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Ethnozoological study of animal-based medicine used by traditional healers in Northern Western Ghats of Maharashtra, India

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Abstract. *Zope A, Sonawane A, Patil S, Nirgude B, Jagdale P. 2025. Ethnozoological study of animal-based medicine used by traditional healers in Northern Western Ghats of Maharashtra, India. Asian J Ethnobiol 8: 1-11.* Since the beginning of human history, animals have been used for various purposes. Animals provided food, medicine, and clothes for people. In this regard studies on ethnozoology have gained interest in India over the last decade. Ethnozoological research is required to identify novel treatments for human health and it is crucial to document this information. Thus, the authors endeavor to conduct a pilot ethnozoological study from the Northern Western Ghats of Maharashtra. Ethnomedicinal data was gathered from traditional healers through interviews, casual encounters, and overt observations using semi-structured questionnaires. The information collected was analyzed using the Informant Consensus Factor (ICF) and Fidelity Level (FL). The ethnozoological data include names of the animals and their body parts (organs) used in the local language, preparation, and administration method of medicine, and other informative pieces deemed helpful for research. A total of 37 animal species were identified for treating around 59 diseases. Mammals were the most frequently used therapeutic species (33%) by traditional healers. We are the first to report oral use of Maharashtra zipper Loach (*Paracanthocobitis mooreh*) as a therapy for drooling in the study area. It is considered that documenting ethnozoological knowledge could lead to the development of novel medications. Therefore, it is believed that the data in this work will be helpful in future research on ethnozoology, ethnopharmacology, and conservation.

Keywords: Anthropological field studies, ethnomedicine, ethnozoology, indigenous knowledge, zootherapy

INTRODUCTION

Traditional medicinal knowledge is an important alternative for the healthcare system in modern society (Hyma and Ramesh 2002; Febriyanti et al. 2024). The knowledge, abilities, and practices derived from Indigenous theories, beliefs, and experiences across various cultures constitute traditional medicine utilized to prevent, diagnose, treat, or improve physical and mental ailments (Kandari et al. 2015). Traditional medicine provides primary health care to approximately 70-80% of the world's rural population (WHO 2014). These traditional medicines are primarily administered following an agreement formed privately between consenting parties, and oral folklore has typically been the source of knowledge about traditional techniques (Eshete et al. 2016). Therefore, indigenous knowledge is based on tried-and-true methods that evolve due to people interacting with their surroundings. It is the product of many years and generations of experience, close observation, and trial-and-error research (Phichonsatcha et al. 2022; Bihari 2023). However, since different ethnic groups pass down their traditional medical knowledge verbally from elderly people to future generations, this knowledge may be lost with the passing of competent elderly people (Borah and Prasad 2016).

Research in ethnobiology is crucial to understanding the future viability of biocultural systems (Fopa et al. 2020). According to Faiz et al. (2022), cultural uses of animals (such as in food, medicine, hunting, business, entertainment, and religion) can influence people to think and act in ways that benefit animal conservation operations. Nevertheless, these techniques can harm or even threaten these species if they are not carried out sustainably or are impacted by economic, marketing, and political reasons (Dickman 2010; Mozer and Prost 2023). It is crucial to consider additional factors, such as environmental and climate alterations, when examining how people utilize particular animal species for therapeutic and cultural purposes (Alves et al. 2018).

Resources that indigenous people use worldwide around 60% of commercially available medications based on bioactive substances collected from natural resources (Ansari et al. 2023; Chaachouay et al. 2023). Although plants and plant derivatives have been prominent components of traditional medicine, identifying animal resources for medical healing is also essential in human health care (Borah and Prasad 2017; Castillo and Ladio 2018; Souto et al. 2018). Paws, skins, skeletons, bird feathers, and horns are among the byproducts of domestic and wild animals that are valuable elements in the formulation of medicinal, protective, and preventive remedies (Borah and Prasad 2016; Jugli et al. 2019). Thus,

ethnozoology is the study of the historical and contemporary interactions between humans and animals, documenting their distinct knowledge of animals to find new sources of food, medicine, and social aspects of animals in the world of humans (Borah and Prasad 2016; Bagde and Jain 2017).

Since ancient times, several cultures have used biodiversity as a source of therapeutics (Alves and Albuquerque 2012; Sen and Samanta 2015). As their livelihood is based on their local environment (Bhattacharjee et al. 2016; Sharma and Mohan 2024) most of the people living in the Western Ghats rely on traditional medicinal systems. People learned how to use natural systems in the form of food, medicine, and other applications for their survival (Chellappandian et al. 2014). India has an extensive biodiversity of fauna, which comprises about 10% of all reported biological species on the planet, and ranks first in terms of insects (54,600), followed by fishes (2546), birds (1232), reptiles (456), mammals (390), and amphibians (209) (Rangarajan 2006). In India, the known historical book such as Charak Samhita has reported and documented various zoo-therapeutic traditional medicines. Approximately 15-20% of Ayurvedic remedies are based on substances derived from animals (Unnikrishnan 1998). Different tribes and ethnic groupings in India have an immense quantity of information about animals and their medicinal usefulness for their basic healthcare needs (Mahawar and Jaroli 2008). Thus, further research is required to learn more about how India uses fauna that has therapeutic qualities. As a result, it is crucial to document the traditional indigenous knowledge of many ethnic communities, as numerous rural areas are losing their social and cultural traits (Alonso-Castro et al. 2011).

In various regions of Maharashtra, traditional medical practices are still widely used; however, research on medicinal animals or animal products has not been conducted in Maharashtra. Therefore, the current study seeks to investigate and document the traditional uses of animals and animal-derived products in their entirety in Maharashtra. It is believed that the current documentation would serve to preserve this diminishing information before it completely vanishes from tribes of the Nashik District. It is also expected that the current documentation will be crucial in protecting traditional knowledge and conserving and sustaining the biodiversity of the Northern Western Ghats for future generations.

MATERIALS AND METHODS

Study area description

The study was conducted in different regions of the Northern Western Ghats of Nashik (19.9975° N, 73.7898° E), Maharashtra. Nestled amidst verdant mountainous surroundings (Gangurde and Kumbhar 2018), Nashik is situated in the northern region of the state of Maharashtra. Also, the world-renowned Western Ghats is the northernmost portion of Nashik District. The Sahyadri Hills, another name for the Western Ghats, are renowned for their diverse and abundant flora and fauna. This region of Western Ghats extends from the north to the south of the district, which is characterized by its hilly terrain. Nashik has been endowed with enormous biodiversity with variations at the genetic, species-level, and ecological levels. Considering the facts above, the Peth, Surgana, and Trimbakeshwar tehsils of the Nashik district were chosen as the study locations (Figure 1). The Western Ghats Mountains reach into the district, because tribal communities use a broad variety of flora and fauna for the treatment of various ailments, the traditional medicine system is well established in the tribal part of Nashik District. The area is home to several tribes, including the Kokana, Bhill, Koli Mahadev, Warali, Thakur, and Katkari (Palwey 2019; Sonawane et al. 2019).

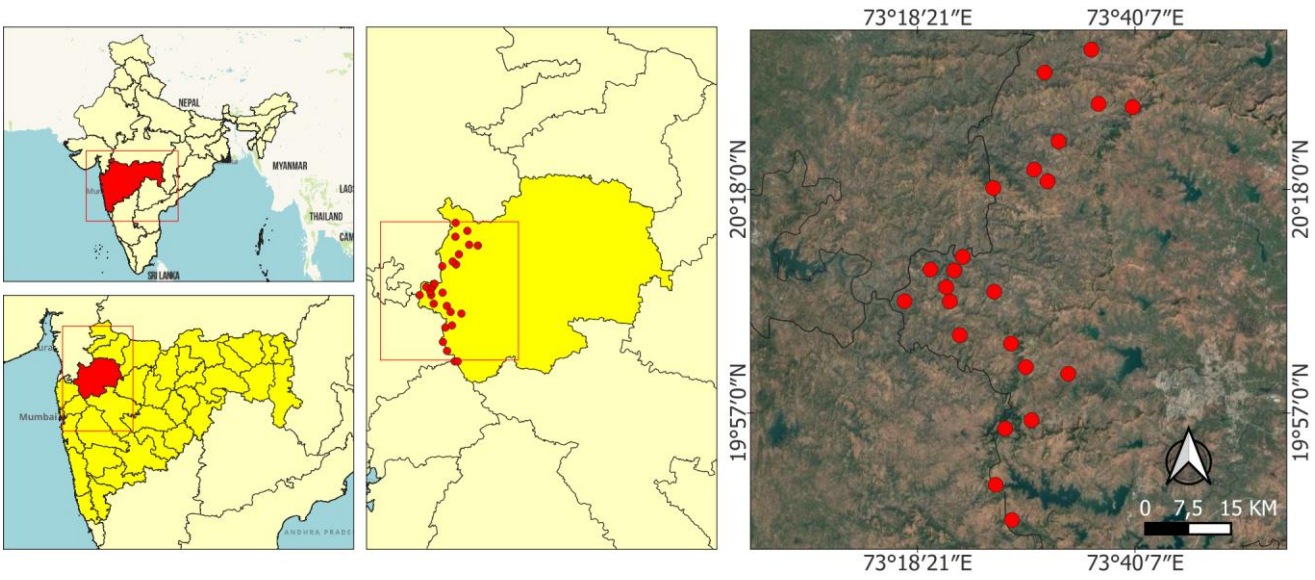

Figure 1. Map showing the field survey localities from Nashik District, India

Selection of study sites

Nashik is primarily located in the vicinity of the Western Ghats, where rainfall is typically higher. The Moist Deciduous Forest is the most prominent forest type in the area, and it is abundant in biodiversity. This forest is particularly prevalent in the areas surrounding Vaitarna Lake, Trimbakeshwar, Anjaneri, Igatpuri, Peint, Harsul, and Surgana. The study was conducted in three tehsils of the Northern Western Ghats of Nashik because the area is inhabited by several tribes. These tehsils were purposefully selected because traditional medicinal practitioners and knowledgeable indigenous people are more in number as compared to other tehsils of Nashik District. During the period of December 2022 to November 2023, this investigation examined potential animals and their components that were employed to treat a variety of ailments (Figure 2).

Sampling and data collection

The study population included all traditional medicinal practitioners and selected indigenous people over the age of 18 who practiced traditional medicine, lived in the study area of the selected tehsil, and were available throughout the data collection period. Community leaders, health extension workers, and local authorities of the respective tehsils assisted in the purposeful selection of indigenous people who were recognized by the local community as knowledgeable ("experts") due to their understanding of traditional medicinal services. Moreover, a snowball sampling technique was used to locate further prospective informants from the people living in the targeted locality. A semi-structured questionnaire was utilized to collect ethnozoological data from each informant (local name, indication, components of the animal used, technique of preparation, route of administration).

Quality assurance of the study

A semi-structured questionnaire was prepared in English form after reviewing different literature. The original form of the questionnaire was translated into the local language of Marathi, and then it was translated back into english. This was done to ensure that the questionnaire remained authentic. To test the data collection checklist, a pretest was done in November 2022 among four informants in Kachurli Village of Trimbakeshwar Tehsil, Nashik District. During the entire time that the data were being collected, they were checked to ensure that they were comprehensive and consistent.

Data analysis

SPSS and microsoft excel spreadsheets were used to clean, enter, and analyze data. Descriptive statistics were used to analyze quantitative data. The following formula was used to calculate the fidelity level (Tugume et al. 2016), informants consensus factor (Uddin and Hassan 2014), and use-values (Vitalini et al. 2013) from the collected data. For following formula IMA denotes the number of informants who stated a specific animal species used to treat certain ailments and FC denotes the overall number of informants who used animals as medicine to treat any given ailment.

$$\text{Fidelity Level (FL\%)} = (\text{IMA}/\text{FC}) \times 100$$

Where: Nur is the number of use reports from informants for a specific animal-use category and Nt is the total number of taxa or species used by all informants for that animal-use category. ICF values vary from 0 to 1, with '1' indicating the maximum level of informant consent.

$$\text{ICF} = (\text{Nur-Nt})/(\text{Nur-1})$$

Ethical considerations

The purpose of the study was explained to all study participants, and their right to decline was maintained. Throughout the data-gathering phase, ethical behavior, confidentiality, and anonymity were maintained.

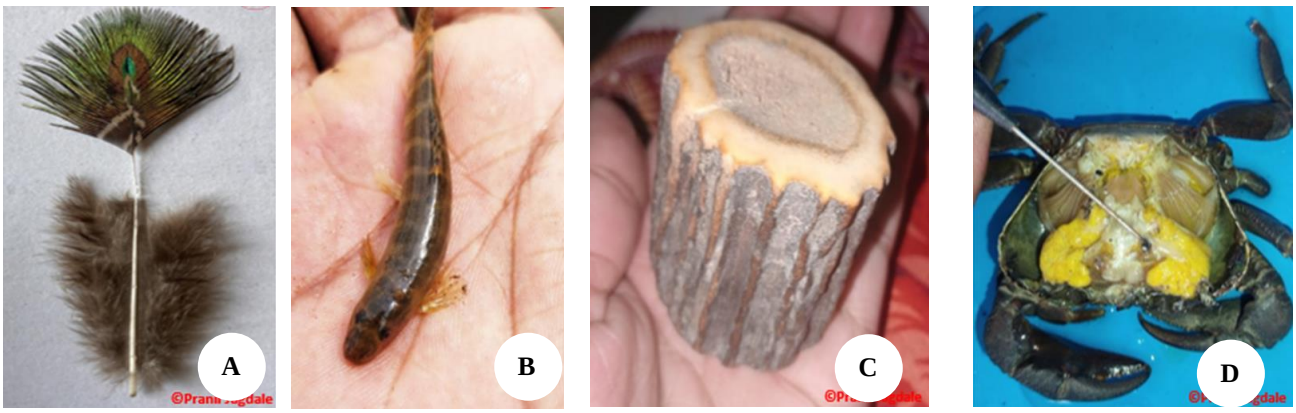

Figure 2. A. Feather/mayur of Indian peacock (*Pavo cristatus* Linnaeus, 1758.); B. Maharashtra zipper loach (*Paracanthocobitis mooreh*); C. Old horn piece with bone marrow of Samber deer (*Rusa unicolor* (Kerr, 1792)); D. Hepatopancreas of crab (*Barytelphusa cunicularis* (Westwood, 1836))

RESULTS AND DISCUSSION

Socio-demographic characteristics of informants

This study had a total of 58 participants, 56 of them were male (96.5% of the total), and only two of them were female (3.5%). A total of 34 individuals (58.5%) of the individuals who provided information were between the ages of 55 and 64, with 06 individuals (10.2%) being 65 years of age or older. A total of 51 individuals (88%) of the people who provided information were married. Figure 3 shows that more than half of the people who responded to the survey were illiterate. A total of forty people were interviewed, and sixty-six percent of them were farmers who offered private traditional medical therapy.

Ethno-zoological data

The majority of the informants, which accounted for 44.8% of the total, were taught by their father about the medical use of animals and associated products. In Figure 4, it can be seen that a sufficient number of respondents, specifically 72.4%, expressed a desire to transmit their therapeutic expertise to subsequent generations. Although forty people, or 68.9%, gave traditional medicine for the purpose of self-satisfaction or in the belief that God's gifts were bestowed upon them. Regarding the dosage, around 26 practitioners, which accounts for 44.8% of the total, utilized various measurements such as spoons, cups, mud pots, and locally available materials.

Category of animals medicinally used in the study area

During the course of this investigation, 37 different species from nine different categories including mammals, avians, reptiles, amphibians, molluscs, pisces, arthropods, and insects were utilized to treat 59 different health-related issues. Mammals were the most frequently used therapeutic species (33%) by traditional healers and Indigenous people in the study area (Figure 5). In contrast to those obtained domestically, 25 species (68%) of the total therapeutic animals or their products utilized historically came from wild sources (Table 1).

Animal parts/products used as traditional medicine

In the present study, meat or fatty meat (28.8%) was the most commonly used animal product. Followed by that whole organism (10.1%), horn powder (8.4%), and egg (6.7%) are used as major parts or products used in traditional medicine for various ailments. The remaining details of other products are given in Table 2. Furthermore, therapeutic values have been recorded for various parts including liver, ghee, eye, hoof (leg toe/nail), blood, feather, legs, bones, shell, brain and gastric content.

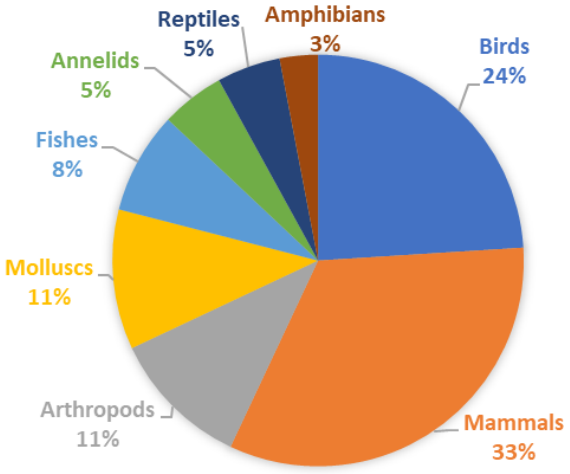

Figure 5. Category of animals used traditionally in Tribes

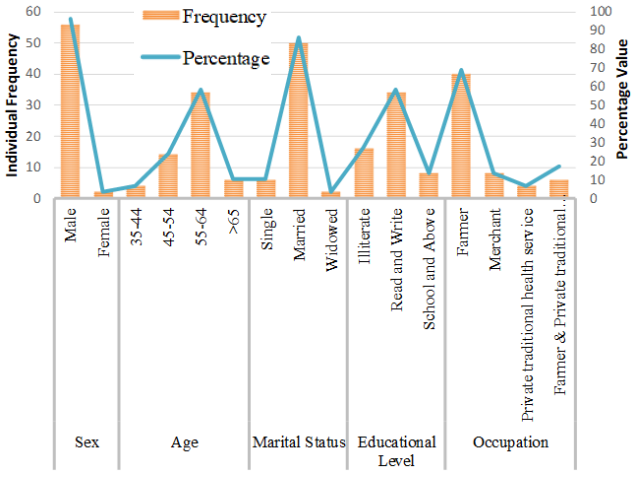

Figure 3. Socio-demographic characteristics of informants

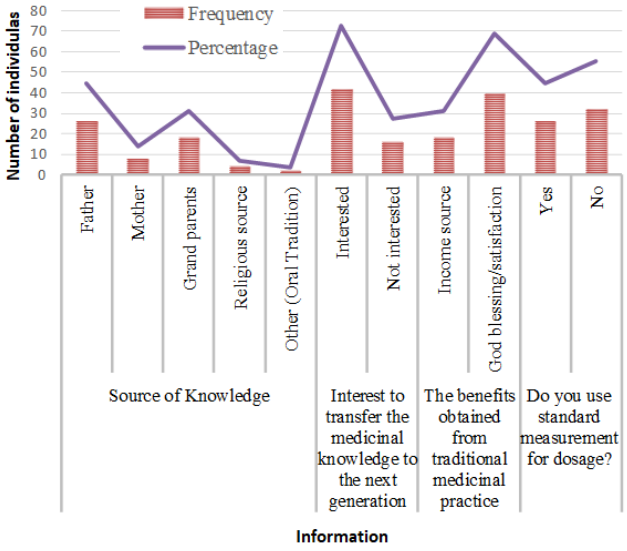

Figure 4. Chart source of knowledge, the attitude of community and practice-related information

Table 1. Medicinal animals, parts/products used, diseases treated, mode of preparation, and routes of administration in the study area

Category & Scientific name	English name	Local name	IUCN status	Ailments/ indications	Part of use	Preparation and dosage	Application	Fidelity level
Mammal								
Prionailurus rubiginosus (I.Geoffroy Saint-Hilaire, 1831)	Rusty-spotted cat	Ranmanjar	VU	Burn	Hairs	Powder mixed in oil and used till it heals	Topical	50
				Cut/injury	Hairs	Powder mixed in ghee/oil and used till it heals	Topical	60
Bos frontalis Lambert, 1804	Gaur	Bail	NE	Swelling	Horn powder	Burning the horn and apply powder on the swelling area till it heals	Topical	66.7
				Sprain/cramp	Bone with bone marrow	Massage the area with forging marrow till it heals	Topical	50
				Anemia	Liver	Eating the fresh liver	Oral	60
Pteropus giganteus (Brünnich, 1782)	Indian flying fox	Watvaghul	LC	Eye irritation	Meat	Cooked. Three pieces of fresh meat for a day	Oral	67.6
				Asthma	Meat	Cooked. Three pieces of fresh meat for a day	Oral	71.4
Lepus nigricollis F. Cuvier, 1823	Indian hare	Sasa	LC	Children cough	Milk	Boil once and give 2 spoons of milk for 3 days	Oral	75
Sus scrofa Linnaeus, 1758	Wild boar	Randukkar	LC	Wellness	Meat	Cooked. Three pieces of fresh meat for a day and consumed	Oral	75
				Joint pain	Brain oil	Cook and massage with extracted oil	Topical	81.8
Bos taurus Linnaeus, 1758	Cow	Gay	NE	Blood sugar/ cancer	Urine	Consumed cup of Urine early in the morning	Oral	71.4
				Cataracts	Ghee/ clarified butter	Put a drop of ghee in the eyes for 5-7 days	Oral/topical	100
Capra hircus Linnaeus, 1758	Goat	Bakri	NE	Blood in increase & wellness/ weakness	Liver/meat/ brain	Cooked meat pieces of fresh meat for a day and consumed	Oral	100
				Cough	Urine	Consumed cup of urine early in the morning	Oral	50
				Fracture	Leg toe	Prepare soup and drink till it heals	Oral	100
Bubalus bubalis (Linnaeus, 1758)	Water buffalo	Mhas	NE	Skin dryness/ itching	Ghee	Apply ghee on the affected surface and massage till oil is absorbed completely	Topical	50
Herpestes edwardsi (É.Geoffroy Saint-Hilaire, 1818)	Indian grey mongoose	Mongoose	LC	Snake bit (non-poisons)	Skin	Apply the paste form of powder on the snake bite	Topical	30
Equus hemionus subsp. *khur* Lesson, 1827	Indian wild ass	Gadhav	EN	Cough to baby	Fresh milk	Give 2 spoons of milk for 3 days	Oral	81.8
				Cold&Fever	Horn powder	Take Steam of horn powder for 3 days	Topical	66.7
Rusa unicolor (Kerr, 1792)	Sambar deer	Sambar	NT	Blood clotting	Horn powder	Apply the paste form of powder on the affected surface	Topical	100
				Injury/cut	Horn powder	Spread the powder on the affected surface	Topical	46.1
Bandicota indica (Bechstein, 1800)	Greater bandicoot rat	Ghus	LC	Weakness	Meat	Cooked three pieces of fresh meat for a day and consumed	Oral	66.6

Aves								
Ardeola grayii (Sykes 1832)	Indian pond heron	Khabra-bagala	LC	Asthma	Meat	Cooked two-three pieces of fresh meat for a day and consumed	Oral	100
				Injury/cut	Foot toe	Spread the powder on the affected surface	Topical	50
Columba livia J.F.Gmelin, 1789	Pigeon	Parva	LC	Paralysis	Blood	Massage the area with blood till it heals	Topical	100
				Asthma	Meat	Cooked at least three pieces of fresh meat for a day and consumed	Oral	83.3
Gallus gallus f. *domesticus*	Domestic chicken	Kombad/ Kombdi	NE	Bone injury	Egg	Consumed. Cooked or row 2 eggs per day till it heals	Oral	100
				Cough	Egg	Consumed. Cooked egg every night day till it heals	Oral	77.4
				Fracture	Meat	Cooked two or three pieces of fresh meat for a day and consumed	Oral	90.9
Coturnix coturnix (Linnaeus, 1758)	Common quail	Titar	LC	Skin problem/ rash	Meat	Cooked two or three pieces of fresh meat for a day and consumed	Oral	60.7
Anas platyrhynchos Linnaeus, 1758	Mallard Duck	Badak	LC	Thyroid	Meat/egg	Cooked two or three pieces of fresh meat for a day and consumed	Oral	50
Phalacrocorax fuscicollis Stephens, 1826	Indian Cormorant	Pankawla	LC	Menstrual cycle	Meat	Cooked at least three pieces of fresh meat for a day and consumed	Oral	70
Pavo cristatus Linnaeus, 1758	Indian Peacock	Mor	LC	Vomiting/ asthma	Feather /mayur	Consumed powder with a spoon of honey once a day	Oral	62.9
				Kidney stone	Undigested food from the stomach	Cook it and consume filtrate only	Oral	33.3
Dromaius novaehollandiae (Latham, 1790)	Ostrich	Emu	LC	Joint pain/skin problem/eye problem	Egg	Cook it and consume the whole egg	Oral	66.6
Galloperdix spadicea (J.F. Gmelin, 1789)	Red spurfowl	Kokatri	NT	Pain in ear	Legs	Cooked in water and pour 2-3 drops of water in the ear	Topical	50
Reptile								
Varanus bengalensis (Daudin, 1802)	Indian Monitor	Ghorpad	LC	Burn	Oil	Apply oil on the surface till it heals	Topical	96
				Cataracts/ blurred vision	Oil	Put a drop in the eyes for 5-7 days	Topical	66.6
				Asthama	Brain	Cooked and eaten for 2-3 days	Oral	40
				Burn	Skin	Mix the powder in oil and apply	Topical	90.9
Pangshura tecta (Gray, 1831)	Indian roofed turtle	Kasav	EN	Hemorrhoids	Meat	Cooked and eaten for 2-3 days	Topical	66.6
Amphibians								
Rana tigrina	Frog	Beduk	LC	Gain strength wellness	Meat	Cooked whole organism and eat it once a week	Oral	60

Pisces								
Labeo rohita (Hamilton, 1822)	Rohu	Rou	VU	Better vision	Meat/eyeball	Cooked whole organism and eat it once a week	Oral	90.9
Catla catla (Hamilton, 1822)	Catla	Katla	VU	Better vision	Meat/eyeball	Cooked whole organism and eat it once a week	Oral	87.5
Paracanthocobitis mooreh	Maharashtra zipper loach	Murhi	NE	Drooling	Whole organism	Keep alive fish on the tongue of baby for few seconds	Oral	80
Insect								
Apis indica Fabricius, 1798	Honey bee	Madhmashi	LC	Mouth ulcer	Honey	Apply on ulcer using finger twice a day for three days	Oral	76.7
Apis dorsata Fabricius, 1793	Rock bee	Madhmashi	LC	Cough	Honey	Take a spoonful of honey once a day for three days	Oral	89.6
Arthropoda								
Hottentotta tamulus (Fabricius, 1798)	Indian red scorpion	Vinchu	LC	Purulent	Whole organism	cooked in oil and apply extracted oil with mayur /bird feather	Topical	56.2
Barytelphusa cunicularis (Westwood, 1836)	Crab	Khekud	NE	Joint pain	Meat	Cooked and eaten for 2-3 days	Oral	100
				Tinea versicolor	Yellow matter/ hepatopancreas	Apply on the affected surface till it heals	Topical	89.6
				Strengthen bones	Bones/skeleton	Make fine powder, mix in goat milk, and have it once a week	Oral	75
Annelida								
Hirudinaria Whitman, 1886	Leech	Jalu	LC	Skin problem/ purulent	Live leech	Keep leech to affected area and allow to suck blood till it heal	Topical	40
Lumbricus terrestris Linnaeus, 1758	Earthworm	Shidad	NE	Lactation	Whole organism	Cook in water, grind it and eat a cupful of organism	Oral	80
Mollusca								
Mariaella dussumieri L.Pfeiffer, 1855	Brown slug	Gogalgai	NE	Children cough	Whole organism	Cooked the whole organism and eat it for 2 days	Oral	68.4
Turbinella pyrum (Linnaeus, 1758)	Chank shell	Shankh	NE	Digestion/upset stomach/eye disease	Novel	Pinch of powder with a spoon of honey once a day	Oral	50
Monetaria moneta (Linnaeus, 1758)	Money cowrie	Kawadi	NE	Asthma allergy/ ear infection	Cowrie white shells	Pinch of powder with a spoon of honey once a day	Oral	45.4
				Kidney stone	Cowrie white shells	5-6 shells keep overnight in lemon juice and have empty stomach next morning	Oral	66.6
Ampullariidae	Apple snails	Khube	NE	Piles	Whole organism	Prepare soup and drink empty stomach for 2 -3 days	Oral	40
				Asthma	Meat	Cook meat with chicken egg and eat once a week	Oral	50

Note: The use of above medications/treatments/therapies is not recommended for readers. The medicines/therapies/treatments discussed in this article are based on traditional practices and local beliefs. They have not been clinically studied, and their efficacy and safety have not been determined. LC: Least Concern; NT: Near Threatened; VU: Vulnerable; EN: Endangered

Table 2. Proportions of parts/products of medicinal animals used in the study area

Parts/product of animals	Frequency	Percentage
Meat/fatty meat	17	28.8
Whole organism	6	10.1
Hair Powder	2	3.3
Horn powder	5	8.4
Oil	3	5
Milk	2	3.3
Egg	4	6.7
Honey	2	3.3
Urine	2	3.3
Skin	2	3.3
Other	14	23.7

Note: Others include: Liver, ghee, eye, hoof (leg toe/ nail), blood, feather, legs, bones, shell, and gastric content which occurs in a unit frequency

Table 3. Informant consensus factor for the common indications that the medicinal animals and animal products used by traditional medicinal practitioners and Indigenous people

Indication	Number of use reports (Nur)	Number of species for the indication (Nt)	ICF
Asthma	86	7	0.92
Cough	142	6	0.96
Joint pain	90	3	0.97
Burn	44	2	0.97
Cut/lacerations	18	3	0.88
Cataracts	13	2	0.91
Bone injury	32	2	0.96
Kidney stone	10	2	0.88
Cancer	11	1	1
Paralysis	21	1	1

Routes of application of medicinal animal remedies in the study area

Therapeutic animal products or treatment remedies were reported to be used in a variety of ways. Majority of treatment is either given orally or given as topical application on the affected surface. During entire treatment the parts (organ) of animals or their products are consumed either in cooked or in a raw form. The oral method is used for more than half of the manufactured animal medical treatments, followed by the topical route (30.8%).

Fidelity level of medicinal animal or animal products

According to the present investigation, fidelity levels range is recorded from 40 to 100% in the medicinal practice of animal and their products. According to the assessment, the use of apple snails to cure piles had the lowest fidelity level at 40.0%, while the use of ghee to treat cataracts, crab meat to treat joint pain, and chicken eggs to treat bone fracture had the highest fidelity level at 100%. Pigeon blood to treat paralysis, Indian pond heron meat to treat asthma, sambar deer horn powder to treat blood clotting. Rest all the other animal species used to treat various ailments with their fidelity level are mentioned in Table 1.

Informant consensus factor

The Informant Consensus Factor (ICF) was used in this study to determine the amount of agreement among respondents about which animal to use for each illness category. According to this study, informants had a high level of agreement (ICF = 1) in the treatment of paralysis and cancer. However, the informants' level of variability in kidney stone therapy was substantial (ICF = 0.85) as given in Table 3.

Discussion

The human-animal relationship has existed for more like millions of years, and it is influenced by cultural and environmental factors (Faiz et al. 2022). Since ancient times, goods generated from fauna have been used for a variety of reasons, including food, tools, ethnomedicine, and magico-religious practices (Chaudhury et al. 2016). Using parchment documents, archives, and medical artifacts, the utilization of animals or products derived from them has been documented throughout human history, including at the urban centers of ancient Mesopotamia, Assyria, and Babylon (Vijayakumar et al. 2015). The development of emotional bonds with specific and numerous species of animals that were kept as pets, particularly birds, mammals, and, more recently, reptiles and amphibians, is associated with this kind of dependency (Alves and Souto 2015; Adil et al. 2022).

In the most recent scenario, there has been an increasing worry regarding the effects of human activity on the preservation of biodiversity and ecosystem services (Dirzo et al. 2014; Haddad et al. 2015; Liu et al. 2018). Enhancing our awareness of the social cultural, economic, and traditional functions that animals perform is the most significant asset that can be gained from conducting ethnozoological research. Accordingly, they play a key role in the management and conservation of the local biodiversity within the framework of the local human populations (de Lima et al. 2014; Alves and Souto 2015).

According to Faiz et al. (2022), Holennavar (2015), and Ahmad et al. (2023), zootherapy is the practice of using animals or products made from animals to treat human health ailments. Zootherapy is the practice of using both domestic and wild animal parts and their byproducts, such as hooves, skins, bones, feathers, and tusks, as important components in the formulation of medicinal remedies intended to be therapeutic, defensive, and preventive (Chaudhury et al. 2016).

According to the current investigation, older populations in the Nashik District of Northern Western Ghats, have more expertise and knowledge than younger generations on the traditional medicinal uses of animals. Similar tendencies were confirmed from previous studies demonstrating that elderly persons are more knowledgeable in zoo therapeutical procedures and they hold the knowledge learned from their parents or senior members of their community (Verma et al. 2014; Borah and Prasad 2016, 2017; Kendie et al. 2018). In the study area, the development of contemporary higher education,

modernization, migration to surrounding cities, and opinions toward the practice as a detrimental tradition are some of the responsible factors for the younger generation's involvement.

The Western Ghats are known for their diverse climatic and ecological conditions and their biodiversity, home to thousands of animal species (Nameer et al. 2001). According to a World Health Organization (WHO) assessment, the role of traditional and complementary medicine in global healthcare, highlighting its use in rural and underserved population (WHO 2019). The reliance of rural populations on traditional medicine, including animal-derived therapies, and emphasizes the ongoing importance of such practices in these areas (Shi et al. 2021). In this study, 37 animal species were observed and identified that were believed to be a cure/prevention of over 59 kinds of ailments. Similar studies (Borah and Prasad 2017) from India reported, that approximately 44 different species of animals are used for the treatment of 40 different ailments by indigenous inhabitants in the adjoining areas of Gibbon Wildlife Sanctuary, Assam, India in addition, traditional healers in Kerala's Silent Valley reportedly using 69 animal species to make 162 practices for various diseases (Vijayakumar et al. 2015). According to Mishra et al. (2011), in the Similipal Biosphere Reserve of the state Orissa, 13 animal species are used as zootherapeutic resources were used to cure 12 different kinds of illnesses.

According to a report from Gibbon Wildlife Sanctuary in Assam, India, insects may have been used primarily due to their easy availability in the study region (Borah and Prasad 2017). Mammals rank second among zootherapeutic animals because some of them are domesticated. Mammals and reptiles, however, are reportedly among the primary groups of animals utilized in traditional medicine (Alves et al. 2017). Mammals were the most commonly used domestic animals in the research locations throughout the present investigation. Additionally, Bagade and Jain (2015) found that in the Madhya Pradesh District of Chhindwara, birds were the most often used species, followed by mammals for the preparation of therapeutic remedies. However, insects and mammals were considerably more important for therapy purposes than birds for the people residing in Tamil Nadu's Kolli Hills (Raja et al. 2018).

Similarly, Das et al. (2017) conducted a review of the 19 ethnic entities in North-East India and also reported most often utilized mammal and bird organs for medical purposes include fresh flesh, gall bladder, adipose tissue, and liver tissue. In contrast, amphibians are often consumed in smaller amounts than reptiles. Many nations have traditionally used frogs as a high-protein food source (Zhan et al. 2020; Mussarat et al. 2021). A variety of active compounds with potential therapeutic applications have been extracted from amphibians (Qi et al. 2011; Zhan et al. 2020), demonstrating the significance of amphibians in medicine. Zhan et al. (2020) report that 118 bufadienolide monomers and 11 indole alkaloids have been extracted from *Bufo* spp. These compounds show a range of pharmacological effects both in vitro and in vivo, including detoxification, immunomodulation, anti-tumor, and anti-inflammatory properties.

The people of the study area were discovered to use several animal parts/products for the treatment of various diseases. Animals and products derived from their organs are included in the inventory of therapeutic compounds (González and Vallejo 2021). Additionally, Meyer-Rochow (2017) claimed that many invertebrate animal tissues were utilized as traditional treatments. The use of oil extracted from Indian monitor (*Varanus bengalensis* (Daudin 1802)) in treatment of cataracts, meat of Indian pond heron (*Ardeola grayii* (Sykes, 1832)) for asthma, horn powder of Sambar deer (*Rusa unicolor* (Kerr, 1792)) achieves the highest fidelity level, whereas hair powder of rusty-spotted cat (*Prionailurus rubiginosus* (Geoffroy Saint-Hilaire, 1831)) on cut/injury, meat of Indian cormorant (*Phalacrocorax fuscicollis* (Stephens, 1826)) used for menstrual problems, soup of apple snail (*Ampullariidae* spp.) used to cure piles have the lowest fidelity. Jaroli et al. (2010) found that Garasiya informants show higher fidelity when using generally known animals compared to lesser-known species. He also reported the highest fidelity level was found in cooked bat flesh (*Cynopterus sphinx* (Vahl, 1797)) for cough and fever relief, after that pigeon blood (*Columba livia* J.F.Gmelin, 1789) for paralysis treatment, and cow urine (*Bos taurus*) for healing wounds. The lowest fidelity level was found in pig flesh (*Sus scrofa* Linnaeus, 1758) for muscular pain relief and elephant flesh (*Elephas maximus* Linnaeus, 1758) for pimples.

The most common route of medicine delivery is oral consumption (69%), followed by topical applications (31%). Nowadays most drugs are administered orally, as reported in other studies (Jaroli et al. 2010; Verma et al. 2014). Topical application is still a crucial form of treatment administration for disorders of the skeleton and muscular system, such as rheumatism, paralysis, swellings, furuncles, tetanus, and arthritis (Chellappandian et al. 2014; Kim and Song 2014; Jaroli et al. 2010; Verma et al. 2014, Vijayakumar et al. 2015). In medical terms, unintentional saliva flow from the mouth is a sign of drooling. This could be due to an excess of saliva or underdeveloped muscles in your mouth (Slavotinek and Dysmorphology 2020; Weiss and Balamuth 2020). Drooling can be caused by neurological diseases or other medical conditions (Nicholson et al. 2023). We are the first to report the oral use of *Paracanthocobitis mooreh* as a therapy for drooling in the study area. The majority of the medicine concoctions contained no additives, while the remaining ones contained various additives such as water, honey, oil, ghee, and egg. According to Mussarat (2021), numerous animals were utilized to treat a variety of diseases, individually or in combination with other animal products and plants such as seeds, flowers, latex, and roots.

In summary, this study reveals that some animal species have a significant role in traditional healing methods among people of the Northern Western Ghats. Additionally, as per the list of IUCN (Table 1), conserving specific threatened animal species is crucial for preserving traditional medical knowledge. The sudden decrease in senior individuals who rely on animals is expected to result in a loss of oral traditional knowledge, which has been observed in regions of Kerala (Vijayakumar et al. 2015). We recognize very

well that traditional knowledge of animal uses that has been passed down orally must be preserved in sustainable ways.

In conclusion, since this study is the initial step for recording the traditional knowledge and practice of zootherapy among the Indigenous peoples of Nashik District from Northern Western Ghats, the findings show that the region is inhabited with a variety of medicinal animals that are utilized to treat a range of ailments in human beings. In the research site, the major healthcare system is the use of animals and animal-derived products for indigenous medical treatments. It may also assist raise awareness of the need to conserve, preserve, and use biological diversity sustainably before it is completely destroyed. This investigation showed that traditional healers in the area are still using animals to cure a variety of ailments. In addition to its medicinal significance, traditional knowledge is important because it relates to the various cultural traditions and emotions had by the indigenous people. This study lays the groundwork for future scientific validation of the therapeutic efficacy of different zoo-therapeutic traditional applications by these people, as well as the discovery of novel biological compounds towards the discovery of new pharmaceuticals.

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