Soliga communities and language. We interpret participants' responses in line with their real-world experiences rather than theoretical frameworks in order to avoid methodological and analytical pitfalls (see Sillitoe, 1998). We use the information we have gathered from our research among the Soliga over many years and any data we present here that does not explicitly address our research protocol was obtained during previous field trips.

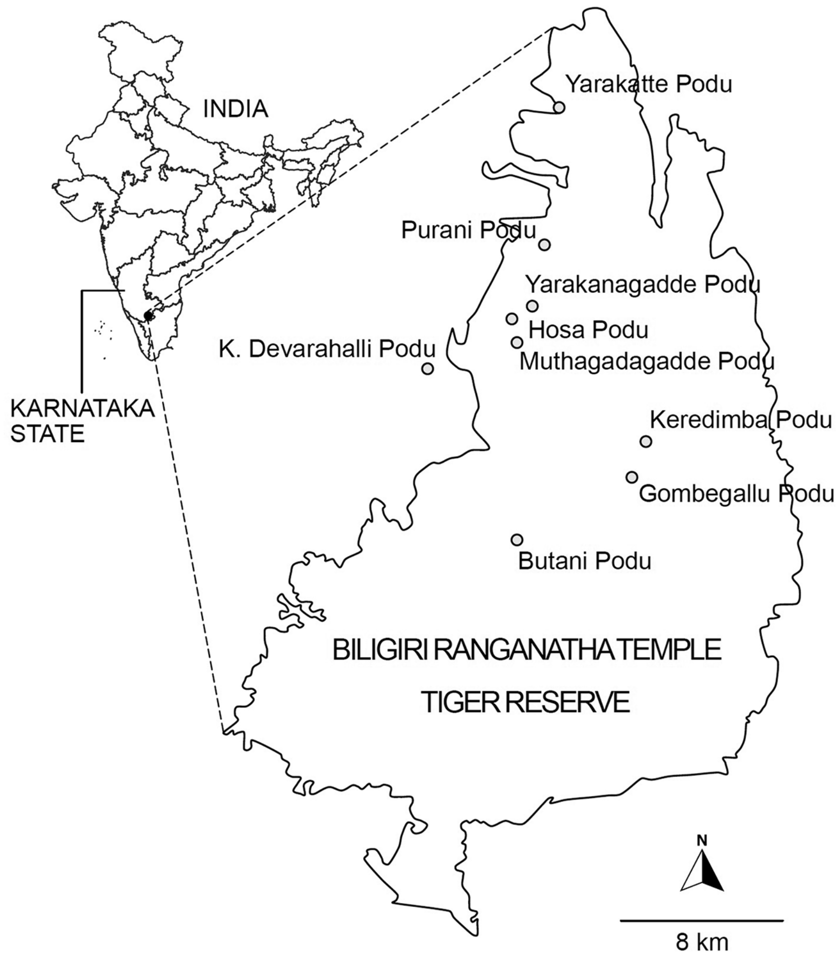

Fig. 1 Map showing the approximate locations of the respondents' settlements in the Biligiri Ranganatha Temple Tiger Reserve

Materials and methods

Study area

The BR Hills are situated in southeastern Karnataka and connect the Western Ghats (a global biodiversity hotspot) to the Eastern Ghats of India. From thorny scrub at the foothills (700 m above sea level) to the unique shola grasslands on the highest hills (1800 m above sea level), this landscape harbours a variety of vegetation types, and several endemic species of flora and fauna. There are approximately 13,000 Soliga living in and around the BR Hills in around 61 *podus*.

This study was carried out immediately after the easing of restrictions relating to the SARS-CoV-2 pandemic in Chamrajnagar District, where the field site is located. Data collection was carried out remotely, i.e., left completely in the hands of local research assistants to remove the need for outside people entering the field site. Authors AS and SA remained in touch with Author CM and the field assistants through phone calls and mobile chat applications. The remote nature of the fieldwork had a bearing on the types of data that could be collected; to minimise the burden on the research assistants, the authors only asked them to carry out a picture identification task, while also recording a bare minimum of individual data, such as gender, age and *podu* of residence.

Selection of Settlements

In order to achieve a good coverage of the flora and fauna encountered by Soliga people, we selected nine *podus* that belong to three different ecological zones: (1) 'Lowland' podus that are surrounded by scrub forest, (2) 'Temple' podus that are situated near the Biligiri Rangaswamy Temple, which is a major pilgrimage site, and is surrounded by forest that could be characterised as high-altitude deciduous rainforest, (3) 'Interior' podus that are found in an area of high-altitude evergreen rainforest. Table 1; Fig. 1).

Interview Protocol and Selection of Stimuli

Interviews were conducted in September 2021 and February 2022 by trained Soliga research assistants in their own language, separately for men and women. Male consultants were interviewed by male research assistants, and

Table 1 Targeted villages and their ecological zones

Zone 1: Lowland	Purani Podu Ketha Devarahalli Podu Yarakatte Podu or Arepalya Podu
Zone 2: Temple	Yarakanagadde Podu/Colony Hosa Podu Muthagadagadde Podu
Zone 3: Interior	Gombegallu Podu Keredimba Podu Butani Podu

Table 2 Respondent counts and average age

Respondent count		
	Female	**Male**
Older	54	44
Younger	47	47
Mean respondent age (± SD)		
	Female	**Male**
Older	47.1 (± 10.4)	46.0 (± 9.0)
Younger	21.3 (± 3.0)	22.2 (± 3.7)

female consultants by female research assistants. The male research assistants were M.R. Madegowda (46) and his son, Jadeswamy (24). Note that it is customary to abbreviate names in this manner in Soliga society; in fact, providing the names in full would make it difficult for other community members to know who was being talked about. M.R. Madegowda has worked closely with the authors since 2004. The female research assistants were Lakshmi M. (29 yrs), who has worked closely with SA since 2018 and Lakshmi P. (24). Both M.R. Madegowda and Lakshmi M. continue to work with community-based organisations on issues of language and cultural revival and gave feedback on the results of the analysis. Consultants belonging to two broad age groups (18–30 years 'younger' and ≥ 40 years 'older') were sought out, and two interviews were conducted per age group per village (leading to a total of 36 interviews for males and 36 interviews for females). A total of 91 men and 101 women participated in the interviews (Table 2). These distinct age groups represent generations that have starkly different lived experiences in the landscape, with the 40 yrs and above group being the last generation of the community to have practiced the traditional ways of living before the draconian wildlife protection policies were implemented in the 1970s and 80s. We omitted to interview people in the intermediate age category because we expected the intergenerational differences to be small and wished to better detect any such differences.

Each interview was carried out with either an individual consultant or with small groups (2–3 people). When more than one participant was involved in an interview session, all interviewees were age matched. Informed consent was obtained from all participants orally, prior to the commencement of data collection. Participants were shown two sets of stimuli comprising A3 charts containing colour photographs of 20 birds and 20 plants and were asked to name them one by one. The number of stimuli was kept low to allow the research assistants to independently interview as many Soliga respondents as possible. Since the plant and bird assemblages change slightly in the lowlands, we used a different set of stimuli for the lowland settlements (Tables 3 and 4). Audio recordings of interviews were made if consent was given, and all responses were also noted down. Interview responses (audio or written) were transcribed by a trained local consultant.

The bird and plant stimulus lists included species that are common and/or visually prominent, as well as those that are less-frequently observed and/or of unassuming appearance. Species for both stimulus sets were chosen based on the authors' prior knowledge of, and research on, the ethnospecies recognised by Soliga people (e.g., Agnihotri & Si, 2012; Si, 2016, 2020b). The plant list included species that have some utilitarian value (as food, medicine, etc.) as well as those that do not. The bird list, similarly, included species of high cultural importance, as well as those that do not have any folklore associations. Specific reasons for choosing each species are listed in Tables 3 and 4. They show that the stimulus sets include organisms that can be characterised as 'easy to identify' (e.g., plants of high cultural/utilitarian value), 'moderately difficult' (e.g., plants and birds that are culturally significant, but seldom encountered) and 'difficult to identify' (e.g., very rare and/or small organisms that may have no cultural/utilitarian value, but are nevertheless named). Note that such an approach was also used by Wyndham (2010). By using such stimuli, we hoped to determine whether knowledge loss was particularly severe for certain types of organisms.

We acknowledge that using naming ability (with stimulus sets) as a proxy for general TEK competence has its limitations, especially due to the small number of stimuli used. However, this practice is common in the ethnobiological literature (e.g., Hunn, 2002, Wyndham, 2010, Pilgrim et al., 2007; Zarger, 2002), and we feel that it is acceptable if certain caveats are kept in mind. Without a doubt, the ability to name an organism from an image says nothing about a person's ability to name and interact appropriately with that organism. The elicitation task we used does not provide any indication of the depth of a person's knowledge. However, our principal aim was to determine differences between gender and age groups presented with the same stimuli. It is likely that in any community, certain population groups will be better informed about certain types of organisms due to their regular interactions with them. An inappropriate selection of stimuli can therefore skew the data in unexpected ways. This possibility also exists in our study, but based on our prior experience with the community, we have been

Table 3 Plants and birds used in the stimulus materials for lowland settlements (Zone 1). For the plant names, *mara* 'tree', *giḍa* 'plant/herb' and *ambu* 'vine' are obligatory components of the plant names, except in certain speech contexts

Plants			Birds		
Scientific name	Soliga name	Reason[1]	Common name	Soliga name	Reason[1]
Chloroxylon swietenoides	*urugilu mara*	c, ar, me	White-throated Kingfisher	*go:regosappa*	c, no
Acacia chundra	*kaggali mara*	c, ar, fi	Red Spurfowl	*keshṭe*	c, ca.
Argyreia cuneata	*kaḷḷãna giḍa*	c, no	Jungle Babbler	*si:danagari*	c, ca.
Gardenia turgida, G. gummifera	*kambi giḍa*	c, ar, me	Greater Coucal	*kembuttã*	c, my
Ziziphus oenoplia	*so:ḍa:ḷi giḍa*	c, be, ed	Brahminy Starling	*taleba:sã*	c, vi
Lagerstroemia parviflora	*sennangi mara*	c, no	Laughing Dove	*bu:jore*	c, my
Dodonaea viscosa	*angarike mara*	c, ar	Indian Grey Hornbill	*na:re*	r, vi
Holorrhena pubescens	*beppa:le mara*	c, ed	Magpie Robin	*biḷisiṭṭe, karisiṭṭe*	c, no
Pterolobium hexapetalum	*iṇḍãna giḍa*	c, be	Grey Francolin	*goujalakki*	c, no
Grewia hirsuta	*uḍupe giḍa*	c, ed	Baya Weaver	*gi:jigã*	c, bh
Terminalia paniculata	*(h)o:luge mara*	c, no	Red-wattled Lapwing	*ṭĩyanakki*	c, bh
Tylophora indica	*a:le ambu*	c, ed, me	Red-vented Bulbul	*koṭoroḷe*	c, ca.
Andrographis serpyllifolia	*ka:sinasara giḍa*	r, ri	Plum-headed Parakeet	*gi:ṇa*	c, cp.
Barleria buxilofia	*kottimuḷḷu giḍa*	c, no	Black Drongo	*karaḷi*	c, bh
Shorea roxburghii	*ja:lada mara*	c, ar, ri	White-spotted Fantail	*koḍangisiṭṭe*	c, bh
Vitex altissima	*navila:ḍi mara*	c, be	Spot-bellied Eagle-Owl	*gumma*	c, my
Limonia acidissima	*be:lada mara*	c, ed	White-cheeked Barbet	*kuṭrakki*	c, ca.
Cordia obliqua	*seḷḷe mara*	c, ed, ar	Hoopoe	*moḍemoka*	c, my
Tridax procumbens	*ḍa:bu giḍa, o:le giḍa*	c, ar	Lesser Yellownape	*marakuṭuka*	c, my
Euphorbia nivulia	*raguta bu:ta:ḷe mara*	r, ri	Purple Sunbird	*tu:gusiṭṭe*	c, bh

[1] Species were included in the stimulus lists due to their abundance or rarity, visual prominence or lack thereof, or one or more documented interactions between Soliga people and those species. These are indicated as follows: c, common; r, rare; ar, artefact (incl. construction, ornaments, toys); be, home to bees; bh, behaviour (noteworthy); ca., call (prominent); cp., crop pest; ec, ecological interaction (with other species); ed, edible; fi, firewood; me, medicinal; my, mythological (incl. folklore, song); no, no known significance; po, poisonous; ri, ritual; vi, visually prominent

careful to select a wide range of stimulus types, from two biological domains, to counteract any baseline variation in TEK.

Data Analysis

Responses were coded as 1 for a correct answer and 0 for incorrect answers or when the respondent was unable to identify a particular species. Here too, the researchers were able to determine which answers were correct due to their past experiences in working with Soliga speakers in numerous *podus* on the very topic of plant and animal naming. The name lists presented in publications such as Agnihotri and Si (2012); Si (2016, 2020b) (Tables 3 and 4) were obtained after much discussion with numerous knowledgeable Soliga men and women. In the case of the Soliga-English Dictionary (Si, 2020b), all names were re-checked with inhabitants of different *podus*, and any inter-*podu* variation was noted. Inevitably, during the current study, we encountered some new plant and animal names that had not been recorded before or were at odds with our expectations (such as *goṇḍe giḍa* for *Tridax procumbens*, cf. Table 3). While coding answers, we were open to the possibility of inter-individual and inter-*podu* variation, and decided to err on the side of caution, especially when a single, novel plant or animal name was offered by most people from a particular *podu.* Responses of this nature were also scored as correct. Such instances were rare, however, and most responses in the identification task matched the names we had already documented in the past. Percentages of correct responses were calculated for each interview, and statistical analyses were carried out using IBM SPSS Statistics 27. To achieve normality in data distribution, a cube transform was carried out on the pooled (plant and bird combined) data, while square and cube transforms were carried out on the separate bird and data respectively. ANOVA was carried out on pooled responses (plant and bird scores combined) as well as on plant and bird responses separately.

Results

Across the dataset, mean plant scores (80.0%) were significantly higher than the mean bird scores (67.5%) (Mann-Whitney Test, z-score=-3.72, $p<0.001$). However, the plant and bird responses for individual interview groups were also significantly correlated (Kendall's Tau-b = 0.446, $p<0.001$). This indicates that although people were, in general, able to name more plants than birds, their performance

Table 4 Plants and birds used in the stimulus materials for highland settlements (zones 2 and 3). Other details as in table 3

Plants			Birds		
Scientific name	Soliga name		Common name	Soliga name	
Dioscorea hispida	*nu:re geṇasu*	c, ed	Malabar Whistling-Thrush	*ka:nagoravã*	r, bh
?Dioscorea glabra, ?D. oppositifolia	*belarre geṇasu*	c, ed	Racket-tailed Drongo	*doḍḍakaraḷi*	c, bh, ri
Caesalpinia mimosoides	*gi:jigãna giḍa*	c, ed	Scarlet Minivet (male and female)	*ma:dilakki, ma:dihakki*	c, bh, vi
Entada rheedei	*seppe ambu*	c, me	White-cheeked Barbet	*kuṭrakki*	c, ca.
Careya arborea	*doḷḷi mara*	c, ec	Malabar Parakeet	*mo:ra*	c, cp.
Syzygium cumini	*na:yĩ ne:ri mara*	c, ed	Red-whiskered Bulbul	*koṭṭipiḍiyã*	c, ca.
Kydia calycina	*beṇḍe mara*	c, ec, me	Black Eagle	*ka:nakattale*	c, bh, vi
Sterculia villosa	*sauvve mara*	c, ar	Changeable Hawk-Eagle	*ko:ṭã*	c, no
Erythrina suberosa	*kincagada mara*	c, ec	Brown Fish-Owl	*gumma*	c, my
Solanum torvum	*suṇḍe giḍa*	c, ed	Greater Flameback	*marakuṭuka*	c, ca., my
Gloriosa superba	*ko:ḷikuṭumada giḍa*	c, po	White-throated Kingfisher	*go:regosappa*	c, bh
Pterocarpus marsupium	*honne mara*	c, be, me	Paradise Flycatcher (male and female)	*saṭṭugaba:la*	r, vi
Biophytum reinwardtii	*horamuni giḍa*	r, bh	Rufous Treepie	*araḍehakki*	c, ca.
Hibiscus lobatus	*ka:ḍukaḍale giḍa*	r, no	Emerald dove	*araḷakki*	c, bh, my
Lantana indica, L. veronicifolia	*ju:jakki giḍa*	r, ed	Grey Wagtail	*pigganakki*	c, bh
Phyllanthus niruri	*nelanelli giḍa*	c, ed	Red-wattled Lapwing	*ṭĩyanakki*	c, bh
Shorea roxburghii	*ja:lada mara*	c, ar, ri	Brahminy Starling	*taleba:sã*	c, vi
Thunbergia fragrans	*simuṭada giḍa*	r, no	Greater Coucal	*kembutta*	c, my
Curculigo orchidoides	*ku:repandi giḍa*	c, ec	Red Spurfowl	*keshṭe*	c, ca.
Nicandra physalloides	*doḍḍagumuṭi giḍa*	ar	Jungle Babbler	*si:danagari*	c, ca.

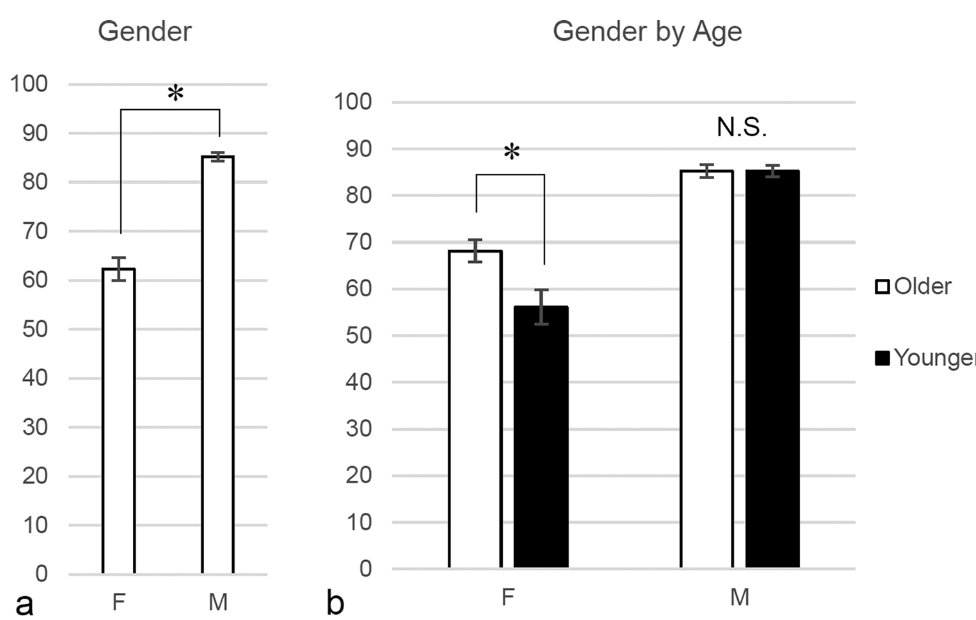

Fig. 2 Overall performance (mean % of species named ± standard error, plant and bird scores combined) of consultants. **(a)** Data by gender, **(b)** data by gender and age. N.S., not significant

in identifying one taxon was a reasonable predictor of their performance in identifying the other.

As mentioned above, the data were analysed in two ways: first, the plant and bird responses for each interview group were pooled, and the overall score was subjected to further tests. Of the three variables Zone, Age, and Gender, only Gender was found to have a significant difference overall, with men achieving higher scores than women (Fig. 2a; Mann-Whitney Test, z-score = -6.80, $p < 0.001$). A two-way ANOVA for Gender and Age showed that the interaction between the two variables approached significance ($F = 3.63$, d.f. $= 1$, $p = 0.061$), as did the effect of Age

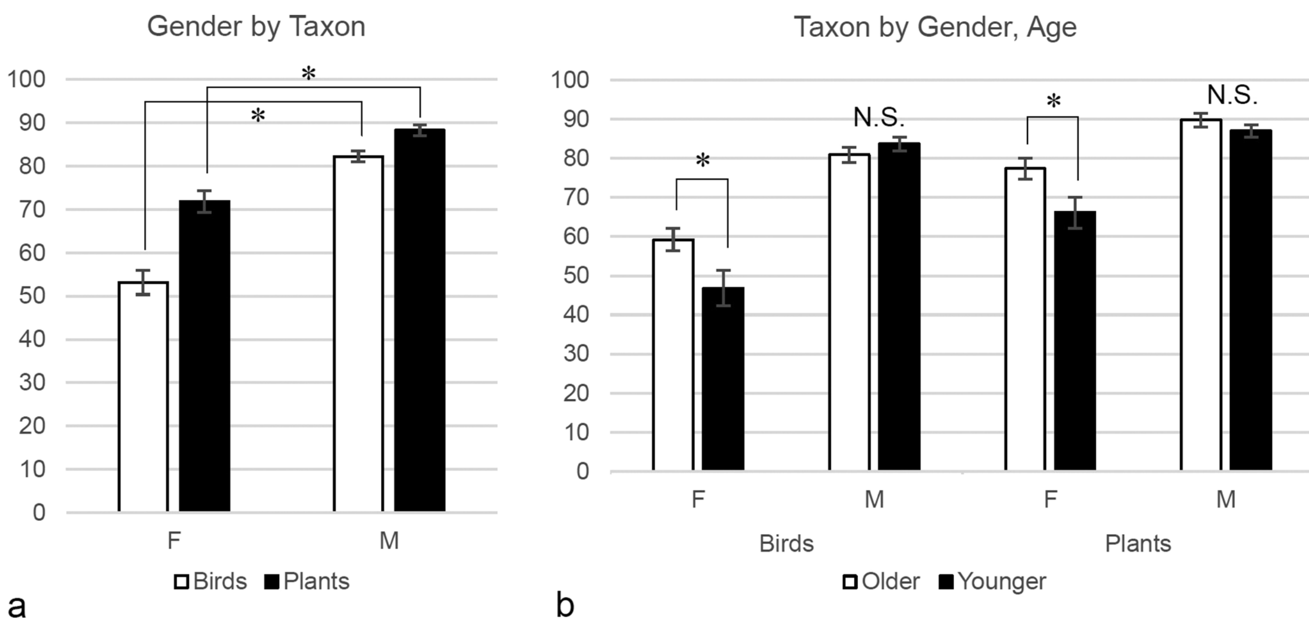

Fig. 3 Performance in the bird and plant naming tasks presented separately (mean % of species named ± standard error). **(a)** Data by gender, **(b)** data by gender and age. N.S., not significant

Fig. 4 Effect of age on performance in the bird and plant naming tasks presented separately for each zone (mean % of species named ± standard error)

separately (F = 3.70, d.f. = 1, $p = 0.058$). This result can be interpreted using Fig. 2b, which shows a significant age difference for the female respondents (ANOVA, F = 6.20, d.f. = 1, $p < 0.05$), but not for the males. The age difference for female respondents was confirmed by a t-test (t = 2.49, d.f. = 35, $p < 0.05$), with older respondents scoring higher.

Next, the interview groups' responses for the plant and bird stimuli were analysed separately. Here too, the variable Zone did not produce an overall significant difference in either the bird or plant responses. A two-way ANOVA for Gender and Age revealed a significant effect of Gender (F = 114.344, d.f. = 1, $p < 0.001$) and the interaction between Gender and Age (F = 4.90, d.f. = 1, $p < 0.05$) for the bird data. In concrete terms, men performed better at identifying birds, and among the women, older respondents performed significantly better than younger respondents (Fig. 3). Looking at the plant data, we find that the variables Gender and Age show significant differences (ANOVA, F = 39.80, d.f. = 1, $p < 0.001$; ANOVA, F = 5.81, d.f. = 1, $p < 0.05$). The effect of gender is much greater, with males outperforming females again. Figure 3b shows that, as in Fig. 2, there is an age difference for females only (for both bird and plant responses; ANOVA, F = 6.20, d.f. = 1, $p < 0.05$), and not for males. Further analysis, using Taxon (plant vs. bird) as a variable, showed that both males and females were better at naming plants than they were at naming birds (ANOVA,

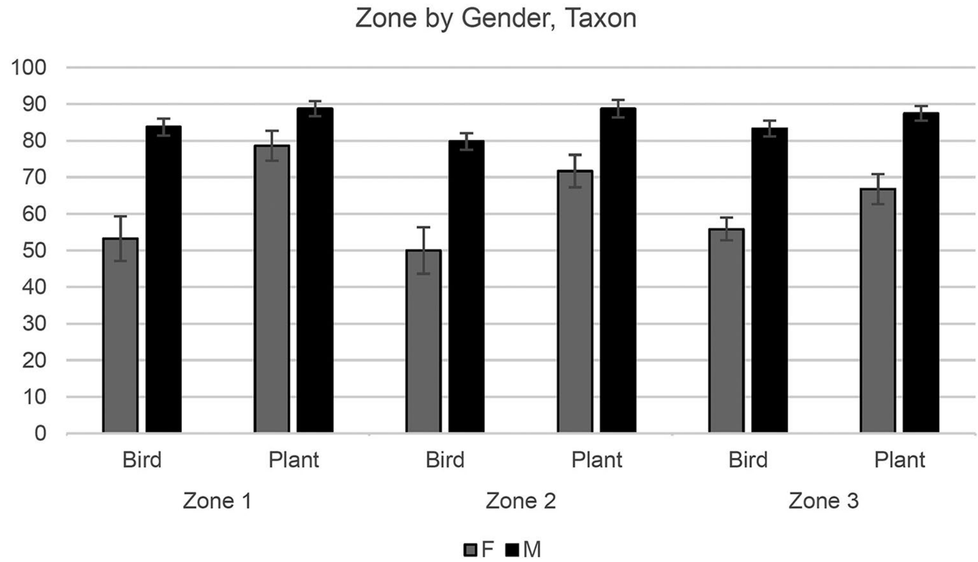

Fig. 5 Effect of gender on performance in the bird and plant naming tasks presented separately for each zone (mean % of species named ± standard error)

Table 5 Plants and birds known to fewer than 60% of respondents, by gender and zone

	Plants	Birds
Males		
Highland	Total: 3	Total: 5
	Biophytum reinwardtii	Malabar Parakeet
	Hibiscus lobatus	Black Eagle
	Thunbergia fragrans	Brown Fish-Owl
		White-throated Kingfisher
		Red Spurfowl
Lowland	Total: 2	Total: 4
	Holorrena pubescens	Indian Grey Hornbill
	Tylophora indica	White-spotted Fantail
		Hoopoe
		Purple Sunbird
Females		
Highland	Total: 7	Total: 11
	Kydia calycina	Malabar Whistling-Thrush
	Sterculia villosa	Scarlet Minivet
	Gloriosa superba	Black Eagle
	Biophytum reinwardtii	Changeable Hawk-Eagle
	Hibiscus lobatus	Brown Fish-Owl
	Lantana indica, *L. veronicifolia*	White-throated Kingfisher
	Thunbergia fragrans	Paradise Flycatcher
		Rufous Treepie
		Red-wattled Lapwing
		Brahminy Starling
		Red Spurfowl
Lowland	Total: 7	Total: 9
	Acacia chundra	White-throated Kingfisher
	Lagerstroemia parviflora	Red Spurfowl
	Terminalia paniculata	Brahminy Starling
	Tylophora indica	Indian Grey Hornbill
	Andrographis serpyllifolia	Grey Francolin
	Tridax procumbens	Spot-bellied Eagle-Owl
	Euphorbia nivula	White-cheeked Barbet
		Hoopoe
		Purple Sunbird

males, $F = 11.50$, d.f.=1, $p = 0.001$; females, $F = 26.14$, d.f.=1, $p < 0.001$).

Figures 4 and 5 show the interview results from respondents in the three Zones, first by Age and Taxon (Fig. 4) and then by Gender and Taxon (Fig. 5). As mentioned above, there were no significant differences for the variable Zone.

To determine if all stimulus species were equally recognisable to respondents, or if certain species were more prominent than others, we analysed the responses for each plant and bird species separately. Our results show the species that were correctly identified by fewer than 60% of male and female respondents, while overall the latter identified far fewer species (Table 5).

In the case of plants, we found that among the males in highland villages the two small groundcover plants *B. reinwardtii* and *H. lobatus*, as well as the vine *T. fragrans* could be named by fewer than 60% of respondents. In the lowlands, the shrub *H. pubescens* and the vine *T. indica* fared similarly (the latter was accurately identified by only four of 12 male respondents, or 33%). Female respondents from highland villages scored below 60% for the same three plants as their male counterparts. In addition, they had problems identifying the trees *K. calycina* and *S. villosa*, the vine *G. superba* and the small, herbaceous *L. indica* and *L. veronicifolia*. In the lowlands, female respondents scored below 60% for the trees *A. chundra*, *L. parviflora* and *T. paniculata*, the large succulent shrub *E. nivulia* (0%) and the groundcover plants *A. serpyllifolia* (7%) and *T. procumbens* (43%). Some striking differences were observed in the performances of male and female respondents with respect to certain plants but are difficult to explain with the current data. For instance, *A. serpyllifolia* and *E. nivulia* were correctly identified and named by 91% and 66% of male respondents, but in the case of females, the proportions of correct responses were much lower, at 7% and 0% respectively. Similarly, the small plants *L. indica* and *L. veronicifolia*, which produce small clusters of sweet, edible fruit, could be identified by 83% of male respondents, but only 39% of female respondents.

For birds, the number of species for which scores were less than 60% were more than for the plants. In the highlands, male respondents had low scores for five species of birds, whereas female respondents had low scores for 11 species. The Black Eagle, The Brown Fish Owl and the White-throated Kingfisher could not be correctly identified by both groups.

In the lowland interviews as well, male respondents scored less than 60% for four species of birds (but none had a score lower than 40%), and female respondents for nine species. In fact, the Hoopoe and White-spotted Fantail were not correctly identified by a single female respondent (cf. 42% and 58% respectively for males). This reflects a general lack of bird knowledge among females. The Indian Grey Hornbill was identified by very few respondents across the groups, and this may be a result of the sparse distribution of this species in this landscape.

While the Brown Fish Owl was correctly identified by very few respondents in the highlands (21% and 29% for females and males respectively), its lowland counterpart the Spot-Bellied Eagle Owl was correctly identified by all male respondents (100%) by 31% of females. The mythology surrounding the different species of owls and their calls in the BR Hills warrants further inquiry, but there is a belief among the Soliga (especially in the highlands) that evil shape-shifting spirits often turn into owls, which are consequently viewed with fear. Children are brought up to fear owl calls for the same reason. This could explain the difficulty in identifying the Brown Fish Owl and playing a corresponding audio stimulus might have resulted in higher scores. However, most highland respondents misidentified the Brown Fish Owl as other species of smaller owls (*gu: be*, *natta: re*), and once again, it could simply be that the photo stimulus did not provide enough context for the interviewee to judge the size of the owl. Overall, for birds, presenting corresponding audio stimuli might have resulted in higher scores.

Respondent age appeared to play a role for some of the species in question. Looking at the species which were unknown to, or misidentified by, by at least twice the number of younger respondents, as compared to older respondents, we found that among males, the Black Eagle (highlands) and the plant *B. reinwardtii* (highlands) fell into this category. Among females, the birds Changeable Hawk-Eagle, Paradise Flycatcher, Rufous Treepie, Red-wattled Lapwing (highlands), Red Spurfowl (lowlands), and the plants *A. chundra*, *Te. paniculata* and *Tr. procumbens* (lowlands) were not known to at least twice as many younger people as older people.

Discussion

General Patterns

As noted earlier, the ability to name local plants and animals is only a small aspect of an individual's repertoire of TEK. In a potential language endangerment scenario, however, ethno-taxon names may be among the first items of the Indigenous lexicon to be forgotten (Dickson, 2015). A likely result is that the organisms referred to by those names, though widely known earlier (Agnihotri & Si, 2012; Agnihotri et al., 2021), are no longer talked about in the community in question. From the perspective of a linguistic community, this is a poignant indication of the links between language, memory, culture, and identity, and how a loss in any one of these domains can severely impact the others. Investigating people's ability to name plants and animals – this ability can also be considered part of a person's eco-literacy – can therefore provide valuable insights into the current relevance or salience of local organisms at the individual or community level. A previous study carried out at a location (in the state of Tamil Nadu) near our field site found that individual ability to name useful plants was dependent on wealth status and gender, with the poorest individuals having the highest overall eco-literacy and knowledge of plant uses, and women knowing more about medicinal plants than men (Pilgrim et al., 2007). Our results have also revealed some important patterns in the distribution of plant and bird naming ability in the Soliga community, but further investigations with a broader scope are required to assess people's depth of knowledge of key ethno-taxa, including process-based knowledge (Hunn, 1982), as well as detailed meta-data on their life histories (*podus* of birth and marriage, education) and ways of interacting with the forest (honey gathering, knowledge of traditional medicine, grazing of livestock, collecting minor forest produce, foraging for traditional foods, visiting the forest for religious activities, and so on).

Our finding that people's awareness of plant names exceeded that of bird names is likely a result of a greater level of engagement with plants on a day-to-day basis (see Pam (2017) for an example of a community with little interest in birds). While birds are generally very important in Soliga culture (Agnihotri & Si, 2012) Soliga people nowadays only observe wild birds from a distance, without interacting with them directly. This can be attributed to the general hunting ban in the Tiger Reserve and the reduced access to large parts of the forest due to the presence of

Lantana thickets. In contrast, people continue to regularly forage for numerous useful plants that can be found in the vicinity of their settlements. The Soliga situation is markedly different from that seen in other parts of India, where bird hunting still occurs on a regular basis; in the state of Meghalaya, for instance, Tynsong et al. (2012) have found that the War Khasi community possesses a wealth of TEK regarding birds and bird hunting.

Among the Soliga, another general pattern observed was that people who can name more plants are also better at naming birds (or vice versa). This is probably the result of other lifestyle-related factors that were not investigated in this study, such as education, income level and type of occupation. Due to the fieldwork constraints mentioned above, we do not have such data at this stage, but lifestyle factors, in general, are explored in more detail in the discussion of gender-related differences below. For now, we surmise that people who go foraging more frequently are exposed to more plant and bird species in general, and therefore performed better in the interviews. Observing similar kinds of variation at his field site in Indonesia, Ellen (1979) suggested that there may be several underlying causes: these include two variables investigated in this study (age and gender) but also status, kinship position, linguistic competence, physical and mental ability and special skills.

The Effect of Gender and Age

The role of gender in TEK has been studied in several communities around the world, and researchers have found gender-based differences in ethnobotanical knowledge that manifest themselves in many forms (see Pfeiffer & Butz, 2005 for a review). Broadly speaking, researchers writing about gender differences tend to mention absolute, quantitative differences (e.g. the ability of one gender to name more plants or animals than the other, as in Pieroni, 2003; Setalaphruk & Price, 2007; Souto & Ticktin, 2012) or a more nuanced structuring of ethnobiological knowledge by gender, as in Da Costa et al., 2021; Goebel et al., 2003; Poncet et al., 2021; also see Pfeiffer & Butz, 2005). Our current data only allow us to make generalisations of the first type, in that male interviewees achieved higher overall scores in the naming tasks and in the plant and bird interviews, separately, than female participants. This does not mean, however, that more nuanced gender effects do not exist in Soliga society, and further research should be carried out to determine and existing patterns.

As mentioned above, lifestyle factors may be key to understanding this pattern. Both Soliga men and women routinely leave their settlements to either collect non-timber forest products (NTFPs) for commercial, culinary or medicinal purposes, to graze livestock, or to visit sacred sites or other settlements along forest paths. Such excursions naturally provide ample opportunity to observe the plants and animals occurring in a locality and to obtain information about the life histories of these organisms and the ecological interactions among them. In recent decades, however, the structure of the forest has changed drastically, primarily due to the spread of the invasive species *L. camara* (Niphadkar et al., 2016; Sundaram et al., 2012). This plant, normally a large thorny shrub, can modify its growth habit according to its needs, sometimes climbing up trees or forming huge impenetrable walls several metres high. *L. camara* has effectively smothered the forest understorey in many parts of the BRT, leading to the local extinction of many culturally important plants, such as grasses, edible plants and medicinal herbs (Agnihotri et al., 2021). This is not a problem unique to India; indeed, the negative impacts of invasive species on Indigenous cultures and knowledge systems have been noted in other parts of the world (some North American examples are reviewed in Voggesser et al., 2013). Another detrimental impact of *Lantana* is much reduced visibility for humans walking through the forest: the *Lantana* can be so dense that it is nowadays difficult to spot even large, potentially dangerous animals, such as elephants. Women could still access these plants by travelling much farther away from their settlements but are reluctant to do so due to the reduced visibility and increased encounter rates with elephants. The latter too now need to use the same paths as humans, and the Soliga believe that *Lantana* has made the elephants more agressive. Young boys (18 and above) and men, on the other hand, still venture into the forest, albeit in small groups, for 2–3 day trips to gather honey or other minor forest produce like *pa:se* (lichen) and *nelli ka:yi* (fruits of amla or Indian gooseberry, *Phyllanthus emblica*). Often being the sole earning members of their households, a significant part of their annual income stems from the sales of these forest products. These factors seem to have conspired to negatively affect TEK transmission in women more than men.

It is interesting that there were no zone-based differences in people's responses although *Lantana* is more widespread in the highlands than in the lowlands. While this phenomenon needs to be further investigated, it is possible that different factors have varying impacts in the two zones. Thus, while local extinction due to *Lantana* may be a key reason for the breakdown in TEK transmission in the highland *podus*, other factors, such as increased time spent in urban areas, may bear greater responsibility for causing the same effect in lowland podus. TEK erosion can be driven by a range of factors (reviewed in Zent, 2013), and it cannot be ruled out that two or more different factors may exert their effects on different sub-populations within a community.

Looking at the bird and plant data separately, we see that the difference between the two scores is far higher for women than for men. In fact, female respondents were, on average, only able to correctly name around half of the birds in the stimulus set. In contrast, the average men's score was around 80% (Fig. 2a). This can once again be attributed to traditional lifestyle factors: in earlier times, it was primarily young men who hunted birds and collected bird eggs in the wild. A similar gender-based difference in bird knowledge is attested in many communities around the world (Bonta, 2003; Frye & Si, 2023; Si, 2020a). Although bird hunting activity has now declined in the BR Hills, since it became illegal under the Indian Wildlife Protection Act (1972), men still conduct expeditions into the forests to gather honey and minor forest produce and would therefore have more opportunities than women to encounter birds. Women are nowadays more engaged in household and agricultural work, and do not wander far from the *podus*.

Age is one of the most frequently reported correlates of TEK, and it is often interpreted through the lenses of either TEK acquisition by children and young adults, or TEK erosion in endangerment situations (reviewed in Zarger, 2011). We take the latter approach in this study and compare the naming abilities of older and younger Soliga adults, to detect potential breakdowns in the transmission of TEK. There was no effect of age on men's ability to name the organisms in the stimulus sets, but younger women performed worse than older women, both overall, and for plants and birds separately. In other words, there seems to be a disruption in the transmission of TEK among women. While life history information (such as educational status, marriage status, etc.) was not collected in the present study, we tentatively attribute the disruption of TEK transmission among women to differences in the residential history of men and women, particularly in the context of marriage. Most of the female interviewees in the 'young' category were married, with the average age of marriage being 18. Soliga society is largely patrilocal, and after marriage, the woman moves into her husband's house. Quite often, marriages take place between people living in settlements that may be separated by large distances, and/or situated in different ecological zones. As a result, a woman's new home after marriage may be in an area containing unfamiliar plant and bird species.

The observed gender differences may also be attributed to differences in the educational status of young Soliga men and women. There is anecdotal evidence that girls tend to stay on longer in school, and even pursue higher education in nearby towns. Boys, on the other hand, tend to drop out of school after the 10th grade. Both young men and women pursuing university education often reside at hostels in the towns where the educational institutions are, such as Yelandur, Chamarajanagar, Kollegal and Mysore. Younger Soliga who prioritise formal education may also migrate to these towns to take up jobs. This phenomenon may also be responsible for the poorer performance of young women in our study, as they would have had disproportionally less engagement with TEK due to spending more time in town.

Species-Related Effects

Our results indicate that some species of plants and birds were poorly known to interview participants. Several factors may be responsible for these patterns. It is possible that the small groundcover plants are difficult to identify because they are inconspicuous or infrequently encountered. It is also possible that the ecological changes that have occurred in the forest in recent decades (due to the spread of *L. camara*) have caused these plants, as well as vines such as *T. fragrans*, to become rarer. This is especially true in the highlands, where *Lantana* has almost completely replaced the native understorey (Agnihotri et al., 2021; Niphadkar et al., 2016; Sundaram et al., 2012). It would be interesting to investigate this local extinction hypothesis in a future study, perhaps by comparing empirically observed biodiversity levels in different parts of the forest with a type of rapid biodiversity assessment (e.g., Hellier et al., 1999; Hoye, 2022; Müller, 2009) carried out using only local people's ability to name and/or recognise plants and animals in their surroundings.

In the case of the medicinal plants *H. pubescens* and *T. indica*, it could be that a general move away from traditional remedies, and a greater dependence on Western medicine, is responsible for people becoming less familiar with these plants. It is also worth pointing out that most plants used for traditional medicine are small, typically annual herbs, and that these are the plants most affected by invasive weeds. Several of these species are also fire-adapted and according to the Soliga, their populations have also been greatly affected by the ban on their traditional leaf-litter fire practices, which were slow-moving cool burns conducted every year in the dry season (Hiremath et al., 2018; Sundaram & Hiremath, 2012; Sundaram et al., 2012, 2015).

Conclusions

Our results show a disruption in the inter-generational transmission of TEK among Soliga women. Several factors may be responsible for this phenomenon, including the invasive weed *Lantana*, patrilocal marriage and reduced interaction with culturally important organisms due to the pursuit of formal education and division of labour. Certain species may be more prone to being neglected during TEK transmission: they may be rare due to environmental degradation, or their cultural utility may have waned due to lifestyle change. The current study has three key limitations: (1) the relatively small sample size, (2) the lack of relevant socio-economic and lifestyle-related data and (3) the use of naming ability as a proxy for TEK. While the first two limitations can be addressed in future studies, we do not necessarily consider the third to be problematic, as our past long-term research experience with the Soliga community allowed us to select plant and animal stimuli that were well suited to an investigation of the current type. Nevertheless, future studies could also investigate respondents' depth of knowledge regarding culturally important organisms, in addition to the identification/naming task reported here.

Our results suggest that any future interventions that attempt to reverse language attrition and/or TEK erosion should focus more on girls and younger women, and on specific plant and animal species that are in danger of being forgotten or going locally extinct. For the moment, however, much TEK is to be found in the language, culture and practices of the Soliga community in general. It is ironic that the invasive weed *Lantana* that is partly responsible for TEK erosion among the Soliga could in fact be controlled by the community's own traditional agricultural practices (leaf-litter fires) that are now banned (Sundaram et al., 2012). As many have suggested, policy makers should consult local peoples and consider TEK while making decisions aimed at biodiversity and endangered species conservation (Berkes et al., 1994; Gadgil & Berkes, 1991; Nabhan, 2000; Rai, 2022; West & Brockington, 2006), and create spaces for TEK to flourish, develop and be transmitted to later generations.

Acknowledgements The authors heartily thank the knowledge holders and elders of the Soliga community that supported and participated in this work. This research would not have been possible without the enthusiastic participation of the key research assistants M.R. Madegowda, Jadeswamy M., Lakshmi M., Lakshmi P. and Nagendra P. The authors would also like to thank the Ashoka Trust for Research in Ecology and the Environment's (ATREE) BRT Community Conservation Centre, the Institute for Public Health (IPH - Bangalore) Field Station at B. R. Hills and the Zilla Budakattu Girijana Abhivruddhi Sangha (District Tribal and Mountain-Dweller Development Council) for supporting this research.

Author Contributions A.S., S.A. and C.M. conceptualised the study and planned data collection and fieldwork; S.A. and C.M. co-ordinated data collection; A.S. and S.A. carried out data analysis; A.S. and S.A. wrote the manuscript. All authors reviewed the manuscript.

Funding The project was funded by a Postdoctoral Fellowship (Project Number 430905037) from the German Research Council (Deutsche Forschungsgemeinschaft, DFG).

Data Availability The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval and Consent to Participate This study is a linguistic field survey, and does not involve any human or animal-related experimental trials. Verbal consent was obtained from all respondents prior to data collection.

Competing Interests The authors declare no competing interests.

References

Agnihotri, S., & Si, A. (2012). Solega ethno-ornithology. *Journal of Ethnobiology*, *32*, 185–211.

Agnihotri, S., Madegowda, C., & Si, A. (2021). Tiger becomes termite hill: Soliga/Solega perceptions of wildlife interactions and ecological change. *Frontiers in Conservation Science*. https://doi.org/10.3389/fcosc.2021.691900

Berkes, F., Folke, C., & Gadgil, M. (1994). Traditional ecological knowledge, biodiversity, resilience and sustainability. In C. Perrings, K. Mäler, C. Folke, C. Holling, & B. Jansson (Eds.), *Biodiversity conservation: Problems and policies* (pp. 269–287). Springer.

Bonta, M., & Texas (2003). A & M University.

Da Costa, F., Guimarães, M., & Messias, M. (2021). Gender differences in traditional knowledge of useful plants in a Brazilian community. *PloS One*, 16(7), e0253820.

Dickson, G. (2015). Marra and Kriol: the loss and maintenance of knowledge across a language shift boundary (Australian National University unpublished PhD thesis). Retrieved 18 February, 2019, from. https://openresearch-repository.anu.edu.au/handle/1885/149678

Eberhard, D., Simons, G., & Fennig, C. (Eds.). (2023). *Ethnologue: Languages of the World. Twenty-sixth edition*. SIL International. http://www.ethnologue.com

Ellen, R. (1979). Omniscience and ignorance: Variation in Nuaulu knowledge, identification and classification of animals. *Language in Society*, *8*, 337–364.

Fernández-Llamazares, A., Lepofsky, D., Lertzman, K., Armstrong, C., Brondizio, E., Gavin, M., Lyver, P., et al. (2021). Scientists' warning to humanity on threats to indigenous and local knowledge systems. *Journal of Ethnobiology*, *41*, 144–169.

Frye, H., & Si, A. (2024). Variation in the bird-name lexicon in Qaqet (East New Britain Province, Papua New Guinea). *Asia-Pacific Language Variation*, *9*, 239–264.

Frye, H., Balar, S., & Si, A. (2022). Experiences with remote linguistic-ethnobiological fieldwork on bird names in the Qaqet language of Papua New Guinea. *Language Documentation and Conservation*, *16*, 341–363.

Gadgil, M., & Berkes, F. (1991). Traditional resource management systems. *Resource Management and Optimization*, *8*, 127–141.

Goebel, A. (2003). Gender and entitlements in the Zimbabwean woodlands: A case study of resettlement. In P. L. Howard (Ed.), *Women and plants: Gender relations in biodiversity management & conservation* (pp. 115–129). Zed Books Ltd.

Hays, T. (1974). Mauna: Explorations in Ndumba ethnobotany (University of Washington unpublished PhD thesis). Retrieved 18 August, 2023, from https://digital.lib.washington.edu/researchworks/handle/1773/6552

Hellier, A., Newton, A. C., & Gaona, S. O. (1999). Use of indigenous knowledge for rapidly assessing trends in biodiversity: A case study from Chiapas, Mexico. *Biodiversity & Conservation*, *8*, 869–889.

Hiremath, A., Prasad, B., & Sundaram, B. (2018). Restoring *Lantana camara* invaded tropical deciduous forest: The response of native plant regeneration to two common *Lantana* removal practices. *Indian Forester*, *144*, 545–552.

Hoye, T., Groom, Q., Juslén, A., Mandon, C., Dinesen, L., Rosenberg, A., Hendriks, R., Eggermont, H., & Vihervaara, P. (2022). *Biodiversity monitoring knowledge gaps and research & innovation priorities*. Biodiversa+.

Hunn, E. (1982). The utilitarian factor in folk biological classification. *American Anthropologist*, *84*(4), 830–847.

Hunn, E. S. (2002). Evidence for the precocious acquisition of plant knowledge by zapotec children. *Ethnobiology and Biocultural Diversity*, *604*, 13.

Mallegowda, P., Setty, S., & Rengaian, G. (2017). Conservation through conversation: A collaborative corridor restoration initiative in BRT tiger reserve. *Current Science*, *113*(7), 1440–1442.

Müller, J. G. (2009). *Including local voices in global discourse in biodiversity conservation: An ethnobotanical study in Boumba, Niger (Park W)*. PhD thesis, Tufts University.

Mundoli, S., Joseph, G., & Setty, S. (2016). Shifting agriculture the changing dynamics of Adivasi farming in the forest-fringes of a tiger reserve in South India. *Agroecology and Sustainable Food Systems*. https://doi.org/10.1080/21683565.2016.1189475

Nabhan, G. P. (2000). Interspecific relationships affecting endangered species recognized by O'odham and Comcaac cultures. *Ecological Applications*, *10*(5), 1288–1295.

Niphadkar, M., Ficetola, G., Bonardi, A., Nagendra, H., & Padoa-Schioppa, E. (2016). Effects of landscape context on the invasive species *Lantana camara* in Biligiri Rangaswamy Temple Tiger Reserve, India. *Tropical Ecology*, *57*, 9–21.

Pfeiffer, J. M., & Butz, R. J. (2005). Assessing cultural and ecological variation in ethnobiological research: The importance of gender. *Journal of Ethnobiology*, *25*(2), 240–278.

Pieroni, A. (2003). Wild food plants and Arbëresh women in Lucania, Southern Italy. In P. L. Howard (Ed.), *Women and plants: Gender relations in biodiversity management & conservation* (pp. 66–82). Zed Books Ltd.

Pilgrim, S., Smith, D., & Pretty, J. (2007). A cross-regional assessment of the factors affecting ecoliteracy: Implications for policy and practice. *Ecological Applications*, *17*, 1742–1751.

Poncet, A., Schunko, C., Vogl, C., & Weckerle, C. (2021). Local plant knowledge and its variation among farmer's families in the Napf region, Switzerland. *Journal of Ethnobiology and Ethnomedicine*, *17*, 1–19.

Rai, P. K. (2022). Environmental degradation by invasive alien plants in the anthropocene: Challenges and prospects for sustainable restoration. *Anthropocene Science*, *1*(1), 5–28.

Rai, N. D., Benjaminsen, T. A., Krishnan, S., & Madegowda, C. (2019). Political ecology of tiger conservation in India: Adverse effects of banning customary practices in a protected area. *Singapore Journal of Tropical Geography*, *40*(1), 124–139.

Renck, V., Apgaua, D., Tng, D., Bollettin, P., Ludwig, D., & El-Hani, C. (2022). Cultural consensus and intracultural diversity in ethnotaxonomy: Lessons from a fishing community in Northeast Brazil. *Journal of Ethnobiology Ethnomedicine*. https://doi.org/10.1186/s13002-022-00522-y

Reyes-Garcia, V., Luz, A., Gueze, M., Paneque-Galvez, J., Macia, M., Orta-Martinez, M., Pino, J., & Team, T. B. S. (2013). Secular trends on traditional ecological knowledge: An analysis of different domains of knowledge among tsimane' men. *Learning and Individual Differences*, *27*, 206–212.

Setalaphruk, C., & Price, L. L. (2007). Children's traditional ecological knowledge of wild food resources: A case study in a rural village in Northeast Thailand. *Journal of Ethnobiology and Ethnomedicine*, *3*, 1–11.

Si, A. (2016). *The traditional ethnobiological knowledge of the Solega - A linguistic perspective*. Springer.

Si, A. (2020a). Patterns in the transmission of traditional ecological knowledge: A case study from Arnhem Land, Australia. *Journal of Ethnobiology and Ethnomedicine*. https://doi.org/10.1186/s13002-020-00403-2

Si, A. (2020b). *Solega-English Dictionary*. Aditya Printers.

Si, A., & Kyawphyo, A. (2023). Patterns in fish naming ability in two fishing communities of Myanmar. *Journal of Ethnobiology and Ethnomedicine*. https://doi.org/10.1186/s13002-023-00610-7

Sillitoe, P. (1998). The development of indigenous knowledge – a new applied anthropology. *Current Anthropology*, *39*(2), 223–252.

Souto, T., & Ticktin, T. (2012). Understanding interrelationships among predictors (age, gender, and origin) of local ecological knowledge. *Economic Botany*, *66*, 149–164.

Sujarwo, W., Arinasa, I., Salomone, F., Caneva, G., & Fattorini, S. (2014). Cultural erosion of balinese indigenous knowledge of food and nutraceutical plants. *Economic Botany*, *68*, 426–437.

Sundaram, B., & Hiremath, A. (2012). *Lantana camara* invasion in a heterogeneous landsPatternstterns of spread and correlation with changes in native vegetation. *Biological Invasions*, *14*, 1127–1141.

Sundaram, B., Krishnan, S., Hiremath, A., & Joseph, G. (2012). Ecology and impacts of the invasive species, *Lantana camara*, in a social-ecological system in South India: Perspectives from local knowledge. *Human Ecology*, *40*, 931–942.

Sundaram, B., Hiremath, A., & Krishnaswamy, J. (2015). Factors influencing the local scale colonisation and change in density of a widespread invasive plant species, *Lantana camara*, in South India. *NeoBiota*, *25*, 27–46.

Tynsong, H., Tiwari, B., & Dkhar, M. (2012). Traditional knowledge associated with traditional harvesting bird harvesting of War Khasi Meghalaya. *Indian Journal of Traditional Knowledge*, *11*, 334–341.

Vandebroek, I., Reyes-Garcia, V., De Albuquerque, U., Bussmann, R., & Pieroni, A. (2011). Local knowledge: Who cares? *Journal of Ethnobiology and Ethnomedicine*. https://doi.org/10.1186/1746-4269-7-35

Voggesser, G., Lynn, K., Daigle, J., Lake, F. K., & Ranco, D. (2013). Cultural impacts to tribes from climate change influences on forests. In J. Maldonado, B. Colombi, & R. Pandya (Eds.), *Climate change and indigenous peoples in the United States: Impacts, experiences and actions* (pp. 107–118). Springer International Publishing.

West, P., & Brockington, D. (2006). An anthropological perspective on some unexpected consequences of protected areas. *Conservation Biology*, *20*(3), 609–616.

Wyndham, F. (2010). Environments of learning: Rarámuri children's plant knowledge and experience of schooling, family, and landscapes in the Sierra Tarahumara, Mexico. *Human Ecology*, *38*, 87–99.

Zarger, R. (2002). Acquisition and transmission of subsistence knowledge by Q'eqchi' Maya in Belize. In J. Stepp, F. Wyndham, & R. Zarger (Eds.), *Ethnobiology and biocultural diversity* (pp. 593–603). University of Georgia.

Zarger, R. (2011). Learning ethnobiology: Creating knowledge and skills about the living world. In E. Anderson, D. Pearsall, E. Hunn, & N. Turner (Eds.), *Ethnobiology*. Wiley-Blackwell.

Zent, S. (2013). Processual perspectives on traditional ecological knowledge – continuity. erosion, transformation, innovation. In R. Ellen, S. Lycett, & S. Johns (Eds.), *Understanding cultural transmission in anthropology: A critical synthesis* (pp. 213–265). Berghahn Books.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.