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Journal of Threatened Taxa

10.11609/jott.2023.15.4.22927-23138

www.threatenedtaxa.org

26 April 2023 (Online & Print)

15(4): 22927-23138

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)



Open Access





ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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Cover: Mauve Stinger *Pelagica noctiluca* by Swaathi Na. Medium used is soft pastels and gelly roll.



as a source of protein and medicine, but most of them are unknown to the general public of the region. An understanding of local people's knowledge and ideas is a prerequisite for constructive collaboration between farmers and scientists towards conservation (Gurung 2003). Therefore, the objectives of this study were to: 1) Understand the perception and knowledge of communities from Mangdi valley about the bee and wasp fauna; 2) Identify potential conservation threats to bee and wasp fauna in central Bhutan.

MATERIALS AND METHODS

Study Area

Trongsa District is located at 27.4465°N, 90.504°E in the heart of the country. It covers an area of about 1,807 km² with 87.15% of the total area under forest cover, and the elevation ranges 800–4,800 m (National Statistics Bureau 2012). The district experiences annual average temperatures ranges 8.9–19 °C, and average

annual rainfall of 870 mm (National Statistics Bureau 2013). The district comprises of five blocks, and the study was conducted in Nubi and Tangsibji Block (Figure 1). These blocks feature broadleaved to blue pine and mixed conifer forest types. The district has a mixed climate of humid and warm temperate with sandy and clayey loam-based soil. The terrain is rough, with steep slopes in the south and deep canyons to the north. Alpine scrub, blue pine, chir pine, fir, mixed conifer, shrubs, meadows, broadleaved woods make up the majority of the vegetation type. The most dominant forest types in the district are broadleaved forests with more than 50%, followed by mixed conifer with over 26%. Various crops and vegetables are grown. The wide elevation range and the mountainous and complex terrain create complex climatic conditions, from wet sub-tropical in the south to cold temperate in the northern high elevation areas. The Tangsibji hydropower project and Mangdichu hydropower projects were underway.

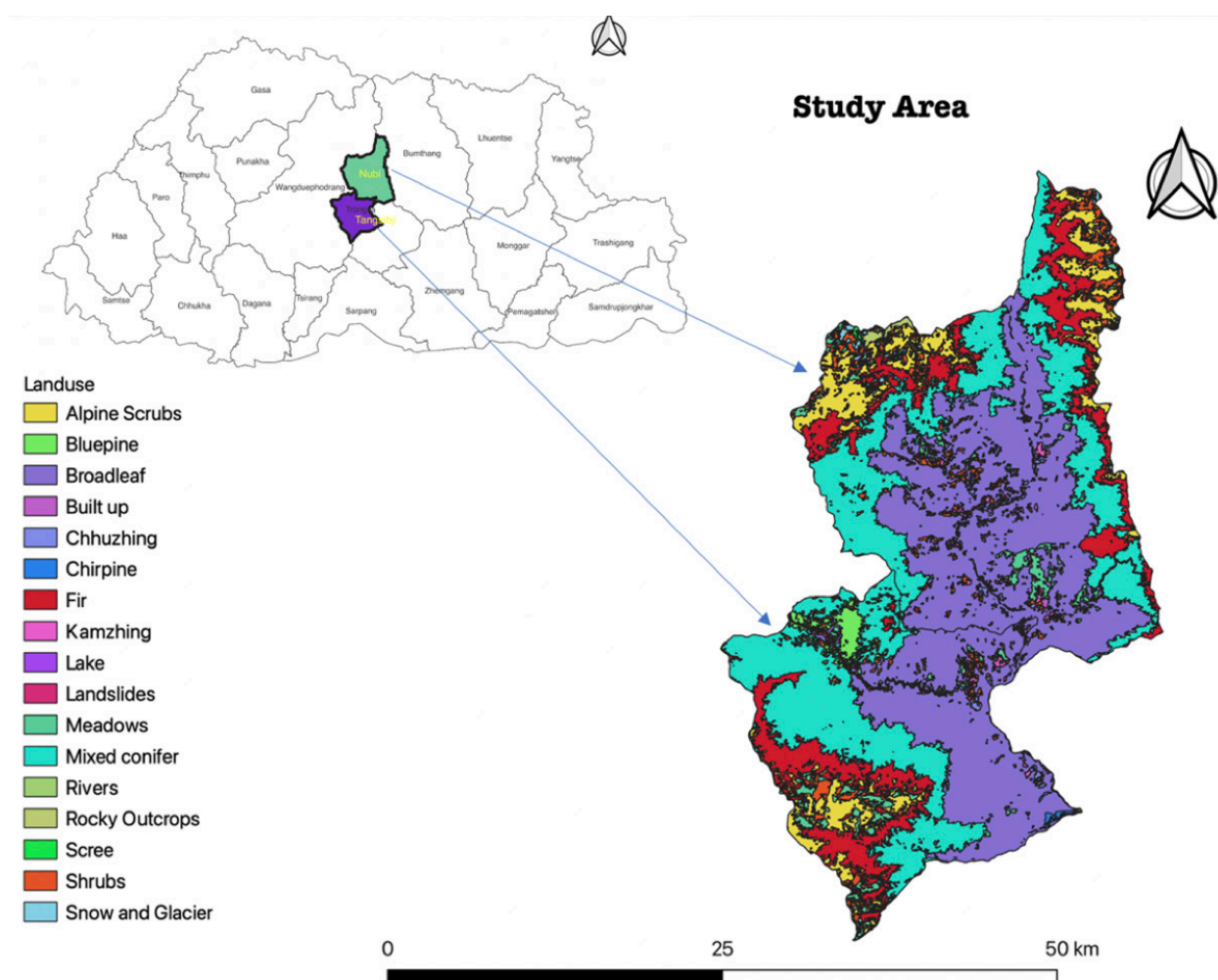


Figure 1. Map showing study area (Nubi and Tangsibji Block) concerning different land use area. Inset map show the 20 districts of Bhutan.

Data Collection and Analysis

Data were obtained from June to September 2018 by means of both close and open-ended structured questionnaires. People of both genders prioritizing the elderly villagers were interviewed. The respondents were selected based on stratified random selection, where the population was divided into strata or subgroups based on village wise with same ethnic group, and then individual samples and respondents are randomly selected from each stratum. The secondary data was gathered through various sources. Reports, journals, and various other research works, online sources and print media related to the context of this study. GPS handset was used to locate the site and record coordinates.

Descriptive statistics like frequency counts, percentages and tables were used in analyzing the data. Excel spreadsheet of office 2007 and pivot table was used for the data entry and segregation.

RESULT AND DISCUSSION

Perception of bees and wasps

The respondents represented a mixture of gender, age groups and education status. The social interview covered a total of 32 individuals from different areas and six education strata. One-hundred percent ($n = 32$) of the respondents were aware of bees and wasps, and 56% ($n = 18$) knew of 5–10 species of bees and wasps. This study found that 94% ($n = 30$) of respondents consumed bee and wasp products primarily for medicinal value ($n = 13$). The people usually collect bees and wasps during autumn and winter, collecting was once in a season. Through respondent interviews it was found that the authority restricting the collection of bee and wasp products was Department of forest and park services (Table 1).

According to respondents, bees and wasps usually begin to appear during April–June ($n = 19$), with wasps beginning to disappear during October–December while bees are seen throughout the year. A majority of respondents said aculeates are found in forested areas and agriculture land. The different types of bees and wasps found in different land use types in the study area are shown in Figure 2. Of the 32 respondents, 68% stated that bees and wasps were not harmful to human and agricultural crops. However, 32% of the interviewees stated that the bees and wasps are noxious.

Threats to bees and wasps in central Bhutan

The numbers of bees and wasps remain constant according to 14 respondents, while nine stated, numbers are decreasing compared to earlier days. Bees

Table 1. Regulatory authorities on hunting and consumption of bees and wasps.

	Regulatory/ Objecting Authority	Number of respondents
1	Department of Forest and Park Services	24
2	Block Administration	0
3	No objection	2
4	No idea	6
5	Total	32

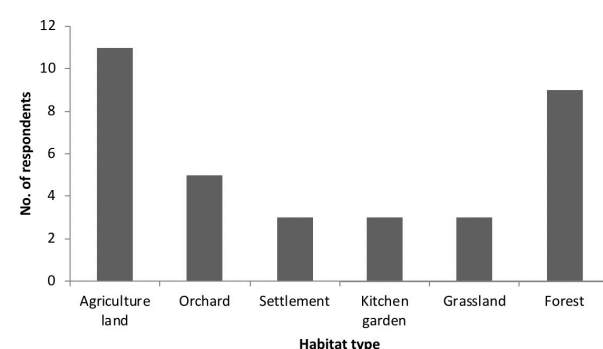


Figure 2. Occurrence of bees and wasps from different land use type as per respondents.

Table 2. Conservation threats faced by bees and wasps as per respondent perceptions.

	Conservation Threats	Number of respondents
1	Disease	5
2	Chemical fertilizer	4
3	Natural	1
4	Hunting and consumption	6
5	Developmental Activities	16
	Total	32

and wasps are important pollinators that play a crucial role in maintaining the biodiversity of ecosystems. However, their populations have been declining in recent years due to various factors, including habitat loss and fragmentation, pesticide use, climate change, and disease. As stated by Moron et al. (2008), one of the major contributors to the decline of bees and wasps are the loss of their natural habitats as a result of developmental activities such as deforestation, urbanization, and agriculture expansion. These activities often involved the destruction and fragmentation of natural habitats, including the removal of flowering plants that bees and wasps rely on for nectar and pollen.

The current study found that the loss of natural habitats contributed to a reduction in the availability of nesting sites for bees and wasps, which further impacted their populations. Bees and wasps require different types of nesting sites depending on their species, but many rely on natural cavities in trees, shrubs, or the ground. Furthermore, the use of pesticides in agriculture and other activities adversely affected bees and wasps, leading to reduced populations and decreased biodiversity. According to respondents, the main threats faced by aculeates were developmental activities like construction of hydropower dams, road, and buildings, followed by hunting and consumption (Table 2) for example, when people burn down wasps to extract the larvae and pupae for consumption, in the study area. Bhutan is now in full swing of developmental activities such as hydropower, buildings, and roads, which results in habitat loss and fragmentation. Maximum numbers of respondents from both elevations suggested the Department of Forest and Park Services should frame effective rules and regulations to minimize threats to bees and wasps. Seven respondents did not have any suggestions for conserving aculeate fauna (a group of insects that have stingers or sharp pointed structures that can be used for defense or hunting).

CONCLUSION AND RECOMMENDATION

This study provides baseline information on local peoples' perceptions of bees and wasps, their habitat types and conservation threats in central Bhutan. Feelings, knowledge, and behavior towards these insects are rationally coherent. Forty-three percent of the respondents said that numbers of bees and wasps remain constant, while 28% said they were decreasing. Major threats faced by bees and wasps include development activities, hunting, and consumption. Control measures for hunting and consumption of these valuable insects need to be taken. It is further suggested that this work may be extended to other parts of the country to assess perceptions of various groups of people concerning these valuable insect fauna and enhance conservation awareness.

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Appendix 1. Questionnaire for social survey.

Date.....

Respondent's Name.....

Gender: Male/ Female. Age.....

Education level: 1. College 2. Secondary 3. Primary 4. Non Formal Education 5. Illiterate

Village.....

Gewog/block.....Dzongkhag/District.....

Interviewer's Name.....

Part I: People's knowledge and perception on Bees and Wasps

1. Do you know what a bee and wasp is?
1. Yes 2. No
2. How many types of bees do you know?
.....
3. How many types of wasps do you know?
.....
4. Do you consume bee product?
1. Yes 2. No
If yes, 1. Annually 2. Monthly 3. Whenever available 4. No idea
5. Do you consume wasp product?
1. Yes 2. No
If yes, 1. Annually 2. Monthly 3. Whenever available 4. No idea
6. Why do you consume?
1. Medicinal value 2. As supplementary diet 3. Pleasure
7. How do you consume them?
1. Raw 2. Boil 3. Fry 4. Dry
8. Do you collect them?
1. Yes 2. No
9. Does any organization or authority object you from collecting them?
1. Yes 2. No

Part II: Ecology and habitat preference of Bees and wasps as per people's knowledge

1. When do they appear, Month?
.....
2. Which month do they disappear, month?
.....
3. Where do they go?
.....
4. In what type of habitat/land use are they found frequently, Rank them?
1 Agriculture 2. Forest 3. Grass land 4. Orchard 5. Settlement 6. Kitchen garden
5. Are they harmful to any crops?
1. Yes 2. No
If yes, how?.....
6. Are they harmful to human and livestock?
1. Yes 2. No
If yes, how?.....
7. Do you know ecological importance of bees and wasps?
1. Yes 2. No
If yes, what are the importance.....
8. Which weather does the bees and wasps appear mostly?
1. Rainy day 2. Cloudy day 3. Sunny day 4. anytime
9. Did the number of bees and wasps increased or decreased from past ten years?
1. Increased 2. Decreased 3. Constant/Same 4. No idea
Why?.....
10. What are the threats faced by the bees and wasps?
1. Disease 2. Agriculture practice/Chemical fertilizers 3. Natural predators 4. Hunting and consumption 5. Developmental activities 6. No idea
11. What could you suggest to minimize the threats to bees and wasps?
.....

NOTE: Please share any interesting social dynamics about bees and wasps which is not covered in the above questionnaire.

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Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore,
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Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64



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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

April 2023 | Vol. 15 | No. 4 | Pages: 22927–23138

Date of Publication: 26 April 2023 (Online & Print)

DOI: 10.11609/jott.2023.15.4.22927-23138

www.threatenedtaxa.org

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