Journal of Bioresources 10 (2): 1-6, July – December 2023

JOURNAL OF BIORESOURCES

journal webpage: https://jbr.rgu.ac.in

ISSN: 2394-4315 (Print)
ISSN: 2582-2276 (Online)

RESEARCH ARTICLE

Traditional ecological knowledge on honey hunting in Singhason Hills, Karbi Anglong district, Assam

Ni-et Teronpi[1] and Robindra Teron[2*]

[1]Department of Botany, Cotton University, Guwahati – 781001, Assam, India.
Email: nietsoteronpi@gmail.com

[2]North Eastern Institute of Ayurveda & Folk Medicine Research, Pasighat- 791102, Arunachal Pradesh, India.
Email: robin.teron@gmail.com

[*]Corresponding author email: robin.teron@gmail.com
Article No.: NTJBR11; Received: 14.04.2023; Revised: 11.06.2023; Accepted: 10.10.2023; Published: 31.12.2023
Doi: https://doi.org/10.5281/zenodo.10513950

Abstract

Traditional Ecological Knowledge (TEK) is the knowledge acquired by indigenous people which is location specific and concerned with their relationship with the environment. Honey hunting is usually practiced among indigenous communities which require skills which is part of traditional ecological knowledge. The present work discusses TEK of bees and honey hunting in Singhason Hills of Karbi Anglong district, Assam. Semi-structured interview, focused group discussion and participant observation were adopted to collect information on honey hunting practices among the local Karbi community. Traditional method of collecting honey, tools used, honey yielding season were recorded from honey hunters. Four honey bees namely *Apis dorsata, Apis cerana indica, Meliponini* species and *Apis andreniformis* have been recorded from Singhason Hills. For the ease of collection, honey hunters use plants like *Olax acuminata*, *Hydnocarpus kurzii* and *Etlingera elatior* to pacify the aggressive bees. The risks and unsustainable practice in traditional honey hunting need improvement for collecting pure honeys and the wax. The annual cycle of honey bee migration between plains and Singhason Hills was observed to be largely influenced by the local ecological setting and climatic factors prevailing in the region. The use of equipment and plants in honey hunting trips owe much to the availability of the resource in the local habitat rather than cultural continuity. Validation of traditional knowledge of plants used during honey collection and management of bee venom is primary step in identification of bioactive compounds and protection of medical knowledge and intellectual property of honey hunters. Inventory of plants foraged by honey bees will be helpful in apiculture planning for creating rural livelihood opportunities. TEK of bees and honey hunting will be useful for NTFP foragers to locate honeybee hives and avoid bee attack. This empirical knowledge will be useful for security personnel who, in the line of duty, often had to trek the hills in various parts of India.

Keywords: TEK; Honey Hunting; Honey Bees; Singhason Hills; NTFP; Karbi Community; Assam.

1. Introduction

Collection of wild honey is a common occupation and also an essential subsistence practice in different regions of the world. Honey hunting or honey harvesting which plunders wild honey bees nests to obtain honey and beeswax is still vibrant among rural people with subsistence living (Ajao and Oladimeji, 2015). Wild honey collection requires skill and techniques that have been acquired and developed by various tribes and communities over long years by observation of activities and behaviour of the bees. Such empirical knowledge has contributed to the knowledge system of indigenous people particularly forest dwellers, hereafter referred as Traditional Ecological Knowledge (TEK). Honey used to be gathered from the wild when people were still oblivious of the practice of beekeeping. Even today, people living in remote areas and forests still practice the art of harvesting honey from the wild. Wild Honey is usually collected by pacifying the bees with smoke and cracking the habitat of the bee's nest thereby causing destruction to the colony (Reuber, 2015). Honey bees are among the few insects that have established a harmonious co-existence with mankind, the key factor being the honey they yield. The Singhason Hills range in Karbi Anglong district, Assam is a biodiversity rich region (Teronpi et al., 2015b). The various ethnic groups residing in the hill range live in close association with forests and they are primarily dependent on forest products for subsistence and other requirements. There is minor activity of exploitation or extraction of forest resources by the forest inhabitants for their livelihoods.

By virtue of long association with local forest environment, the people have developed sound foundation of Traditional Ecological Knowledge (TEK) by close observation of the behaviour of plants and animals. Their skills and techniques of gathering forest resources are profound which leaves a lighting imprint on the abilities of the people. In the present studies, TEK on bees and traditional honey hunting in the Singhason Hills range are discussed. Despite being a mini-biodiversity hotspot in the state of Assam, people-forest interactions in the region has not been properly assessed to date. Only few studies have been initiated in Singhason Hills notably plant antidotes (Teronpi et al., 2015a) environmental degradation and plant resources of home gardens with horticultural importance (Teronpi et al., 2015c). One of the reports (Teronpi et al., 2015a) underlined current trend of increasing human interferences in the Singhason Hills including *jhum*, unsustainable mining of natural resources, over-harvesting of forest products and monoculture which has accelerated degradation of the fragile ecosystem. Besides enumeration of flora and fauna, it is important to document TEK of the native inhabitants to understand the pattern of their interactions with local forests and exploitation of bioresources. Such information helps in documentation of natural resources and identification of new bioresources for mankind, industries and pharmaceuticals. TEK-based exploration is useful to prioritize plants and animals for human benefits and conservation.

Table 1. Honey cycle and local inhabitants' perceptions

Months	Local inhabitants' perception	
	Events	Explanation
January	Honeybees migrate to Singhason hills	Dearth of food plants in the countryside
January to February	Best quality of honey for consumption	Availability of winter plants like mustard, asters and other seasonal flowering plants.
Mid March	Honey flow starts	Flowering of other plants start
April to May	Highly concentrated honey as well as medicinal honey	Increase in the foraging activity of the worker bees as surplus food source (pollen and nectar) are available
June	Migration towards foothill areas	Less availability of food source in the hills
July to September	Honey of low quality with least therapeutic effect	Decline of food plants
October to December	Honeybees retreat to their hives to escape the cold	Forms winter cluster to survive.

2. Materials and method

2.1. Study Area

The Singhason Hills in Karbi Anglong district (25°30' to 26°36' N and 92°90' to 93°54' E) of Assam state (Figure 1) comprises of the Singhason peak (1360m) and the adjacent hills which also includes a few protected areas (Teronpi et al., 2015a). Being located in the eastern part of the district, the Singhason Hill range is surrounded by the Rengma Hills. The region abruptly rises through successive ranges to the north of the Jamuna River. On the east and west, it gradually slopes down to the neighboring plains of Golaghat and Nagaon respectively while to the north it reaches the Brahmaputra River through a low plateau surface (Phangcho, 2001). The Singhason region is home to different ethnic communities mainly *Karbi, Kuki, Rengma, Naga,* and *Chakma* who have converted the hill range into a cultural landscape through their innumerable agricultural and other practices. Among these tribes, the Karbis are more active in collecting honey and other NTFP as compared to the rest of the tribes. Honey is an important item for the people of Singhason Hills as it provides not only food but a viable source of monetary income and livelihood. The present study concentrates on Karbi's traditional way of honey hunting in Singhason Hills in Karbi Anglong district, Assam.

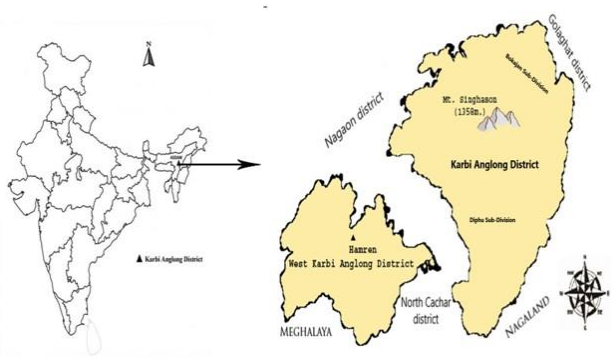

Figure 1. Map of Karbi Anglong District, Assam showing the Singhason peak.

2.2. Data Collection

Field study was conducted during September 2016 to April 2021 in Singhason Hills for which permission was obtained from forest department. Seven villages were selected for field study; and in each site, village heads and potential informants were appraised of the objectives of the research before collecting information. Semi-structured interview and participant observation (Martin, 1995; Alexiades, 1996) methods were adopted to collect information on honey hunting practices in Singhason Hills. Focused group discussion was also carried out among village elders including sixteen traditional honey hunters of the age group ranging between 25-45 years. They were interviewed on various aspects of traditional honey hunting like (i) nomenclature of bees, (ii) identifying honey and non-honey bees, (iii) locating types of bee hives, (iv) life cycle of honey bees and (v) prediction of honey yield. Authors also accompanied the hunters during five honey hunting trips and recorded hunters' knowledge of identifying honey bees, locating hives, predicting honey yield, equipments used and the step-wise method of actual collection of the honey. The Photographic information of honey collection was captured with Sony DSC-W610 digital camera. Local makeshift markets were also visited to document honey sold and to acquire knowledge on the economic returns of the honey sellers. Different floras (Kanjilal et al., 1934 – 1940; Bor, 1940; Balakrishnan, 1981 – 1983), relevant literatures (Batra, 1977; Jain and Rao, 1977; Michener, 2007; Rahman et al., 2015; Gogoi et al., 2018; Bui et al., 2020) and online databases http://www.efloras.org/, https://indiabiodiversity.org/group/bees_of_india, http://www.worldfloraonline.org/ were consulted for authentic identification of bees and plant species used during honey hunting. Further, the identities of honeybees were also verified by consulting experts from Cotton University and B. Borooah College in Guwahati, Assam. The voucher specimens were collected and submitted to the herbarium of Assam University: Diphu Campus, Diphu for future references.

3. Result and discussion

3.1. Diversity of Honey Bees and plant species used in honey hunting

Present investigation has revealed that the local tribal people of Singhason Hills have a sound TEK on bees and they have gathered profound skills and knowledge in traditional honey harvesting in the wild since time immemorial. In the present study, it has been found that there are four types of honeybees predominant in Singhason Hills in Karbi Anglong district, Assam. These honey bees include i) *Jopi* (*Apis dorsata* Fabricius), ii) *Jove* (*Apis cerana indica* Fabricius), iii) *Joram* (*Meliponini* species) and iv) *Jovur* (*Apis andreniformis* F. Smith). TEK of honey hunters on honey cycle has been recorded for four seasons (in months) and presented in Table 1 and a graphical representation is shown in Figure 2. Subsequently, four plants namely *Olax acuminata* L., *Etlingera elatior* L., *Hydnocarpus kurzii* (King) Warb., and *Kaempferia galanga* L. were found to be used during honey harvesting in the wild vicinity of Singhason Hills [Figure 3 and 4 (e,f,g,j)]. These plants release active components which are presented in Table 2. Apart from honey hunting, it is also found that many of the bee products are used by the people for various categories which is described and presented in Table 3. The annual cycle of honey bees migration between the plains and

Table 2. Plants for honey-hunting and their phytochemical constituents

Plant species	Major constituents of the essential oil	References
Olax acuminata Wall. ex Benth.	α-Terpineol (11.5 %)	Chetia and Phukan, 2014
Etlingera elatior (Jack) R.M.Sm.	myrcene (13.5%), a-humulene (11.8%), b-caryophyllene (10.7%), camphene (18.0%), and b -pinene (16.9%)	Jafar et al., 2007
Hydnocarpus kurzii (King) Warb.	Chaulmoogric (29.6), gorlic (25.1), hydnocarpic (23.0), palmitic (8.4), palmitoleic (6.0) and oleic (5.4) acids	Koranapallil B et al., 2011; Sengupta et al., 1973; Cole and Cardoso, 1939
Kaempferia galanga L.	ethyl-p-methoxy-cinnamate (30.6%), trans-ethyl-cinnamate (26.8%), trans-cinnamaldehyde (11.5%)	Mohammad et al., 2020; Umar MI et al., 2014

Singhason Hills is largely influenced by the local ecological setting and climatic factors prevailing in the region. The use of equipment and plants in honey hunting trips owe much to the availability of the resource in the local habitat rather than cultural continuity. However, there are a few traditional beliefs ascribed to honey bees and bee products, which are still vibrant in social life of Karbi ethnic groups.

3.2. Traditional Ecological Knowledge on Bees

Karbis inhabiting the Singhason Hills in Karbi Anglong district of Assam acquired excellent knowledge of the local environment including bees and honey. According to them, bees are usually of two types- honey producing and non-honey producing bees. In the present study, four types of honey producing bees have been recorded in the Singhason Hills which includes *Jopi* (*Apis dorsata* Fabricius), *Jove* (*Apis cerana indica* Fabricius), *Joram* (*Meliponini* species) and *Jovur* (*Apis andreniformis* F. Smith). These honey bees choose underground holes or caves, tree hollows and rock cavities as their natural nesting sites. As informed by the honey hunters in Singhason Hills, nesting sites and colour of the nest is noteworthy for identifying the type of honeybees. *Jopi* prefers their nesting sites in open air and combs are exposed under cliffs or branches of thick and tall trees like *Trewia nudiflora* L., *Bombax ceiba* L., *Erythrina* sp., *Ficus* sp., Cinnamon, *Syzygium cumini* (L.) Skeels, etc. Nest of *Jopi* is characterized by a single comb which is typically large in size and honey is stored usually in the upper section of the nest and the larvae reside at the bottom. *Jove*, on the other hand, prefers their nesting sites at low heights usually in dark and enclosed cavities [Figure 4 (a & b)] like tree hollows, underground, wall and roof cavities. These honeybees build multiple comb nests for storing honey and the larvae. *Joram* are stingless bees [Figure 4 (b)] which produces honey of less quantity; therefore, not used for commercial purpose. Their nesting sites are observed in hollow tree trunks, underground cavities and wall cracks. The comb is dark coloured and appears sticky where honey and the larvae are stored. *Jovur*, generally known as dwarf bees by the honey hunters, prefer their nesting sites in small shrubby forests where they build their nest on twigs or branches of plants like *Mikania* sp., *Cucurbita* sp., *Luffa* sp., *Momordica* sp., etc. Local hunters identified the comb to be white in colour where honey as well as the larvae resides on the corners of the comb. Honey hunters also indicated that *Jovur* are rare to find unlike the other three species of honeybees reported in present studies.

Table 3. Local uses of bee-products

Categories	Description
Food	Honey is joyfully relished with red tea and roasted rice powder as breakfast. The larvae have crunchy texture with nutty flavor; cooked and eaten as side dish.
Medicine	Honey is effective in treatment of flu, wound healing, mouth ulcers, bee sting pain reliever.
Cash crop	Fresh local honey highly valued than imported honey. Local honey is considered a stable commodity and can be stored for many days as it has long shelf life.
Textile	Beeswax used in traditional weaving for smoothing the threads of weft yarn.

As per the information of local Honey hunters, honeybees start migrating into the Singhason Hills from the foothill areas at the end of the winter season *i.e.*, from January in response to prolonged scarcity of food resources or unfavourable environmental conditions. Honey flow starts in the midst of March till June which is considered the best time for honey collection. The monsoon rainfall however, has a significant bearing on the quality of honey. Honey collected during the monsoon has higher moisture content which results in the growth of yeast that ferments sugar which changes the flavor of honey after long duration of exposure to high moisture and hence does not fetch good price in the market. As informed by honey hunters, honey collected in the month of April and May are usually preferred for its medicinal value. The honeybees start their migration from the hills to the low-lying areas in the month of June. The time between July to September is a difficult period for

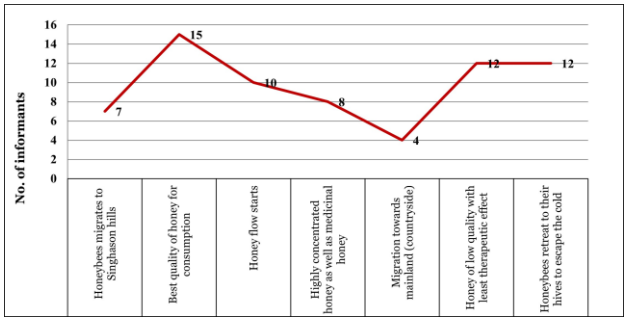

Figure 2. Graphical representation of honey cycle according to local people perceptions

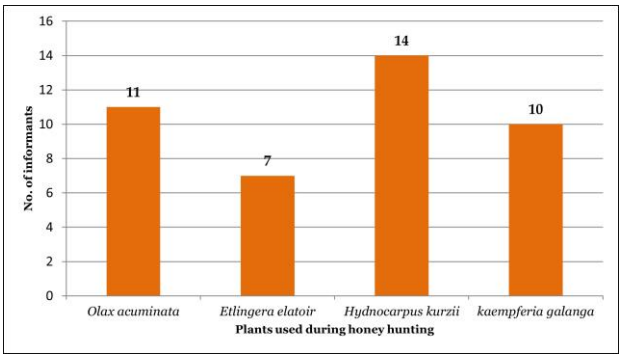

Figure 3. Graphical representation on commonly used plants during honey-hunting in Singhason Hills.

the bees as not many flowers are available in the Singhason Hills, probably because it is the time when the first crops of flower ends and seedlings for next crop are planted. The honeybees, then, may have to forage on coconut (*Cocos nucifera* L.) and a few other flowering plants like *Acacia* sp., *Moringa* sp., *Ficus* sp., *Nyctanthes* sp., *Terminalia* sp., etc. It has also been observed that honeybees living in region of Singhason Hills, abandon their colonies at the end of honey flow. From the above account, it can be said that the annual cycle of honey bees migration between the plains and Singhason Hills is largely influenced by the local ecological setting and climatic factors prevailing in the region, primarily availability of food plants and seasons. This migration behaviour of honeybees are being exploited by honey hunters of Singhason Hills (maybe elsewhere too) to monitor the status of honey accumulation for harvesting. TEK of honey hunters of Singhason Hills on honey cycle is presented in Table 1 and a graphical representation is shown in Figure 2.

3.3. Traditional Honey Hunting in Singhason Hills

Planning for honey hunting trips mandatorily take into account the prevailing season, the phases of moon and plants blooming at the time, to predict the best time for honey harvesting. Honey hunters of Singhason Hills explained bees exhibit some markers indicating status of the nests relating to honey yield. The honey hunters, in the region, discover the nesting habitats of wild bees [Figure 4 (a,b,c,g,k)] generally during other forest activities like firewood collection, hunting, fruit gathering, etc. Once the hunter comes in contact with bees or animals like squirrels, fox, rabbits, etc. who regularly visits bee nests; he follows them towards the bee colonies. Honey collection is usually accomplished by two methods. First, only the upper portion of the comb which contains honey is neatly cut off using knife or sickle. This method of collecting honey is sustainable as it does not destruct the comb where the larvae reside. In second method, the whole comb including honey and the larvae is collected [Figure 4 (d)]. This method is destructive as it kills the adult bees and larvae, and hence, results in low production of honey in the next honey flow season.

Figure 4.a. *Jove* (*Apis cerana indica* Fabricius) nesting inside drainage pipe; b. *Joram* (*Meliponini* species) nesting inside tree hollow; c. Wild honeybees' nests hanging on tree branches; d. Freshly connected honeycomb with honey and larvae; e. Smoking torch of leaves of *Olax acuminata* L. during honey harvesting; f. Rhizome of *Etlingera elatior* L. deters bees during honey collection; g. Bark of *Hydnocarpus kurzii* deters bees during honey collection; h. A traditional cuisine (bee larvae with spices), a delicacy consumed after roasting; i. Fresh honey collected and ready for sale in old plastic bottle; j. *Kaempferia galanga* L. soothes pain caused by bee's sting.

Bees generally guard their hives very well and this makes the honey hunters reluctant to intrude the beehives fearing that the bees might attack and cause severe injuries or even death. To prevent themselves from bee attack, hunters adopted techniques through long term strategies with use of plant resources. The collection process begins with the hunter gathering all the required equipment and supplies. Generally, honey hunter uses leaves of *Olax acuminata* L., locally known as *hanboka*, which are wrapped and tied around a stick to make a torch [Figure 4 (e)] leaving a small gap for lighting fire. The moment the hunter approaches the nest, he lits a fire at the tip of the torch and smoke is released through the opening. The smoke distracts the bees and forces them to leave the comb while some are burnt alive. The hunter, then, removes the honeycomb carefully from which he wrings and compresses out honey and stores in the containers. At times, this method ends up in burning down the nests completely. The hunters bring the torch so close to the comb that a number of worker bees get scorched by fire. The queens along with the other bees are often killed in this process of honey hunting which results in low productivity in the next season. Another plant material used for collecting honey is rhizome of *Etlingera elatior* L., locally known as *pindong* [Figure 4 (f)]. Hunter pounds the rhizome and blows through the holes where bees nest exist. A swarm of bees scatter outside the hole and collapse on the ground. The hunter then collects the honeycomb from the holes and keeps them on a wooden basket which is later squeezed to gather honey. Bark of *Hydnocarpus kurzii* (King) Warb., locally known as *thebongthor* [Figure 4 (g)], is mostly preferred by the honey hunters as a repellent to pacify bees while harvesting wild honey. Hunters scrape the barks using sharp knife and pound them into shreds. The shredded bark is then taken on the palm and blown towards the hive. These activities force the bees to scatter away from the hive for a short duration when the hunter collects the honey comb and leaves the location. The effect on bees caused by these plants is probably because of the active components released by the plants (Table 2). During the study, the local hunters expressed ignorance about selection of these plants which invariably suggests knowledge on the plants has been passed on from elders or through participation in honey hunting activities. Further, the use of equipment and plants in honey hunting trips owe much to the availability of the resource in the local habitat rather than cultural continuity. A graphical representation on the plants used by honey hunters is provided in Figure 3.

Another traditional method of acquiring honey is the most sneaky and unhygienic way where the hunter invites a man having strong odour of the armpit. He grabs the man's odourful armpit with bare hands and blows the odour towards the bee nests. Under the influence of the bad odour, swarm of bees scatter out of the

beehive for a while. During this short period, the hunter collects honey and stores them in containers.

3.4. Bee and Bee Products

Though honey is the major bee product utilized, other bee products also play important role in the social and cultural lives of the people in Singhason Hills. The larvae of *Jopi* are consumed as food where people mix the larvae with different spices, wrapped in leaves of plants like *Musa* sp., *Phrynium* sp., *Curcuma* sp., etc. and baked in hot ashes [Figure 4 (h)]. The stored honey is used either for consumption or for receiving operational capital by selling them in local makeshift markets which cost about INR 500 for each bottle of 1 litre honey produced by *Jove* while honey produced by *Jopi* fetches not less than INR 200 per litre. Many vendors sell local honey directly to the consumers after collecting them in a plastic bottle [Figure 4 (i)] or alcohol bottles. Honey produced by *Jove* is primarily desired by consumers as it is considered to have effective therapeutic properties. People generally identify the source of nectar from the taste of honey, for example, peppery taste indicates the bees must have collected nectar from plants like *Tolypanthus involucratus* (Roxb.) van Teigh, locally known as *Birhu*, and *Derris elliptica* (Wall.) Benth. locally called *Rumet*. Honey is generally taken as medicine by the people during flu. Also, person suffering from mouth ulcers usually apply honey as a first-hand remedy. Hunters often apply honey to relief pain from bee sting during honey harvesting. The various categories of bee products and their significance is described and presented in Table 3.

3.5. 'Sustainability' aspects in traditional honey hunting

Collection of honey has been a traditional occupation of the people of Singhason Hills. During the study it has been observed that people adopt various means to collect honey from the wild. Naturally, the skills and techniques of gathering wild honey may have developed due to their close association with forest and its resources for longer period of time. It has been observed practically that the smoke used by honey hunters often kills a number of bees along with the queen. Hence, the operation is carried out with great caution. Also, there is a need to improve the smoking operation in order to minimize the damage to the colonies and bees. Blowing of armpit odour and essence of pounded rhizomes of *Etlingera elatior* seemed unhygienic but does not result in the death of bees. Besides the numerous torrential streams originating from the Singhason Hill range that feed major rivers in the Brahmaputra plains of Assam, provide bountiful fresh water sources to honeybees and other wildlife. Lastly, the region is rich with honey and pollen producing plants like *Zizyphus jujuba* Mill., *Moringa oleifera* Lam., Asters, Curcurbits, *Brassica* sp., *Syzygium* sp., *Mangifera* spp., *Psidium guajava* L., *Azadirachta indica* A. Juss., *Tamarindus indica* L., *Emblica officinalis* L., etc. which results in honey production even during odd time of the year.

3.6. Bee venom and its management

Often, honey hunters as well as market-goers or children encounter bee attack at one point in their life. This happens occasionally when bees hover around the hive that indicates the ripening of honey they produced. Out of their natural fear instinct, the worker bees attack any traveler or animal that passes by the hive, thereby causing pain, redness, itching and ultimately swelling on the victim's body. The residents of Singhason hills primarily rely on traditional remedies for management of bee's sting. On most occasions honey is applied on the area where the bee had stung; this soothes redness and pain with its cooling effects. But when pain is severe and does not subside, leaf paste of a local herb *Kaempferia galanga* L. locally known as *Bithi Phaknur* [Figure 4 (j)] is applied on the affected area. It is rumored that victim should consider gulping down strong local rice beer to relief pain from bee's attack. This is suggestive because the victim will be in an inebriated state and sedated to deep sleep while disremembering the pain.

3.7. Cultural importance of honeybees

Karbi people believe honey bees' behaviour (availability, migration, foraging, etc.) carry valuable information and hence, are good biological indicators. The year with a good yield of honey is regarded an indication of good harvest enough to survive the whole year. The people also have a firm belief in traditional lifestyle asserted that if bees are found buzzing around a woman, the woman is said to have many suitors for marriage. In Karbi's traditional lore, names of bees are usually taken to relate 'love and affection of a man towards a woman'. Folk songs express true emotions of the people and often the name '*Jove'* is mentioned as an erotic symbol. For an instance, excerpt from the folk song '*Bong'oi mir tampe…….Nangkangvai Jove, bong tinkok nangse*' describing the 'buzzing sound of the bees is thought to be of the girl's voice that the boy is deeply in love with'. Karbis are well known for their witty metaphor for example, '*Joram a helik kardik*', that explains a situation of person who arrived at a gathering only to find to his utter dismay that the solemn occasion was over. There is also a common belief that when bees make their hives in any corner of a house, the household members experience good fortune. People even believed in the concept of tying honeycomb at the entrance of the house which protects them from negative energies [Figure 4 (k)]. It is also said that when a person experiences nightmare involving bees, it relates to ill luck or an indication of the person having several enemies in life. There is a cultural belief among the people that when a new born child causes tantrums, a pinch of honey should be given to calm down the child. There also exists an old saying that a man's hair turns grey when touched with honey. Beeswax is used by the weavers for smooth shuttling of thread of weft yarn while weaving with a loom. The beeswax is rendered from old honeycomb by melting the wax inside a bamboo tube placed above fire. It is believed that, while melting down the beeswax, the bamboo tube should not be viewed else the tube cracks.

4. Conclusion

Honey hunting in Singhason Hills is an apt expression of invaluable TEK that is crucial for subsistence and livelihood of resource poor families. This study has contributed to the documentation of their traditional knowledge and the importance of honey and bees for human well-being (food, medicine, livelihood, biological indicators, etc). Traditional method of honey harvesting often results in few complications where it is often told that the harvesters are either badly stung to death or the whole nests is destroyed. Consequently, it becomes necessary to adopt scientific approach for collecting pure honeys as well as the wax that would help in conserving local biodiversity. Results of this study provide baseline information on the honey bee resource and their ecology in Singhason Hills. Interest is also generated on the investigation of the chemical constituents of plants traditionally used to stupefy bees during collection of honey and management of bee venom. This will help in validation and protection of empirical medical knowledge and intellectual property of honey hunters. Further, inventory of plants foraged by honey bees can be helpful in developing apiculture which in turn will carter the urgent need of creating rural livelihood opportunities. While it is advisable to adopt scientific methods for sustainable collection of wild honey, it is also imperative to state that traditional knowledge of honey hunting should be documented as this practice has been inherited as a result of their cultural upbringing and continued transmission of the knowledge through oral tradition. Traditional ecological knowledge of bees and honey hunting discussed here will be useful for NTFP foragers to locate wild honeybee nests as well as to escape from bees' attack.

This empirical knowledge will come handy for security personal who in the line of duty often had to trek forests in different parts of India. Particularly during shortage of ration, such TEK can help armed forces with food source by locating bee nests and harvesting the wild honey with little or minimum risk.

Acknowledgement

Authors are thankful to the local residents of Singhason Hills for sharing their traditional knowledge related to honey collection from wild habitat. Authors expresses their deep sense of gratitude to Mr. Sampri Kro, Rangsina Ronghang, Thong Teron, Sarthe Kro, Lt. Rupsing Singnar, Jiten Singnar, Khoyasing Teron and the villagers who provided logistic support and local guidance during field visits.

Author's contributions: The first author contributed in data collection, preparation of the manuscript and communication with the journal, while the second author contributed in framing the research design and manuscript preparation.

Conflict of interest: The authors declare that there is no conflict of interest.

References

Ajao AM and Oladimeji YU. 2015. Structure, production and constraints of honey hunting and traditional bee keeping activities in patigi, Kwara state, Nigeria. Egyptian Academic Journal of Biological Science 8 (1): 41 –52.

Alexiades MN. 1996. Collecting ethnobotanical data: An introduction to basic concepts and techniques. In: *Selected Guidelines for Ethnobotanical Research: A Field Manual*. Ed. Alexiades MN. The New York Botanical Garden Press, New York. Pp: 53 – 94.

Balakrishnan NP. 1981 – 1983. *Flora of Jowai,* Vol. 1-2. Botanical survey of India, Howrah.

Batra S. 1977. Bees of India (Apoidea), their behavior, management and a key to the genera. Oriental Insects 11 (3): 289 – 324. doi: 10.1080/00305316.1977.10433811

Bor NL. 1940. *Flora of Assam* Vol. 5 (Gramineae). Assam Govt. of Press, Shillong.

Bui M, Singh HK, Aleminla AO, Chauhan A and Behere GT. 2020. Diagnostics of wild stingless bees from northeast India. Indian Journal of Entomology 82 (2): 337 – 342.

eFloras: Electronic floras (http://www.efloras.org/) hosted by Missouri Botanical Garden, St. Louis, MO and Harvard University Herbaria, Cambridge, MA.

Gogoi H, Umbrey C, Taba M, Badak and Riso N. 2018. Honeybees in Eastern Arunachal Himalaya: Colony status, comparison of pH and protein profile (1D SDS) of honey produced. Journal of Bioresources 5 (2): 58 – 64.

Jain SK and Rao RR. 1977. *A handbook of field and herbarium methods*. Today and Tomorrow Printers and Publishers, New Delhi. Pp: 157.

Kanjilal UN, Kanjilal PC and Das A. 1938. *Flora of Assam,* Vol. 2, Assam Govt. Press, Shillong.

Kanjilal UN, Kanjilal PC, Das A and Dey RN. 1939. *Flora of Assam,* Vol. 3, Assam Govt. Govt. Press, Shillong.

Kanjilal UN, Kanjilal PC, Das A and Dey RN. 1940. *Flora of Assam,* Vol. 4, Assam Govt. Govt. Press, Shillong.

Kanjilal UN, Kanjilal PC, Das A and Purkaystha C. 1934. *Flora of Assam,* Vol. 1, Assam Govt. Press, Shillong.

Martin GJ. 1995. *Ethnobotany: A Methods Manual.* Chapman and Hall, London. Pp: 265 – 270.

Michener CD. 2007. *The bees of the world.* 2nd edition, John Hopkins University Press, Baltimore.

Phangcho PC. 2001. *Karbi Anglong and North Cachar Hills – A study of geography and culture*. Printwell, Diphu, Karbi Anglong, Assam, India.

Rahman A, Das PK, Rajkumari P, Saikia J and Sharmah D. 2015. Stingless bees (Hymenoptera: Apidae: Meliponini): Diversity and distribution in India. International Journal of Science and Research 4 (1): 77 – 81.

Reuber B. 2015. *21st Century Homestead: Beekeeping, First Edition*, Lulu.com. Report available online at: https://www.lulu.com/shop/brant-reuber/21st-century-homestead-beekeeping/paperback/product-1ererp4v.html

Teronpi N, Tamuli AK and Teron R. 2015b. Challenges and Remedies to Biodiversity in Singhason Landscape. Ambient Science 2 (1): 16 – 24. doi:10.21276/ambi.2015.02.1.ra03

Teronpi N, Tamuli AK and Teron R. 2015c. A study of wild plants from Singhason hills with horticultural importance. Pleione 9 (2): 289 – 300.

Teronpi N, Terangpi R, Tamuli AK and Teron R. 2015a. Ethnobotanical investigations on antidotes in Singhason hills, Karbi Anglong district, Assam, India. International Journal of Research in Ayurveda and Pharmacy 6 (1): 50 – 156. doi:10.7897/2277-4343.06130

WFO: World flora online (http://www.worldfloraonline.org/) hosted by Royal Botanic Gardens, Kew, UK and Missouri Botanical Garden, St. Louis, MO.