Traditional Healing Practices in Dehradun: Ethnobiological Perspectives and Conservation Status

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Abstract- **The present study was conducted in Dehradun to document ethnobiological knowledge associated with traditional healthcare practices. A total of 39 species were recorded, including 29 plant species and 10 animal species. The documented plant species were classified into 22 taxonomic families, while the animal species belonged to six families. Among animals, the Cyprinidae family was the most dominant, comprising *Catlacatla, Cirrhinuscirrhosus, Labeorohita,* and *Tor putitora*, followed by Phasianidae, which included *Gallus gallus* and *Perdix perdix*. Roots were the most frequently utilized plant parts (N=8 species), while animal tissues were the most commonly used components (N=4 species). A total of 29 medicinal plant species were identified, used for treating 14 diseases, with injuries being the most frequently addressed condition. Similarly, 10 animal species were used to treat 11 ailments. Conservation status assessment revealed that *Saussureacostus* and *Thymus linearis* are Critically Endangered (CR), *Gastrodiaelata* and *Parrotiopsisjacquemontiana* are Vulnerable (VU), *Swertia petiolata* is Near Threatened (NT), and *Trillium govanianum* is Endangered (EN). Among animals, *Tor putitora* is classified as Endangered (EN). These findings highlight the critical role of plant and animal species in traditional medicine and underscore the need for conservation efforts to safeguard this valuable biological resource.**

Keywords: **Ethnomedicine, flora, fauna, ethnic communities, conservation.**

I. INTRODUCTION

Plants and animals have been integral to human civilization, serving various purposes, including medicine, food, culture, and religious affiliations. The awareness of their therapeutic properties dates back to prehistoric times and has been preserved in cultural heritage (Ahad et al., 2023). Historical records suggest that medicinal plant use extends over 60,000 years (Verma et al., 2023). Traditional medicine systems have effectively treated seasonal diseases; however, ethnopharmacological knowledge is declining due to modernization (Painuli et al., 2021).

Ethnobiology has evolved from documentation to practical applications and sustainable management of traditional knowledge. Specific plant parts such as leaves, stems, and roots, along with animal products like trotters, liver, and skin, are commonly used for medicinal purposes. The choice of these parts depends on bioactive compound concentrations. Remedies are administered in various forms, including drinks, pills, and topical applications (Geszke-Moritz et al., 2023). The loss of this knowledge is a growing concern among ethno-biologists.

Approximately 80% of the global population still relies on traditional herbal medicines due to their affordability and availability (Hosseini et al., 2021). Of the estimated 390,000 plant species, around 28,000 have medicinal properties (Mumpower, 2023). Among the 8.7 million known animal species, about 5,000 have been documented for medicinal use (Lagat, 2022).

In the Himalayan region, ethnic groups like the Gujjar, Pahari, and Buxa depend on natural resources for their healthcare needs. Their indigenous knowledge varies due to socioeconomic and religious influences and is typically passed down orally (Das & Behera, 2023). The Buxa tribe, residing in Dehradun, possesses unique ethnobiological knowledge. Historically linked to the Panwar Rajputs, they migrated due to adverse geo-social conditions and adopted Hindu cultural practices (Singh, 2017; Ranjan, 2008). The Bhuksas, a non-Aryan lineage, predominantly inhabit the Tarai-Bhabar region and adhere to a patrimonial societal structure (Fiol, 2017).

Conservation efforts are essential to sustain biodiversity and protect traditional knowledge. Indigenous tribes play a crucial role in maintaining ethno-biological resources, yet species face depletion due to unsustainable harvesting and climate change (Mir et al., 2021). Effective conservation strategies include community-based approaches, protected areas, reforestation, documentation of traditional knowledge, and education on sustainable practices. Collaboration between researchers and ethnic groups can enhance conservation efforts (Waliczky et al., 2019).

The International Union for Conservation of Nature (IUCN) classifies species based on their extinction risk, emphasizing the need for systematic documentation, sustainable harvesting, seed banks, and conservation awareness (Shafi et al., 2021). Ecotourism and sustainable livelihoods can further incentivize conservation (Di Sacco et al., 2021).

Despite extensive research on the Buxa community's ethno medicinal practices (Srivastava & Agnihotri, 2023; Pandey et al., 2012, 2013; Sharma & Lata, 2021), no comparative study has examined the ethnobiological use of flora and fauna. This gap led to the development of the following objectives:

1. To evaluate the comparative ethnopharmacological usage of plants and animals across the Buxa community.
2. To investigate the IUCN conservation status of the documented species employed for ethnopharmacological purposes within the Buxa community.

II. MATERIALS AND METHODS

2.1. Study area

Dehradun (Figure1), also known as Dehra Doon, is located in the northwestern part of the state (Uttarakhand) in the foothills of the Himalayas nestled between Song River, a tributary of Yamuna on the west, at an elevation of about 640m above sea level (Kumar et al., 2021). Nearly 80, 7000 people live in the area, distributed among five communities. The total area of Dehradun is 3088 sq. km (Shetty et al., 2021). According to the last census, most of the people are Hindu (82.53%) followed by Islam (11.75%), Sikhism (3.50%), Christianity (1.06%), Buddhism (0.29%), and Jainism (0.63%). As per Koppen's classifications, Dehradun falls under the "Cwa" category, indicating a humid subtropical climate with dry winters. Summers (March to June) are hot and dry, while the monsoon season (July to September) brings substantial rainfall. Winters (October to February) are mild and dry, with temperatures ranging from 5°C to 20°C. The region exhibits a pronounced seasonal contrast in precipitation patterns. Dehradun experiences an average annual temperature of approximately 21°C. During the summer months from March to June, temperatures range between 24°C to 38°C. The monsoon season, spanning July to September brings temperatures ranging from 23°C to 30°C, coupled with substantial precipitation. Winter, occurring from October to February, sees temperatures ranging from 5°C to 20°C (Islam et al., 2020). These seasonal temperature fluctuations underscore the climatic diversity of Dehradun throughout the year. Dehradun features diverse vegetation shaped by its topographical and climatic variations. It hosts subtropical broad-leaf forests in lower regions transitioning to temperate coniferous forests at higher altitudes, dominated by species like Sal, teak, oak, and various pines. The fertile plains also support the agricultural cultivation of crops such as rice, wheat, mangoes, lychees, and citrus fruits, contributing to the region's botanical richness and agricultural productivity across various professions and industries (Kumar et al., 2020). Agriculture and forestry form the bedrock of Dehradun's economy, supported by complementary services. In addition to these sectors, the local population engages in diverse livelihoods such as daily wage workers, government employment, and the sale of dairy products derived from cows and buffalo (Panda, 2021). These activities collectively underpin the socio-economic framework of the region.

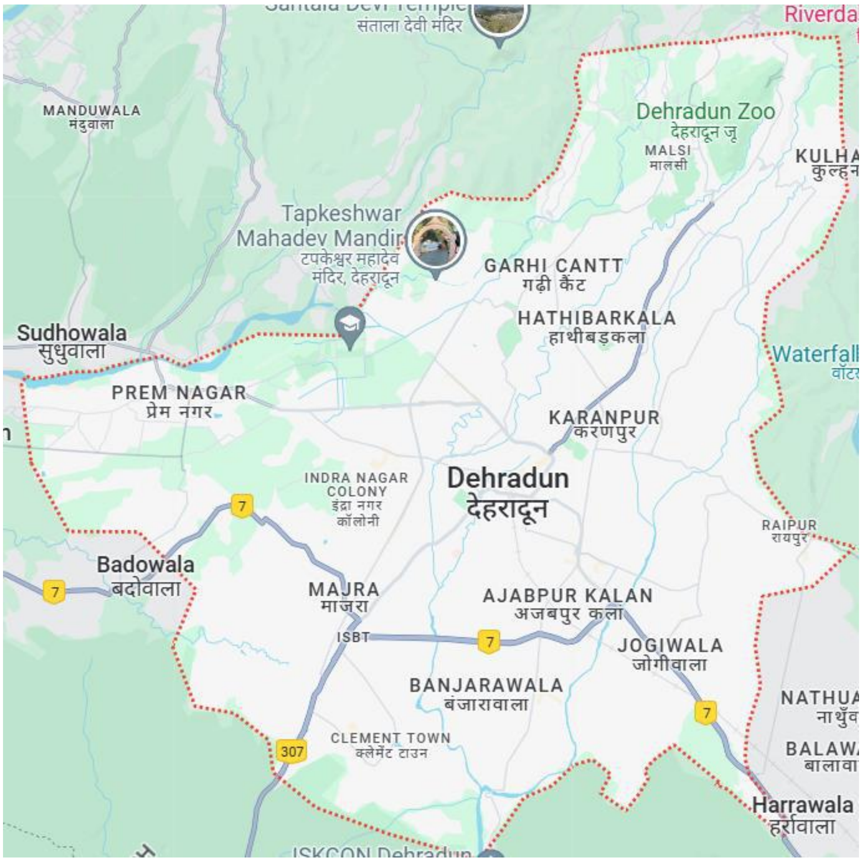

Figure 1: Map of the study area (Source: Google Maps)

2.2. Socioeconomic background of Bauxa

The Bauxa community, also known as the "Bhoxa", are Indigenous peoples living in the states of Uttarakhand and Uttar Pradesh (Bhatt and Rani, 2018). They are mostly concentrated in the Dehradun and Nainital districts in the foothills of the outer Himalayas they are found in the Bijnor district of Uttar Pradesh, where they are known as Khas (Srivastava and Agnihotri, 2023). Both communities have been granted scheduled tribe status. An examination of their socioeconomic background reveals various dimensions, engaging mainly in subsistence agriculture and forest-based livelihoods, with some members working as wage labourers due to limited agricultural resources. Their literacy rates are low, impacted by poverty, remote living conditions, and insufficient educational infrastructure, despite efforts by the government and NGOs to improve access (Dutta, 2015). Healthcare access remains inadequate, with reliance on traditional medicine prevalent. Housing conditions are modest, with limited access to essential amenities like clean water, sanitation, and electricity. Recognized as a scheduled tribe (ST), the Buxa community is eligible for various governmental benefits aimed at socioeconomic improvement; however effective implementation of these programs is inconsistent (Verma, 2008). The community faces significant challenges; including land rights issues, displacements, environmental degradation, and social exclusion, which collectively hinder their socioeconomic development (Mishra, 2021).

2.3. Demography of informants

The demographic detail underscores the importance of inclusive approaches in ethnobiological research to ensure the representation of diverse knowledge holders (Dawson et al., 2021). In the present study, a total of 60 individuals were selected for the interview process, consisting of 33 men and 27 women. The predominance of men over women can be attributed to cultural constraints. Before recording data, frequent visits were made to the study area to ensure active participation from the local community. The data collection was done via simple random sampling with a focus on traditional knowledge related to using plants and animals for medicinal and dietary purposes (Hassan et al., 2022). The study was conducted from April to June 2024. Before each interview, verbal consent was obtained from the participants, and a code of ethno biology (https://ethnobiology.org/about-societyethnobiology/ethics) was followed. The interviews were conducted in Hindi and included informants of various ages, genders, and occupations (Table1). Semi-structured questions were utilized to capture traditional knowledge effectively. It was observed that the elderly were the most knowledgeable group. Additionally, a notable proportion of the respondents (17.74%) were illiterate. The nomenclature of plant species was verified by World Flora Online (http://www.worldfloraonline.org), and animal species by Integrated Taxonomic Information System (ITIS) (www.itis.gov).

For the quantitative data analysis of the results, we employed the chord diagrams and matrix heatmap using Origin Pro (2021).

Table1: Demographic information of respondents

Demographic Features	Number	Percentage
Ethnic group		Bauxa
Education		
Illiterate	11	17.74%
Primary education	17	28.33%
Secondary education	13	21.66%
Higher education	19	31.66%
Age range		
Young (18- 26)	12	20%
Middle (27-55)	22	36.66%
Old (56-75)	26	43.33%
Profession		
Farmer	10	16.66%
Skilled / semi-skilled workers	9	15%
Grower/ agriculture workers	14	23.33%
Government employees	12	20%
Housewives	6	10%
Shopkeepers	5	8.3%
Herders	4	6.6%
Gender		
Male	33	55%
Female	27	45%
Religion	Hindu	100

III. RESULTS AND DISCUSSION

3.1. Taxonomic profile

In the present study, a total of (N=39) species were documented with ethnobiological attribution, out of which (N=29) are plant species and (N=10) are animal. The documented animal species were classified into (N=6) taxonomic families and plant species were classified into (N=22) taxonomic families.

In the case of animals, we found that the Cyprinidae family is the most dominant, comprising 4 species: *Catlacatla, Cirrhinus cirrhosis, Labeorohita,* and *Tor putitora*, followed by Phasianidae comprising two species: *Gallus gallus,* and *Perdix perdix*(Figure 2a). Four families (Numididae, Columbidae, Sisaridae, and Anatidae) are found to be monotypic (Figure 2a). Hassan et al., (2022) reported the maximum usage of species of the Cyprinidae family in the ethnomedicinal realm in Garhwal Himalayan, India; Likewise, Basumatary et al., (2023) reported the usage of many different families of plant species for ethnobiological usage. The ascendency of the Cyprinidae can be ascribed to the reason that they are a rich source of essential nutrients, they are palatable. They help in wound healing & boost the immune system easily available at a low cost which makes it possible for the local people to meet the adequate demand for these nutrients and elements for food insecurity. The species of the family is a good source of vitamin A, Vitamin D3, and a few minerals. This nutritional value is supported by `many scientific studies like Islam et al., (2023); Vyas et al., (2020); and Basumatary et al., (2023).

Concerning plants we identified seven families (Lamiaceae, Papaveraceae, Pinaceae, Poaceae, Asteraceae, Gentianaceae, and Polygonaceae) with a maximum of two species each. The rest fifteen families were found to be monotypic (Figure 2b).Ahmad et al., (2014) reported the maximum usage of species of the family Lamiaceae in the ethno medicinal plant in the high mountainous region of Chail Valley (District Swat-Pakistan); Likewise, Jarić et al., (2024) reported the usage of many different families of plant species for ethnobiological usage.

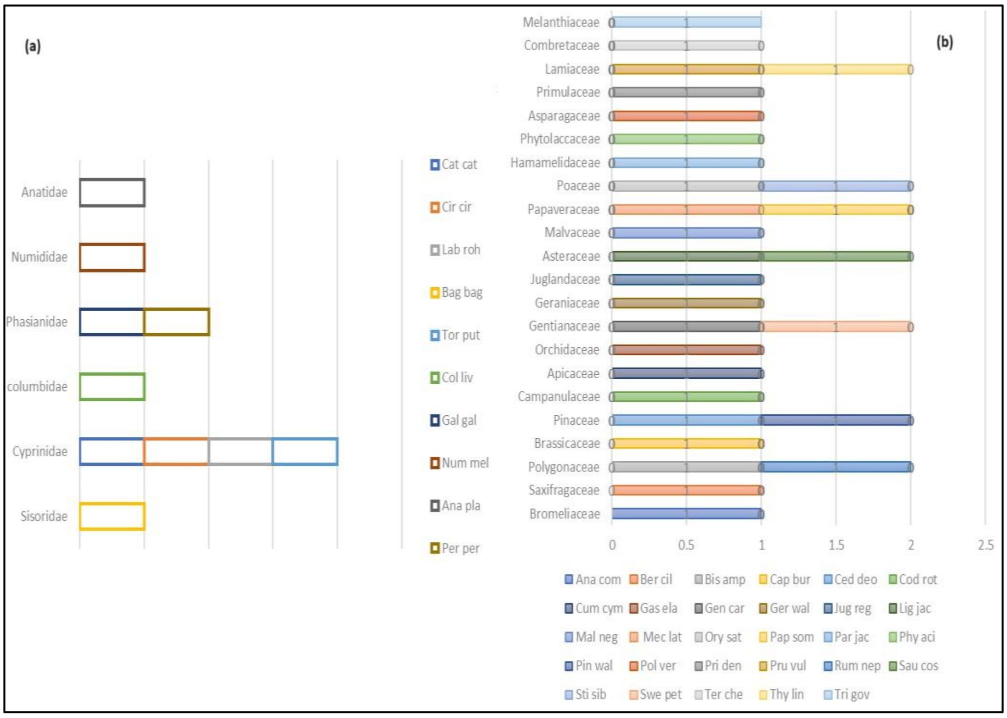

Figure 2: (a) Bar chart revealing the animal species distributed across the families; (b) Bar chart revealing the plant species distributed across the families. The complete names of the species are provided in Table 2

3.2. Part usage for ethnomedicinal usage

In the present study, a total of (N=39) species were enlisted, broadly classified into plants (N=29) and animals (N=10) (Table 2). A variety of parts from both flora and fauna were exploited to treat different documented disorders.

Concerning plants, we found that roots were utilized most frequently, showing dominance and the contributing plant species (N=8) included (*Gastrodiaelata, Bistortaamplexicaulis, Geranium wallichianum, Ligulariajacquemontiana, Polygonatumverticillatum, Rumex nepalensis, Saussureacostus, and Swertia petiolata*). Following "roots", "Whole plant" was found to show ascendency obtained from (N=7) species (*Capsella bursa-pastoris, Codonopsis rotundifolia, Gentiana carinata, Gentiana carinata, Meconopsis latifolia, Prunella vulgarians, and Thymus linearis)* (Figure 3a). Kumar et al., (2011) reported the maximum usage of root parts in the ethnomedicinal realm in Garhwal Himalayan, India; Likewise, Singh et al., (2017) reported the usage of many different parts of the plant species for ethnobiological usage.

In the case of animals, we found that "tissues" were the most frequently used part and the contributing animal species (N=4) included, *Perdix perdix, Anas platyrhynchos, Numida meleagris, and Tor putitora)* followed by "feathers" and the related species (N=3) species included *Perdix perdix, Anas platyrhynchos,* and *Numida meleagris*; fins (*Gallus gallus and, Tor putitora*), scale (*Gallus gallus, and Tor putitora*), whole part (*Labeorohita, Cirrhinuscirrhosus*), fat (*Columba livia*), meat (*Gallus gallus*), and bones (*Gallus gallus*) (Figure 3b). Altaf et al., (2020) also reported the usage of animal species against various diseases across three districts of the Chenab riverine area in Punjab, Pakistan, and likewise, Alves et al., (2013) reported the ethnomedicinal usage of animal species in Brazil.

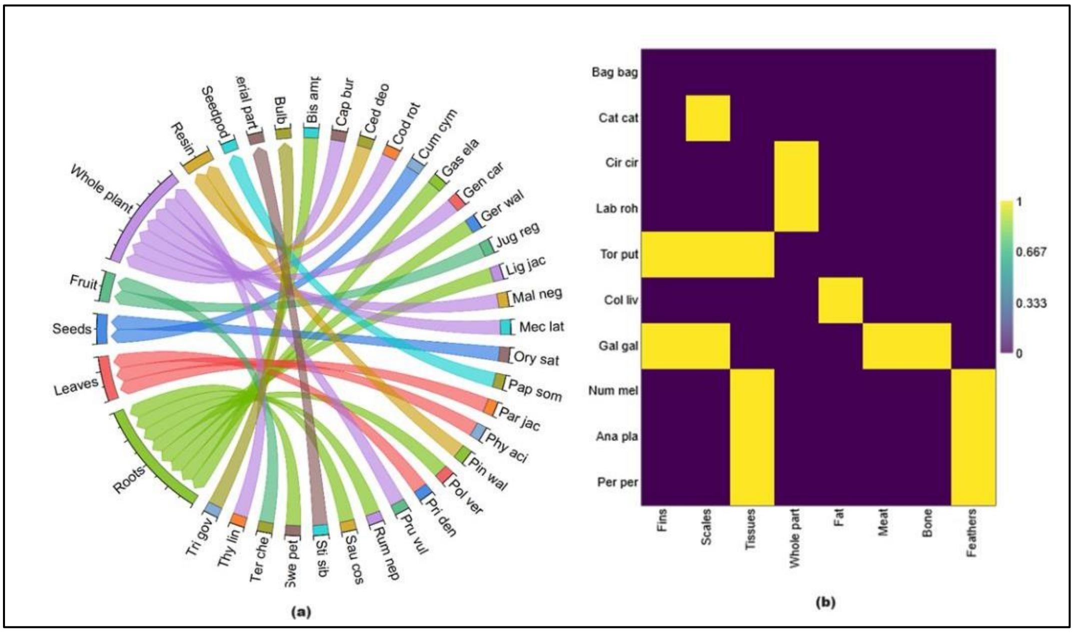

Figure 3 (a) Chord diagram revealing the different part usage of the documented plant species; (b) Matrix plot revealing the different part usage of the documented animal species. The complete name of the species is provided in Table 2.

Table2: Inventory of the documented species for ethnomedicinal usage across the Bauxa community, Dehradun-India

Scientificname (Family)	Abbreviation	Ethnic group	Localname	Part used	Preparation form	Ethnopharmacological usage	Gastronomic usage	IUCN status
Plants								
Ananascomosus (L.) Meer. (Bromeliaceae)	Anacom	Buxa	Pineapple	Leaves	Juiceextracted from the pineapple leaves and mixed with water	Juiceisusedtotreator control diabetes.	Y	NE
Bergeniaciliata (Haw.) Sternb (Saxifragaceae)	Bercil	Buxa	Pashanbheda	Roots	Roots are sundried and ground into powder and rootsareboiled in water for 2 hrs.	Uponcooling,itisgiven to humans to cure liver and lung diseases	Y	LC
Bistorta amplexicaulis(D.Don)Greene (Polygonaceae)	Bisamp	Buxa	Methaor Pindrow	Roots	Driedrootsare boiledinwater to make tea.	Teaisgiventohumansto cure lower abdominal pain and constipation.	Y	LC
Capsellabursa-pastoris L. (Brassicaceae)	Capbur	Buxa	Churkuor Chirchitta	Whole plant	The whole plantisground to make a paste.	Obtainedpasteisapplied to the area bitten by the snake.	Y	LC
Cedrusdeodara Roxb. (Pinaceae)	Ceddeo	Buxa	Deodaror Devdar	Resin	Dried wood is collected and kept in autensil madeup of clay with a small hole at the bottom, another utensil is kept below	Theresinisusedtokill lice.	Y	LC

					thesaidholeso that the Resin will be collected			
*Codonopsis rotundifolia*Benth. (Campanulaceae)	Cod rot	Buxa	Jaljammi	Whole plant	The whole plant is dried andmadeinto powder.	Powderisgivenwith watertocuregeneral weakness	Y	NE
Cuminumcyminun (L.) (Apicaceae)	Cum cym	Buxa	Jeera	Seeds	Roastedseeds and crushed into powder mixed with black pepper, ajwain, and honey.	Seeds are consumed orally,andusedtotreat cough.	Y	NE
*Gastrodiaelata*Blume (Orchidaceae)	Gasela	Buxa	Shadbadba	Roots	Rootsaredried in sunlight, crushed into powder, and mixed with honey.	Rootsareusedtotreat fever.	Y	VU
Gentianacarinata(D. Don) Griseb (Gentianaceae)	Gencar	Buxa	Pangri	Whole plant	The whole plantismade into a decoction.	The decoction is given to humans to cure lower abdominalpainandbloat.	Y	LC
*Geranium wallichianum*Oliv (Geraniaceae)	Gerwal	Buxa	Dhoop	Roots	Rootsaresun- dried, cut into small pieces, and boiled in watertomake decoction.	Thedecoctionisgivento humans to cure general weakness, stomach diseases, and joint problems.	Y	LC
*Juglanasregia*L. (Juglandaceae)	Jug reg	Buxa	Akhrot	Fruit	Juice is obtainedfrom thefruithulls.	Juiceisgiventohumans to cure mouth diseases.	Y	LC
Ligularia jacquemontiana (Decne.) (Asteraceae)	Ligjac	Buxa	Kundru	Roots	Thedriedroots aregroundinto a powder and consumed as an herbal supplement or Mixedwithwateror other substances.	Driedrootsusedtocure intestinal worms and stomach diseases	Y	LC
Malvaneglecta Wallr. (Malvaceae)	Malneg	Buxa	Dwarf Mallow	Whole plant	To prepare a decoction, grind the dried whole plant into a powder, add 2-3 tablespoons of the powder to boiling water, andsimmerfor 10-15minutes. Then,strainout the plant material.	Adecoctionisgivento humans to treat lower abdominal pain and indigestion.	Y	NE
Meconopsislatifolia Prain(Papaveraceae)	Meclat	Buxa	BluePoppy	Whole plant	Thedriedplant canbecrushed into powder andtakenwith	Driedrootsareconsumed along with water to improve overall energy.	Y	NE

					Waterorother substances.			
*Oryzasativa*L. (Poaceae)	Orysat	Buxa	Rice	Seeds	Seedsaremade into decoction.	Thedecoctionis consumedtotreat diarrhea.	Y	
*Papaver somniferum*L. (Papaveraceae)	Papsom	Buxa	Opium Poppy	Seedpod	Driedseedpods are made into powder and boiled in water for half an hour.	Dried seedpods are used byhumanstokeepwarm during winter.	Y	NE
Parrotiopsis jacquemontiana(Decne.) Rehder (Hamamelidaceae)	Parjac	Buxa	Jacquemont's Orchid	Leaves	Leaves are boiledinthe water to produce an extract.	The obtained extract is appliedtopicallytocure skin disease.	Y	VU
PhytolaccaacinosaRoxb. (Phytolaccaceae)	Phyaci	Buxa	Kachnar	Leaves	Leaves are boiledinwater	Theextractisapplied topically to mouth disease.	Y	NE
					toproducean extract.			
Pinuswallichiana A.B. Jacks (Pinaceae)	Pin wal	Buxa	ChirPine	Resins	Resins are collectedand used as raw.	Resins are applied to the woundsforrapidhealing.	Y	LC
Polygonatumverticillatum(L.) All. (Asparagaceae)	Pol ver	Buxa	King Solomon's seal	Roots	Thedriedroots are boiled in water to make tea.	Tea is used to cure indigestionandstomach disease.	Y	LC
Primula denticulata Sm. (Primulaceae)	Pri den	Buxa	Drumstick primula	Leaves	Rawanddried leaves are ground into powder and powdered leaves are mixed with water.	Leavesareusedtocure general weakness.	N	LC
*Prunellavulgaris*L. (Lamiaceae)	Pruvul	Buxa	Self-heal	Whole plant	The whole plant is dried and boiled in watertomake a decoction.	Obtained decoction is giventohumanstocure fever.	Y	LC
*Rumexnepalensis*Spreng. (Polygonaceae)	Rum nep	Buxa	Jangali palak	Roots	Driedrootsare made into powder.	Powdered roots along with water given to humans to cure general weaknessand fractures.	Y	NE
Saussureacostus (Falc.)Lipsch. (Asteraceae)	Saucos	Buxa	Kuth	Roots	Roots are collected,cut into small pieces, sun-dried, and	Powdered roots are used tocuregeneralweakness and joint problems.	Y	CR

					ground into powder.			
Stipasibirica(L.) Lam. (Poaceae)	Sti sib	Buxa	ShuiGhas	Aerial part	Aerial parts of the plants are boiledin water.	Obtainedwaterisapplied topically to treat skin disease.	Y	LC
Swertia petiolata Royle.exD.Don (Gentianceae)	Swepet	Buxa	Kutki	Roots	Roots are ground into powder and mixed with watertomake a paste.	Obtainedpasteapplied on wounds.	Y	
*Terminaliachebula*Retz. (Combretaceae)	Terche	Buxa	Haritaki	Fruit	Fruitsaredried in sunlight, crushed in powder, and mixed with Garlic, Onion, andgreen chili.	Fruitsareusedtotreat stomach problems.	Y	LC
Thymuslinearis Benth (Lamiaceae)	Thy lin	Buxa	Jungliajwain	Whole part	Thewholepart is boiled in water to make tea.	Teaisgiventohumansto treat fever and cold.	Y	CR
Trillium govanianumWall. Ex D. Don. (Melanthiaceae)	Trigov	Buxa	Nag Chhatri	Bulb	The bulb canbe crushed or groundtomake a paste.	The paste is applied topicallytotreatinjury.	Y	EN
Fish								
Bagariusbagarius Hamilton (Sisoridae)	Bagbag	Buxa	Goonch	Skin	Skin either alone or combinedwith othermaterials like turmeric, ginger, honey, coconut oil, and mustard oil.	Skinisusedtotreatanti- inflammatory properties and wound healing.	Y	DD

Catlacatla Hamilton (Cyprinidae)	Catcat	Buxa	Catla	Scales	Scales are groundedintoa paste.	Obtainedpasteisusedto treat skin disorders.	Y	NE
Cirrhinuscirrhosus Bloch (Cyprinidae)	Cir cir	Buxa	Mrigal	Whole body	The whole bodyisusedto make a decoction.	Thedecoctionisgivento treat digestive health, bonehealth,andimmune function.	Y	NE
Labeorohita Hamilton (Cyprinidae)	Labroh	Buxa	Ruhu	Whole body	Decoction	Digestivedisorders,anti-inflammatory,respiratory disease,rheumatism,and arthritis.	Y	LC
Tor putitora Hamilton (Cyprinidae)	Torput	Buxa	Mahseer	Fins, scales, and fatty tissues	Fins, scales, and other tissues are grounded into the paste or usedtomakea decoction.	The obtained paste is used to treat wounds and inflammation. The decoction is used to treat respiratory diseases, rheumatism,andarthritis.	Y	EN
Birds								
*Columbalivia*J.F. Gmelin (Columbidae)	Col liv	Buxa	Pigeon	Fat	Oilisextracted from the bird fats.	Obtainedoilisusedto treat wounds and skin infections.	Y	LC
Gallusgallus Linnaeus (Phasianidae)	Galgal	Buxa	Redjungle fowl	Meat, bones	Chicken soup and chicken broth are prepared by boilingchicken bones and meat.	Soup/brothisusedto treat skin disorders, colds,andrespiratory infections.	Y	LC
Numida meleagris Linnaeus (Numididae)	Num mel	Buxa	Guineafowl	Feathers	Poulticesare made from feathers.	Poulticesareusedtotreat skin disorders, boils, wounds, and rashes.	Y	LC
Anasplatyrhynchos Linnaeus (Anatidae)	Anapla	Buxa	Mallard	Feathers	Feathersare used in ointments.	Feathersareusedtotreat skin disorders.	Y	LC
Perdixperdix Linnaeus (Phasissanidae)	Perper	Buxa	Grey partridge	Feathers	Poulticesare made from feathers.	Poulticesareusedtotreat wounds and skin disorders.	Y	NE

3.3. Ethnopharmacological profile of plant species

The present study has documented (N=29) (Table 2) medicinal plant species used widely to treat various diseases (N=14). Among these, “injury” was treated by the maximum species (N=5; *Pinus wallichiana, Rumex nepalensis, Swertia petiolate, Trillium govanianum)*, the same number of species (N=4; *Terminalia chebula, Polygonatumverticillatum, Malva neglecta, Ligulariajacquemontiana*) were used to get against “stomach problems”. “Weakness” was also treated by the (N=4) species (*Saussureacostus, Rumex nepalensis, Primula denticulate, Codonopsis rotundifolia*) followed by “mouth disease (MD)” treated by (N=3) species *(Cedrus deodara, Phytolacca acinose, and Juglanas regia)*, Parasitic diseases *(Ligulariajacquemontiana, and Cedrus deodara*), mastitis *(Parrotiopsisjacquemontiana, and Stipa sibirica)*, constipation (*Bistortaamplexicaulis, and Gentiana carinata)*, and joint pains (*Geranium wallichianum, and Saussureacostus*). Lung and Liver diseases were treated by only one species (*Bergenia ciliata*) (Figure 4).Hassan et al., 2022 also reported the usage of plant species against various ailments across the western Himalayas, likewise, Haq et al., 2021 reported the ethnomedicinal usage of plant species from Jammu and Kashmir- India. Other studies that are in the line include Bogale et al., 2023; Mir et al., 2021; and Miya et al., 2020.

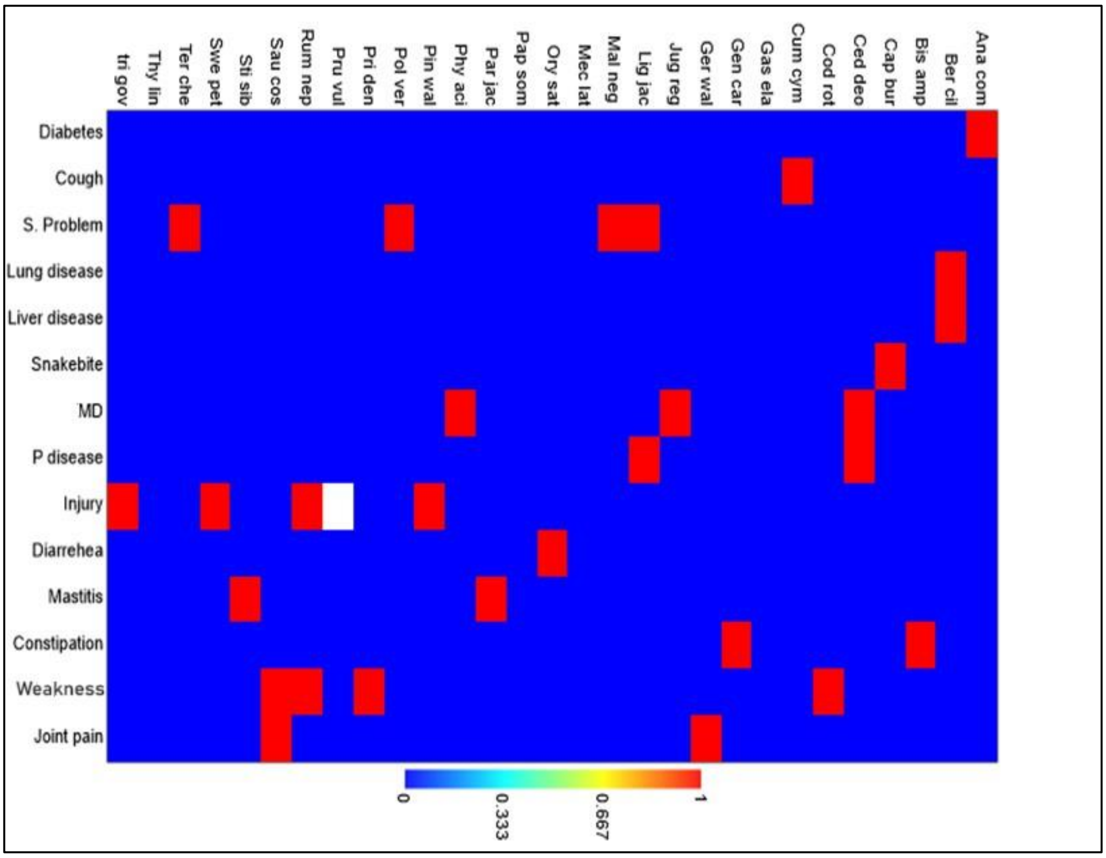

Figure 4: Matrix heat map revealing the diseases the documented plant species treated. The complete name of the species is provided in the Table 2

3.4. Ethnopharmacological profile of birds and fish species

The present study documented (N=10) (Figure 5; Table 2) animal species used to treat (N=11) diseases, including digestive problems, respiratory diseases,inflammation, stomach diseases, rheumatism, arthritis, bone problems, immune diseases, boils, colds, and rashes. Among these, stomach diseases were treated by the highest number of species (N=6): *Perdix perdix*, *Anas platyrhynchos*, *Numida meleagris*, *Gallus gallus*, *Columba livia*, and *Catlacatla*. Respiratory disorders were treated by three species: *Gallus gallus*, *Tor putitora*, and *Labeorohita*. Inflammation was treated by three species: *Bagariusbagarius*, *Tor putitora*, and *Labeorohita*. Rheumatism and arthritis were treated by two species: *Tor putitora*and *Labeorohita*. Bone problems and immune diseases were treated by *Cirrhinuscirrhosus*. Boils were treated by *Numida meleagris*, colds by *Gallus*

gallus, and rashes by *Numida meleagris*. Vijayakumar et al., (2015) also reported using plant species to treat skin disease in the Silent Valley of Kerala, India, likewise, Hussain and Tynsong (2021), reported the ethnomedicinal usage of plant species in North-east India.

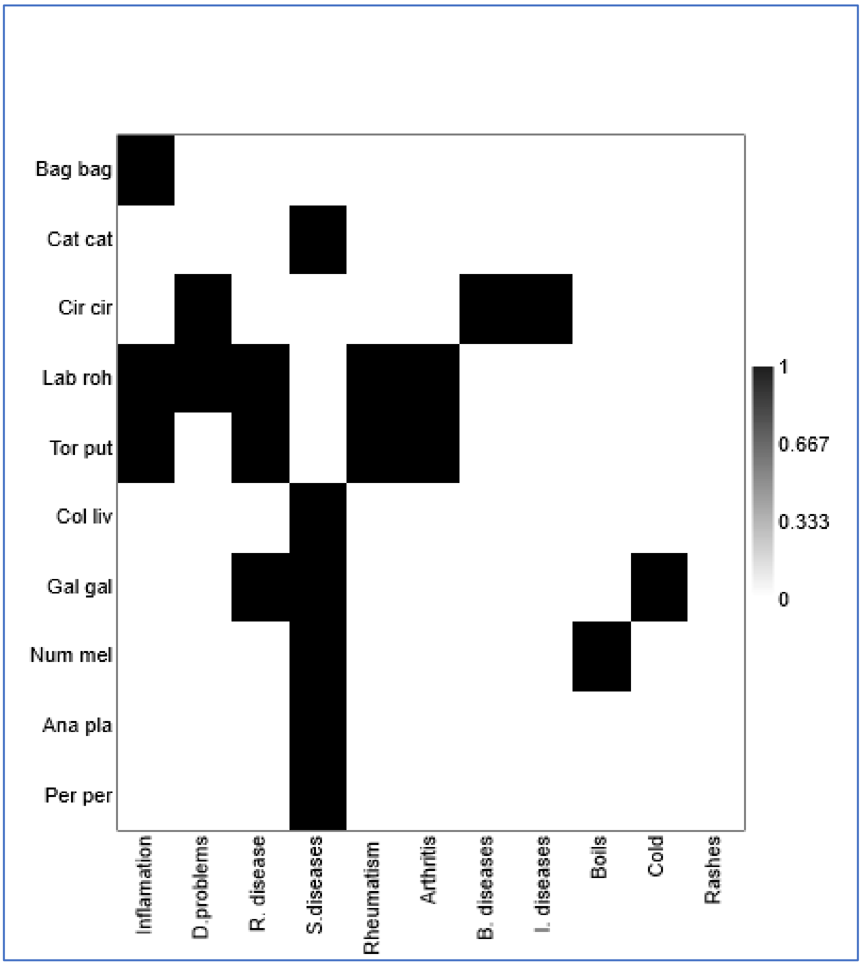

Figure 5: Matrix heat map revealing the diseases treated by the documented bird and fish species. The complete name of the species is provided in Table 2

3.5. IUCN Conservation status of the documented species

Concerning the International Union for Conservation of Nature (IUCN), the present study identified six categories (Least concern, vulnerable, critically endangered, endangered, near threatened and non-evaluated)

Regarding plants, (N=29) species belonging to different IUCN categories were identified. The maximum number of species (N=14) belonged to Least Concern, followed by (N=8) species *(Rumex nepalensis, Phytolacca acinose, Papaver somniferum, Meconopsis latifolia, Malva neglecta, Cuminum cyminun, Codonopsis rotundifolia, and Ananas comosus)* as non-evaluated (NE), N=2 species *(Saussureacostus*and *Thymus linearis)* as Critically Endangered (CR), N=2 species *(Gastrodiaelata and Parrotiopsisjacquemontiana)* as Vulnerable (VU). *Swertia petiolate* is categorized as near threatened (NT) and *Trillium govanianum*is categorized as Endangered (EN) (Figure 6a).Bhat et al., (2020) also reported the conservation status of various plant species from the Himalayas.

In the case of animals, (N=10) species belonging to different IUCN categories were identified. The maximum number of species (N=5) (*Labeorohita, Columba livia, Gallus gallus, Numida meleagris, and Anas platyrhynchos)* belonged to Least Concern (LC), followed by (N=3) species (*Catlacatla, Perdix Perdix,* and *Cirrhinus cirrhosis)* categorized as non-evaluated. *Tor putitora*is classified as an Endangered species (EN) and *Bagariusbagarius*is listed as Data deficient (DD) (Figure 6b). Haq et al., (2023) reported the IUCN conservation status of the animal fauna from the western Himalayas

Recommendations

To conserve critically endangered, endangered, and vulnerable species, comprehensive population surveys and habitat assessments should be conducted, focusing on *Saussureacostus*, *Thymus linearis*, *Trillium govanianum*, *Tor putitora*, *Gastrodiaelata*, and *Parrotiopsisjacquemontiana*. Standardized monitoring protocols are needed to track population size and habitat quality over time. Critical habitats should be protected through the establishment of protected areas, conservation easements, and community-managed reserves, with habitat restoration programs implemented in degraded areas to support species migration and genetic diversity. Ex situ conservation strategies, including seed banking, tissue culture, and captive breeding, should be developed to safeguard against extinction and support reintroduction efforts. Public awareness and community involvement should be increased through educational programs, citizen science projects, and participatory conservation initiatives. Policy and legislation need to be strengthened and enforced to protect endangered species and their habitats, with collaboration among government agencies, NGOs, and international bodies for coordinated conservation actions. Addressing data deficiencies through targeted research and promoting data sharing among stakeholders is crucial, utilizing modern technologies such as remote sensing, GIS, and molecular techniques to enhance data collection and analysis capabilities. By implementing these recommendations, we can improve conservation outcomes for the species listed and contribute to overall biodiversity preservation efforts.

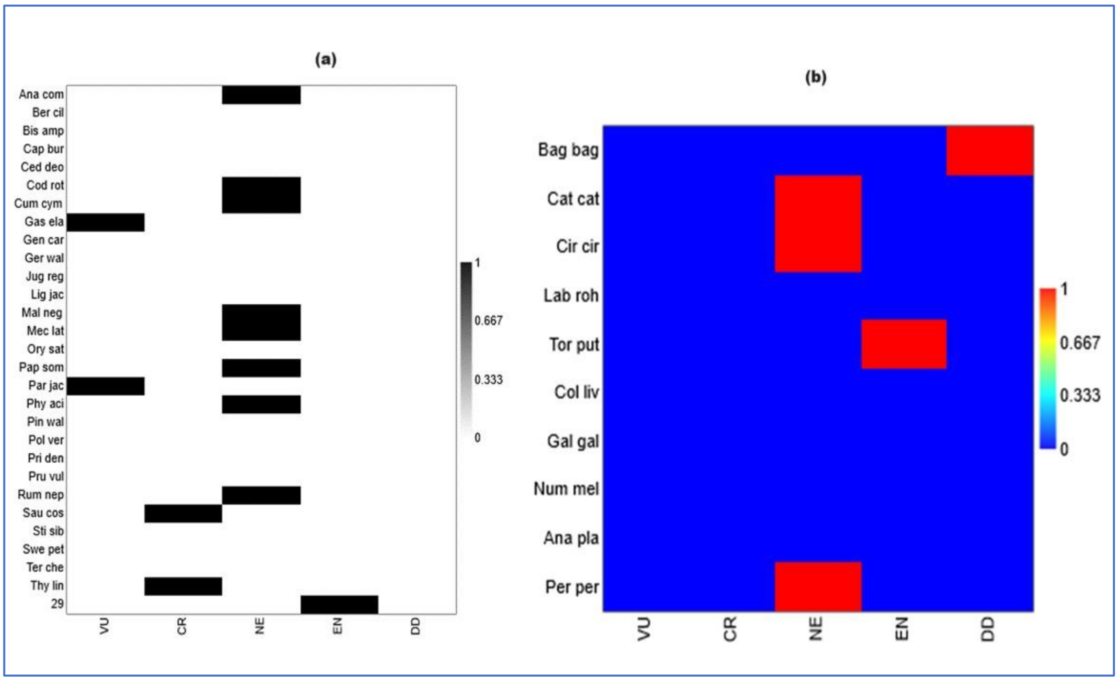

Figure 6: (a) Matrix heat map revealing the documented plant species' conservation status (IUCN). (b) Matrix heat map revealing the documented animal species' conservation status (IUCN). The complete name of the species is provided in Table 2

IV. CONCLUSION

This study sought to address a significant gap in the comparative analysis of ethnobiological usage of flora and fauna within the Buxa community and to assesstheconservationstatusofspeciesemployedintheirt raditionalmedicine practices. The research elucidates the extensive ethnopharmacological knowledgeoftheBuxacommunityrevealingadiverseutil izationofbothplant and animal species for therapeutic purposes. Ethnic communities learn how to use the flora and fauna for their primary needs (medicine and food). Unfortunately, in the present study, it was found that traditional knowledge is primarily limited to the elderly due to the lack of interest among the younger generation. The observed decline in engagement with traditional practices can beattributedtotheprocessesofurbanization,whichhave markedlytransformed lifestyle patterns. The migration of younger generations to urban centers in pursuit of educational and employment opportunities have led to diminished involvement in small-scale, traditional practices. This shift has consequently resulted in a potential interruption in the intergenerational transmission of traditional knowledge with in the ethnicgroup. Inthisregard,itisimperativeto document the eroding traditional knowledge before it is completely lost.The conservation status of documented species as per the International Union for ConservationofNature(IUCN)enlistedthesespeciesasc riticallyendangered, endangered, and vulnerable categories; in this regard, local people require propereducationtoaidintheconservationandlong-termsustainabilityofthese species. The study advocates for a multifaceted approach to conservation that includes sustainable harvesting practices, community-based conservation initiatives, increased educational efforts, and collaboration between traditional knowledge holders and scientific researchers. Furthermore, it underscores the needforpolicyadvocacytoprotectnaturalhabitatsandsup portIndigenousland rights.

V. Acknowledgements

We are thankful to the local inhabitants of the Buxa community of Dehradun, Uttarakhand, whose generosity in sharing their traditional knowledge and experiences significantly enriched this study.
Conflict of Interest: The authors declare no conflict of interest.

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