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Cultural and ecological significance of Odonata (Insecta) to the T'boli of Lake Sebu, Mindanao, Philippines

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Abstract. *Cudera RB, Razon BC, Millondaga KJI. 2020. Cultural and ecological significance of Odonata (Insecta) to the T'boli of Lake Sebu, Mindanao, Philippines. Biodiversitas 21: 2536-2554.* Lake Sebu in Mindanao, Philippines, covered by the Allah Valley Protected Landscape, is home to the T'boli ethnolinguistic group. This study focuses on the cultural and ecological significance of the Odonata (insect order of dragonflies and damselflies) to the T'boli people who are known to have a close connection to their natural environment. According to the T'boli who participated in-depth interviews and focus group discussions, the Odonate larvae of Family Libellulidae and Aeshnidae known as *Kmimi* and *Ogong El* respectively are handpicked by the village members as a food source shared in the community when resources are scarce. The Odonata larvae are also used to cure illnesses and are locally believed to be important components for a love potion. In agriculture, T'boli farmers utilize the adult form of Odonata known as *Klowong* as natural biocontrol agents. Moreover, the Odonata larvae are prominent images in T'boli oral literature, specifically folklore and lullabies, teaching the children the importance of maintaining a harmonious relationship with nature. The results show that the presence of endemic species of Odonata indicates a healthy freshwater environment in the area; thus, studies on the sustainable use and conservation measures of the Odonata should be conducted.

Keywords: Edible insects, Lake Sebu, medicine, Odonata, T'boli

INTRODUCTION

At present, 300 million indigenous peoples occupy one-fourth of the Earth's surface, wherein 80% of their territories belong to the global priority area (Sobrevila 2017). Indigenous people's lives are profoundly intertwined with nature as it serves as their primary source of life support. The market value of indigenous traditional knowledge is estimated to cost $43 billion in 1985 (Principe 1989). Drug companies and food industries have utilized and marketed products traditionally used by the indigenous peoples such as the rosy periwinkle (*Catharanthus roseus*) to cure diabetes and *Stevia rebaudiana* to sweeten drinks, coffee, and tea (Posey and Dutfeld 1996).

However, the documentation of indigenous knowledge and the uses of insects are still under-studied despite being promoted by the Food and Agricultural Organization (van Huis et al. 2013). Although information on edible insects are available in some Asia Pacific countries, the data remain fragmented (Yen 2015). Published data in Malaysia, Myanmar, Nepal, and Taiwan are limited (Johnson 2010), and knowledge gaps still exist in Australia, Indonesia, Papua New Guinea, Philippines, and Vietnam.

In many cultures, the importance of insects is portrayed in the different aspects of people's lives. Indigenous peoples in Australia use insects as baits, medicines, poisons, adornments, toys, indicators of meteorological and other ecological phenomena, and in technology (Turpin et al. 2013). In some regions of Australia, insects are featured in their mythology, songs, ceremonies, and names of places and persons. As such, Hercus (1989, 1992) remarks that the collection and preparation of insect species were shrouded by mystery and prohibitions.

Evidently, insects are an important source of food in many cultures. Entomophagy or the practice of eating insect as food is the most familiar use of insects in Latin America, Africa, and Asia (Raheem et al. 2018). Globally, the most commonly eaten insects belong to the orders of Coleoptera (beetles, often the larvae) (31%), followed by the Lepidoptera (caterpillars) (18%), Hymenoptera (larval and pupal stages of wasps, bees, and ants) (14%), Orthoptera (adult crickets, grasshoppers, and locusts) (13%), Hemiptera (true bugs) (10%), Isoptera (termites) (3%), Odonata (dragonflies) (3%), Diptera (flies) (2%), and others (5%) (van Huis et al. 2013). As shown in the data, Odonata, the focus of this research, is the least consumed. The shift to Westernized diet and urbanization resulted to the decline in insect consumption among countries, such as the Philippines, with a long-standing history of entomophagy (van Huis 2013).

The Order Odonata of Class Insecta is divided into two suborders namely Zygoptera (damselflies) and Anisoptera (true dragonflies). This group spends its time both in water and on land during its life cycle making it an important link between aquatic and terrestrial ecosystems (Kalkman et al. 2008). Its sensitivity to environmental conditions makes Odonata an excellent indicator of wetland health and diversity (Klym and Quinn 2003). Furthermore, Odonata

provides diverse and wide-ranging ecosystem services and benefits. It plays a role in the decomposition and nutrient cycling (Macadam and Stockan 2015). It also serves as both prey and predator, thus maintaining the balance of trophic levels in the food chain (Das et al. 2012). This is elaborated in the study of Jacob et al. (2017) suggesting that the Odonata larvae might control the population of other insects such as mosquitoes. Aside from its ecological importance, the value of Odonata is expressed through its cultural functions. It is said to have inspired artistic expression through paintings and poetry and depicted good omens or protection against death in some societies (Simaika and Samways 2008; May 2019).

In the Philippines, the Odonata studies started almost two (2) centuries ago with the description of *Trithemis aurora*. The expeditions of Dr. Carl Gottfried Semper (1859-1865) and Dr. Med. G. Boettcher (1913-1918) including the local collection in the University of the Philippines (1920-1930s) led to the rich taxonomical knowledge on the Philippine dragonfly fauna (Hämäläinen and Müller 1997). Filipino entomologists including Gapud and Recuenco (1993), Plateros (Unpublished data 1972), and Barrion (1979) have made significant contributions to Odonatology. Recently, in Mindanao, works on Odonata focus on the dragonfly's morphological variation (Demayo et al. 2011; Tabugo et al. 2011), while biodiversity studies on Odonata was provided by Villanueva (Villanueva and Mohagan 2010; Villanueva and Cahilog 2012a, b; Jomoc et al. 2013; Mapi-ot et al. 2013; Quisil et al. 2013; Villanueva et al. 2013; Caparoso et al. 2016). Despite the aforementioned scientific explorations, however, available data on the utilization of Odonata by the indigenous people in Mindanao are still limited; thereby prompting the researchers to conduct this study.

This study aims to document the indigenous knowledge, systems, and practices on Odonata of the T'boli, one of the ethnolinguistic groups in Lake Sebu, South Cotabato. The study examines the people's utilization of Odonata as food and medicine and the insects' symbolic significance to T'boli culture and literature. In doing so, this study seeks to contribute to the existing literature on Odonata in general and fill the gaps in the documentation of the rich culture of T'boli in particular.

MATERIALS AND METHODS

Study area

The study was conducted in Lake Sebu, South Cotabato, Mindanao, Philippines (700 masl; 6°12'33.00" N 124°42'2.99" E) (Figure 1). Lake Sebu is known as the Summer and Eco-Cultural Center of South Cotabato. The place has scenic spots, such as Lake Lahit, Lake Sebu, and Lake Seloton, that attract thousands of visitors. Lake Sebu is a major producer of Tilapia (*Oreochromis niloticus*) and forest products, like bamboo and rattan. It is also part of the Allah Valley Watershed Forest Reserve under the Presidential Decree 2455 of 1985 and Republic Act 7586 (NIPAS or the National Integrated Protected Areas System Act of 1992). Under NIPAS, the Department of Environment and Natural Resources (DENR) is mandated to protect and maintain the natural biological and physical diversities of the environment.

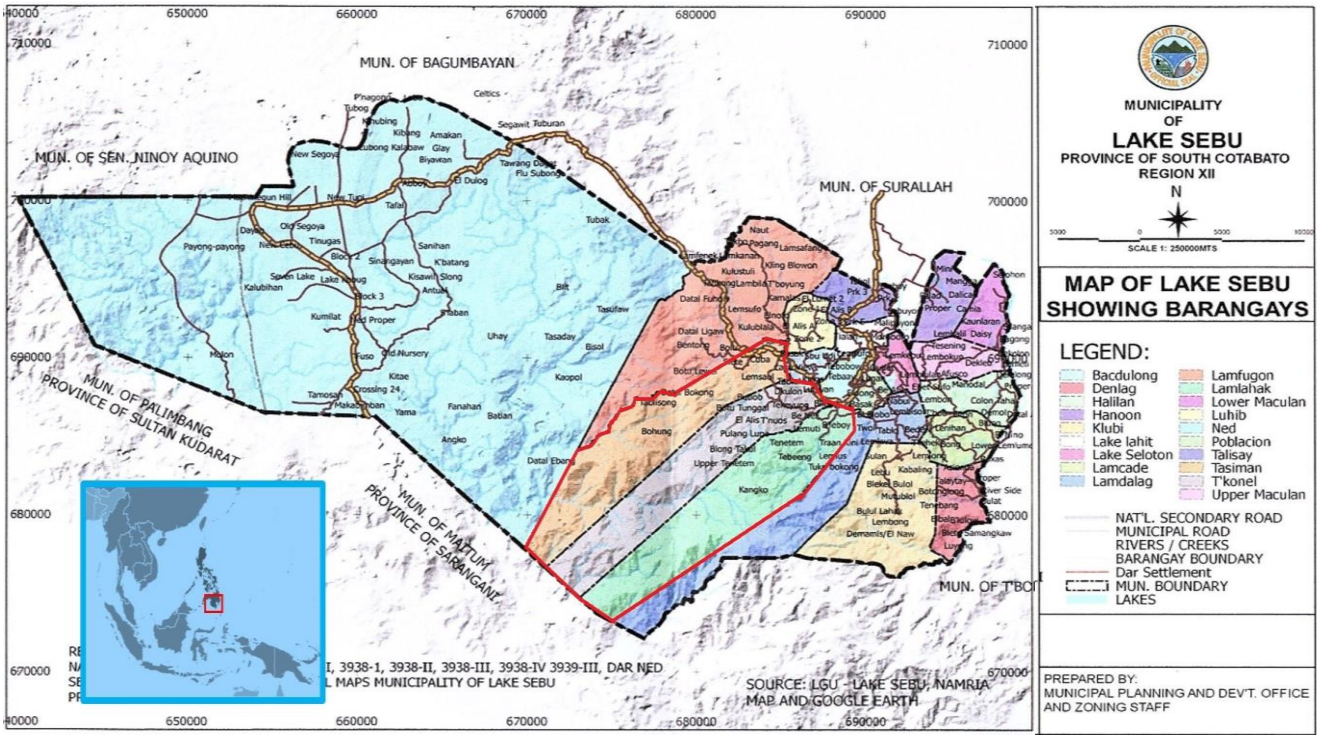

Figure 1. Map of Lake Sebu municipality showing the three (3) sampling sites enclosed in the red line (courtesy of the Lake Sebu Office of Municipal Planning and Development Coordinator)

Three barangays (smallest administrative unit) in Lake Sebu were included in the study, namely Barangay Lamlahak, Barangay Takonel, and Barangay Tasiman. These barangays are known for their cool weather, natural lakes, waterfalls, and other natural landscapes. Barangay Lamlahak is famous for its T'raan Kini river, and it is a home to the Philippine Eagle (*Pithecophaga jefferyi*), while Barangay Tasiman has Sepaka Spring Resort. Other than its natural resources, Lake Sebu is also known as the ancestral domain of the T'boli ethnolinguistic group. However, the group was displaced from their own lands because of the massive influx of settlers from Luzon and Visayas after the Philippine government implemented its resettlement programs.

The T'boli ethnolinguistic group

The T'boli ethnolinguistic group is one of the Indigenous Peoples inhabiting the coastal areas of Saranggani province and the mountainous parts of South Cotabato and Sultan Kudarat. Based on the 2009 survey conducted by the Philippine Statistics Authority (formerly known as National Statistics Office), the T'boli population has reached about 350,000. Anthropologists believe that the T'boli are part of the Austronesian-speaking population (Casal and Bueza 2017) and is closely associated with the Proto-Malay race who arrived in Mindanao through the Balangay expedition. The term T'boli is a combination of *tau*, meaning people, and *bilil,* meaning hill or slope. Thus, T'boli means "people living in the hills" although some inhabit the shores of the Celebes Sea (Casal and Bueza 2017). What makes the T'boli unique is their cultural identity and ethnicity. They are known to be conservative, shy, humble, hospitable, sensitive to the needs of others, and have close family ties (Lugan, n.d.). They are also known for their arts and material cultures including their traditional *tnalak* weaving, beading, and brass-casting (The Provincial Government of South Cotabato 2016). Their way of life, arts, sports, and other tribal activities are further celebrated during the *Helobung* Festival. However, their domain is currently facing environmental and ancestral land degradation due to monocropping, chemical-dependent agriculture, and booming tourism. The T'boli's traditional practices are slowly changing due to modernization as well as Western-type education fails to cultivate and promote their indigenous knowledge systems (Asia Pacific Education Watch 2007).

Research type and ethical considerations

This study is qualitative in nature. As defined by Denzin and Lincoln (2000), qualitative research involves studying certain phenomenon in a people's natural setting, attempting to make sense of or interpret the local meanings they attach to it. The data produced in qualitative research provide a narrative description of the way of life of the people (Munhall 2001). Specifically, the study employs ethnographic method to understand how the insects figure in the lifeworld of the T'boli. Ethnography is both an art and a science used to describe a group or culture (Fetterman 1998). This involves an investigation of patterns employing a systematic, careful, and detailed collection of data through observation and participation. It is known among anthropologists as participant-observation where the researchers take part in people's lives, thereby producing "thick description" (Geertz 1973) about a certain aspect of culture. To do so, ethnographic research entails extended fieldwork and longitudinal engagement. Angrosino (2007) also added that in ethnography, multiple data are collected for triangulation. It also involves a dialogue, since interpretations and conclusions are formed through comments and feedback mechanisms between the participants and researchers. In this sense, ethnography relies heavily on the narratives of the "native" participants while the researchers try to make sense of these data to understand specific cultural practices in a certain period of time (Van Maanen 2011).

Qualitative research or ethnographic studies involving indigenous people require a formal approval from the National Commission on Indigenous Peoples (NCIP), in accordance with the Indigenous People's Rights Act of 1997. As a government agency that is mandated to protect and promote the rights of indigenous peoples in the Philippines, the NCIP has the authority to regulate research conducted in indigenous communities. The NCIP requires researchers to secure the Compliance Certificate before the data gathering. In order to do so, several activities were conducted from August to November 2018 to secure the permit that includes the following: pre-conference with the NCIP team in South Cotabato, community assembly, and the review, negotiation, and signing of the Memorandum of Agreement (MoA). During the community assembly, the research team and an NCIP Officer from Region 12 were present. The NCIP Officer facilitated the activities to ensure that the participants' rights were protected. He gave an overview of the activity and allowed the researchers to present the research objectives to the members of the community as well as the methods of collecting the data. After the presentation, the NCIP Officer sought the opinion of the community and they were given time to express their concerns and ask questions pertaining to the research. He also assured the audience full confidentiality of the data to be collected including the participants' identities. If the need arises for the informant's identity to be disclosed, researchers sought his/her consent. The participants were also informed that their participation was entirely voluntary, and that they could withdraw their participation whenever they felt uncomfortable in the process of data gathering. The community assembly also served as an opportune time to formally ask permission and seek the approval of the community leaders.

In November 2018, the MoA was signed between the researchers and the representative tribal leaders of the T'boli communities. The said MoA is a prerequisite to secure the Gratuitous Permit from the Department of Environment and Natural Resources (DENR) Region XII. The said permit is necessary for research involving the collection and extraction of species from their natural habitat.

The following month, fieldwork and data gathering commenced in the three T'boli villages. The researchers hired a local guide to serve as the translator, assist in

identifying possible informants, and navigate the terrain of the T'boli communities.

Data collection techniques

Key informant interview, focus group discussions, and participant-observation

Between December 2018 to May 2019, the researchers interviewed 21 male and 13 female participants with ages ranging from 30 to 100 years old from the three (3) barangays of Lake Sebu (Lamlahak, Takunel, and Tasiman). The tribal leaders were requested to identify culture bearers, traditional healers, elders, and insect collectors within the community. These participants were purposively selected because of their grasp of the indigenous knowledge systems and practices. Subsequently, a snowballing technique was also used in the recruitment process.

A semi-structured questionnaire developed after reviewing related literature guided the researchers in conducting the interviews. The conversations were recorded using an audio recorder with the participants' permission. Most interviews were arranged beforehand and took place in the respective residences of the participants. The researchers interviewed the participants using Tagalog and Hiligaynon, the vernacular language in the region, since the researchers are not speakers of the T'boli language. The local guide translated the questions into the T'boli language if the participant is not well-versed in Hiligaynon or Tagalog. On average, the interviews lasted between 30 to 60 minutes and the recordings were then transcribed. Insects that were identified by the participants were photo-documented by the researchers.

Essentially, the socio-demographic profiles of the participants were also gathered. This included their age, gender, educational attainment, occupation, marital status, number of family members in the household, annual family income, and daily work activity. The major part of the interview, nonetheless, focused on the indigenous knowledge systems and practices of the T'boli people. They discussed the utilization of insects as food and medicine and their ritual value. They also explained the associated rituals prior to the collection, step-by-step preparation, and preservation of the insects that they use as food and medicine. Along with these, the researchers asked the participants about the assumed benefits of the Odonata and the symbols the insects represent in their oral literature.

Aside from the interviews, the researchers participated in the collection of the Odonata. In March and April 2019, the process of cooking the insects carried out by the elderly women of Brgy. Lamlahak was observed. Through these interviews and participant-observation, the researchers were able to discern the cultural significance of the Odonata to the lives of the T'boli people.

On May 14, 2019, the researchers conducted a focus group discussion (FGD) involving 14 T'boli participants (5 females and 9 males) who have substantial knowledge of Odonata. The objective of the activity was to validate the information gathered during the interviews and obtain more information that will support the previously gathered data. The FGD was conducted in a conducive area, free from any noise to ensure the active involvement of the participants. Two (2) researchers facilitated the activity who served as both a facilitator and an observer. The researchers presented the overview of the research study, emphasized anonymity and confidentiality guidelines, and established ground rules. With the help of the T'boli translator, the researchers were able to ensure a mutual understanding with the participants. The group was also informed that the discussion will be recorded and that the recording will be only shared within the research team. All of the participants were given the time to share their knowledge on Odonata and the facilitator promptly summarized them to ensure the correctness of the written notes. This exchange effectively allowed the participants to clarify the information they have provided and to add further information. The FGD lasted for two (2) hours.

The researchers returned to Lake Sebu on November 19, 2019 to present the written data to the participants of the one-on-one interview and focus group discussion. The activity was also attended by the tribal leaders of Lake Sebu. The information gathered were thoroughly discussed to the participants with the help of the T'boli translator. The presentation of the data served as an opportunity for the researchers to verify the correctness of written information and to obtain feedbacks and suggestions from the participants.

Sampling of Odonata

Samples of the larvae and adult Odonates were obtained from the T'raan kini river of Brgy. Lamlahak and the Sepaka river of Brgy. Tasiman. Odonata larvae were collected through handpicking and using fine mesh nets with a wooden handle. The samples collected were placed in a container filled with water from the river. In the laboratory, the Odonata larvae were preserved in 70% ethanol. The samples were then identified based on the family characters (Neseman et al. 2011). However, the researchers experienced a difficulty in the identification of the larvae to the lowest possible taxa because of the paucity of literature and expertise.

The researchers also collected the adult dragonflies and damselflies through sweep nets and handpicking in order to determine the species of Odonata in the sampling sites. The samples were immediately placed in the glassine triangle paper. In the laboratory, the samples were soaked in acetone for preservation, 12 hours for damselflies and 24 hours for dragonflies (Quisil et al. 2014). Preserved specimens were pinned and stored in insect boxes with naphthalene balls to prevent the entry of other insects. Samples collected were then identified through published references (Villanueva 2010; Villanueva and Mohagan 2010; Villanueva and Cahilog 2012a, b; Villanueva and Cahilog 2014).

During the fieldwork, the researchers took photos of the specimen. The collected samples of larvae and adult Odonates and their photos were shown to the participants during the FGD and community presentation.

Data analysis

The data gathered during the interviews and FGD were transcribed verbatim and ethnographically analyzed following the steps suggested by Roper and Shapira (2000). The analysis included grouping the written data into meaningful categories or codes, sorting for patterns or themes, identifying outliers that do not fit with the findings, discussing the patterns using existing literature, and memoing for further clarification. In this study, the themes identified include the following: traditional Odonata collection techniques, uses of insects as food and medicine, the insects' biocontrol capacity, insects as folklore subjects, and other cultural connections.

Descriptive analysis was also performed. The researchers assigned a specific code number to each participant as presented in their socio-demographic information. A percentage of citation on the main uses of Odonata was also computed. These were supplemented by the participants' anonymous quotations to illustrate the findings and to achieve a better grasp of their practices on the use of Odonata. Similar to other qualitative research studies, this research is limited in size and scope, and captures only certain aspects of the T'boli culture.

RESULTS AND DISCUSSION

Socio-demographic profiles of the participants

Out of the 34 T'boli participants interviewed, 14 of them mentioned that they utilize insects under the Order Odonata. Of these 14 participants, five (5) or 35.71% are females and nine (9) or 64.29% are males. As shown in Table 1, the socio-demographic profiles of 14 informants are further elaborated. 57.14% of the participants are senior citizens with ages above 60 years old. The youngest participant is 40 years old and the oldest is 92 years old. Eight (8) participants or 57.14% did not receive formal education, three (3) or 21.43% reached elementary level, two (2) or 14.29% attended high school, and only one (1) or 7.14% was able to finish college. 10 participants or 71.43% are farmers while four (4) or 28.57% are working as either *Barangay Kagawad*, traditional healer, embroiderer, or small business owner. All of them are married and are living in households with a large family size. Five (5) or 35.71% of the participants have household members of ten (10) and above, reflecting the polygamous nature of the people, particularly the *Datus* (traditional or tribal leader) who can have multiple wives. The highest annual income in the T'boli household is Php100,000.00 (around $1960) and the lowest is Php3,000.00 (around $59). Seven (7) participants or 50% reported that their annual income is above Php50,000.00. 13 or 92.86% of the participants are classified as poor, earning less than Php 7,890.00 per month (Albert et al. 2015). Majority of the participants rely on farming as their livelihood, mainly by planting corn, rice, and other root crops, such as cassava.

Background of the Odonata community

During the interviews and focus group discussion, the T'boli participants mentioned that they use the larvae and adult Odonata. They identified two (2) kinds of Odonata larvae (Figure 2). The dragonfly larvae of Family Libellulidae, locally known as *Kmimi,* were collected in two (2) barangays, while the larvae representing Family Aeshnidae, known as *Ogong El* among the T'boli, was recorded in Brgy. Tasiman. Libellulidae larvae are more abundant than Aeshnidae in the study sites. It was mentioned by Neseman et al. (2011) that Libellulidae larvae are abundant in all types of stagnant water and are able to successfully colonize even in small water bodies with low oxygen where other Odonates cannot survive.

Adult Odonates were also collected in the field and their photos were presented to the participants (Figures 3 and 4). Among the T'boli, the adult dragonflies and damselflies are both termed as *Klowong*.

Based on the gathered data, Libellulidae is the most common family in the study area as represented by seven (7) species (Table 2). The abundance of Libellulidae could be associated with their short life cycle and widespread distribution (Norma-Rashid et al. 2001). Libellulidae is also one of the oriental species that are most likely found in disturbed areas as mentioned by Mapi-ot et al. (2013). The higher number of oriental species can be attributed to the presence of agro-ecosystems wherein most of the lands in the two (2) sampling sites are converted into farms. Villanueva and Mohagan (2010) found out that the agro-system has the highest disturbance approximately 83% and that utilization of water resources for agricultural production implies that this habitat is already disturbed or modified for human use.

Despite being relatively disturbed, 40% of endemism was recorded in Brgy. Lamlahak. Perhaps, this is connected to the fact that a portion of T'raan kini river in Brgy. Lamlahak is considered a protected area and the pristine water is still surrounded by lush vegetation that is also home to endangered species of birds, such as the Philippine Eagle. Moreover, high percentage of endemism in an area could be due to the shading, vegetation-type, and natural spring waters (Schridde and Suhling 1994). The endemic Odonata species are indicators of a healthy freshwater wetlands, particularly in Brgy. Lamlahak. In biodiversity conservation, Odonates serve as an umbrella species and represent specific biotic wetland assemblages (Selvarasu et al. 2019).

Significance of Odonata to the lifeworld of the T'boli people

The T'boli people believe that nature serves as their primary source of support-depicting the community's deep connection with nature. Their nexus with nature is evident in their indigenous knowledge systems and practices (IKSP) on Odonata. The participants shared their methods of collecting Odonata and their utilization of Odonata as food, medicine, and biocontrol agents. In addition, the Odonata has a significant folkloric value and cultural connection to the T'boli lifeworld.

Table 1. Socio-demographic profile of the T'boli participants, Philippines

Code name	Sex	Age	Education level	Occupation	Marital status	No. of family	Annual family income (Php)
TM1	Male	40	High School	Farmer	Married	5	50,000.00
TM2	Male	68	None	Farmer	Married	9	50,000.00
TM3	Male	66	Elementary	Farmer	Married	7	50,000.00
TM4	Male	53	High School	*Brgy. Kagawad*	Married	6	50,000.00
TM5	Male	48	Elementary	Farmer	Married	12	30,000.00
TF6	Female	54	None	Traditional healer	Married	5	60,000.00
TM7	Male	92	None	Farmer	Widow	10	15,000.00
TF8	Female	76	None	Embroiderer	Widow	5	12,000.00
TM9	Male	70	None	Farmer	Married	15	12,000.00
TF1O	Female	70	None	Farmer	Married	16	3,000.00
TM11	Male	49	Elementary	Farmer	Married	9	60,000.00
TF12	Female	63	College Level	Small business owner	Married	5	100,000.00
TM13	Male	57	None	Farmer	Married	8	20,000.00
TF14	Female	62	None	Farmer	Widow	10	10,000.00

Table 2. List of adult Odonata collected in Brgy. Lamlahak and Brgy. Tasiman, Philippines

Sub-order	Family	Scientific name	Site of collection		IUCN status
			A	B	
Zygoptera (Damselflies)	Calopterygidae	*Vestalis gracilis*	+	-	NE
	Calopterygidae	*Vestalis melania*	+	-	ME
Anisoptera (Dragonflies)	Corduliidae	*Heteronaias heterodoxa*	+	-	NE
	Libellulidae	*Rhyothemis phyllis*	+	-	ME
	Libellulidae	*Neurothemis r. ramburii*	+	+	NE
	Libellulidae	*Orthertrum pruinosum clelia*	+	+	NE
	Libellulidae	*Trithermis festiva*	+	-	PE
	Libellulidae	*Diplacina bolivari*	+	+	PE
	Libellulidae	*Sympetrum striolatum*	+	+	NE
	Libellulidae	*Sympetrum flaveolum*	+	+	NE

Note**:** *Legend: A: Brgy. Lamlahak, B: Brgy. Tasiman, NE: Not Evaluated, ME: Mindanao Endemic, PE: Philippine Endemic

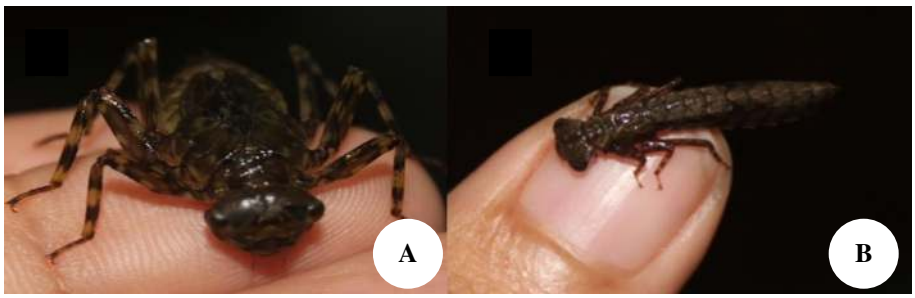

Figure 2. Larvae of dragonfly: A. *Kmimi* of Family Libellulidae; B. *Ogong El* of Family Aeshnidae

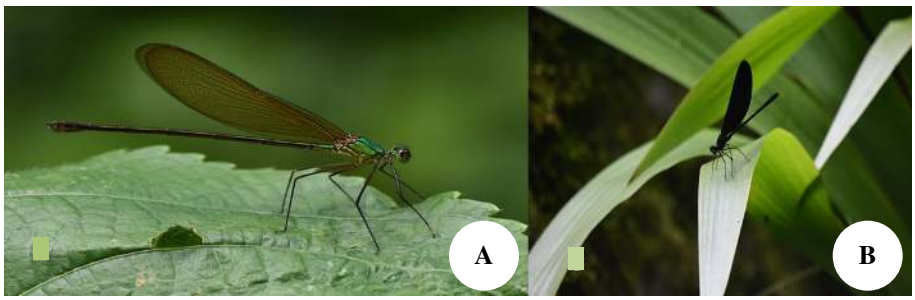

Figure 3. Adult damselflies: A. *Vestalis gracilis*; B. *Vestalis melania*

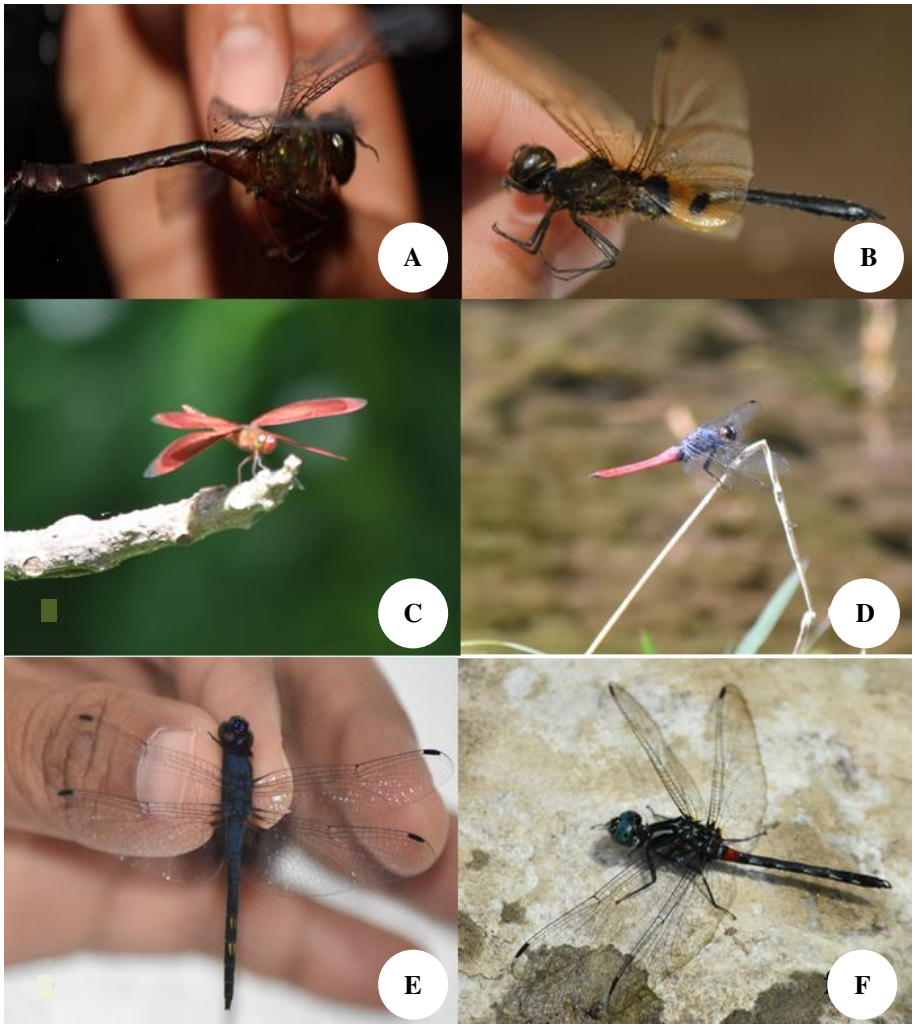

Figure 4. Snapshots of the collected dragonflies: A. *Heteronaias heterodoxa*; B. *Rhyothemis phyllis*; C. *Neurothemis r. ramburii*; D. *Orthertrum pruinosum*; E. *Trithermis festiva*; F. *Diplacina bolivari*

As shown in Figure 5, most of the participants utilize Odonata as food and medicine. 11 out of 14 participants or 78.57% collect and use the larvae of Libellulidae as food while 10 out of 14 participants or 71.43% said that they use the larvae for medicinal purposes. Four (4) and two (2) participants with 35.71% and 21.43% citation gather and use the Aeshnidae larvae as food and medicine respectively. Two (2) participants or 14.29% collect the adult Odonata and use it as biocontrol agent and only one (1) participant or 7.14% associates the Libellulidae larvae to the T'boli oral literature and the polygamous nature of the people. These varied utilization of the Odonata are further elaborated below.

Traditional methods of collecting Odonata

The collection of Odonata is categorized into subthemes such as the following: the place of collection or habitat, availability (time and month of collection), morphology, abundance, mode of collection, storage technique, collectors involved, and rituals performed during collection. To provide a deeper insight on the participants' knowledge in collecting the Odonata, the anonymized quotations are shown in Table 3.

The T'boli participants discussed that the larvae are available in the river all year round, but they have observed that these are most abundant during the wet season. The T'boli living near the river are the "expert" collectors of the larvae. They handpick Odonata during the day, moving the stones in the river to see them under the water (Figure 6). The larvae driven by the water can be collected using a net. They can easily identify the larvae based on their appearance and collect them along with other aquatic organisms. Nowadays, the collected insects are commonly placed in a bottle or plastic container filled with water to keep them alive (Figure 6).

When the T'boli search and gather their food, they invoke the spirits of nature. This practice mirrors their belief of *D'wata*, the God of Nature, who rules and guards their lives and determines their fate and destiny. They also believe in the *Fu* or spirit that inhabits and owns the natural environment. Examples of *Fu* are *Fu El* who is considered the Spirit of Water and *Fu El Melel* or the Spirit of the

River. This belief system highlights the spiritual connection of the T'boli with their nature.

Furthermore, the T'boli participants are also familiar with *Klowong*, the T'boli term used to describe the imago (adult stage) of dragonfly and damselfy. *Klowong* is usually found in a terrestrial environment, near the water bodies. The imago is only collected by the farmers who use them in their farms as a biocontrol agent. It is best collected with a net or sometimes handpicked.

Species with a complex life cycle – an aquatic larval stage and a terrestrial adult stage – such as Odonates (dragonflies and damselflies) occupy different ecosystems (Stoks and Cordoba-Aguilar 2012). The Odonata larvae live in freshwater environment, both in running and standing waters (Kalkman et al. 2008) such as the river and lakes in the municipality of Lake Sebu. The T'boli search under the stones, algae, and leaf litters when collecting the larvae. This is one of the several types of microhabitats where larvae may be found. In running water, most species of Odonata are hiding in the rotten vegetation or concealed under stones. Some may burrow deep in the silt or litter layers that form where the flow is slower. In standing water, more species live openly among the vegetation, only a few species burrowing just below the surface (Orr 2003; Gillott 2005).

The T'boli can easily spot the Odonata larvae based on its appearance. On the one hand, the Odonata larvae are squat, clumsy looking creatures with broad head that lack functional wings but with highly modified labium (Orr 2003). It is easier to identify the larvae to suborder and family. Libellulidae and Aeshnidae collected in the sampling sites in Lake Sebu are morphologically distinct. Libellulidae larvae are minute to medium-sized and have a delicate and comparatively soft body. The larvae are very similar in appearance and shape to Corduliidae but differ by their anal pyramid. Body color of the different species may cover a wide range from bright yellow, light greenish to dark brown. On the other hand, Aeshnidae larvae are the largest among Odonata reaching more than 5cm in length. The larvae are rather elongated with a robust, cylindrical abdomen and very large eyes. The larval color displays a wide range from light yellow, bright green, ochre brown to dark brown (Neseman et al. 2011). Variation in the color of Odonata larvae is associated with their adaptive mechanism that is assuming the colors of their habitat (Orr 2003).

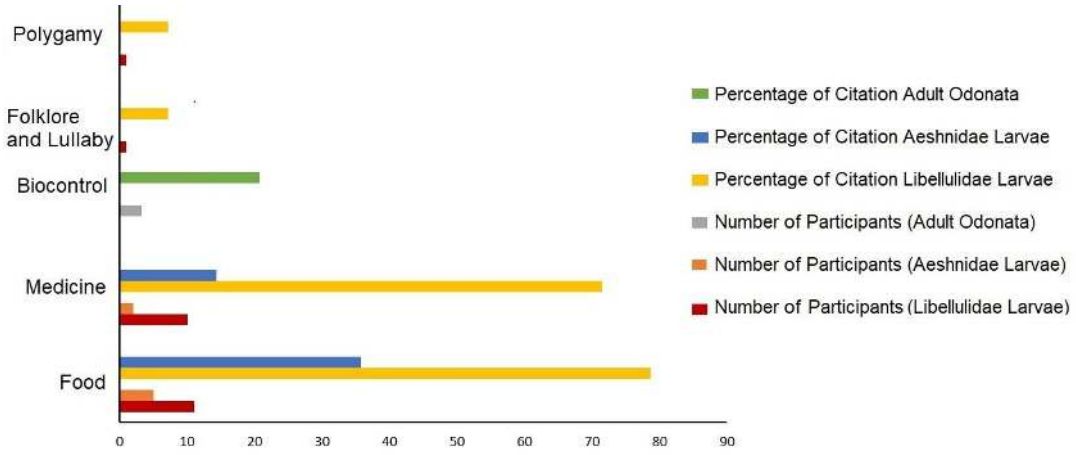

Figure 5. Indigenous knowledge systems and practices on Odonata as mentioned by the T'boli participants

Figure 6. A. T'boli collecting Odonata larvae found underneath the rocks in the river; B. Collected insects placed in a glass container filled with water

Table 3. Responses of the participants during the interviews and focus group discussion in collecting the larvae and adult Odonata

Collection	Odonata Larvae	Adult Odonata
Habitat	"*I will just go to the river to look for Kmimi. I prefer searching them in shallow flowing water where there are rocks covered with algae. I sometimes collect them when gathering snails."* TF10 *"Kmimi can be obtained in the lake and the river. I noticed that more Kmimi are found in the river than in the lake."* TM5	*"Klowong emerges from the water and later develops wings and flies. Klowong usually rests on the leaves of the grasses. When it still in the water we call them Ogong el but once they fly, it is called Klowong."* TM13 "*Klowong are found resting on trees near the water. I also find them in farm fields that are prepared for planting*." TM9
Availability	*"Kmimi and Ogong El crawl on to the rocks after the rain. During the dry season, they can be mostly found beneath rotten leaves on the river."* TM11 *"Kmimi can be easily collected anytime of the day. They are abundant from September to December during the wet season. However, most of them hide when the weather is hot. They are seldom found during dry season."* TM4	"*Klowong is abundant all year round in Lake Sebu and can be collected anytime of the day."* TM13
Morphology	*"The body of Kmimi is wider and round but stout. While Ogong El looks like Kmimi but with elongated body and three (3) pairs of legs. Kmimi clings to the rock and crawls slowly compared to Ogong El."* TM4	*"Klowong has two (2) pair of wings with a tail. It has big eyes and flies like a helicopter. In Hiligaynon, it is referred as Tumbak-tumbak."* TM13
Abundance	*"When the river water overflows after the heavy rain, we collect them using salaf (net). Abundant Kmimi can be collected because the rocks and gravel are displaced. We can still collect Kmimi if the river is not flooded but it is not that much."*TF8 "*In the past, Kmimi and Ogong El are abundant but their population has declined due to the heavy use of pesticides in the farm.*" TM4	*"Klowong are abundant here in our area but we seldom collect them, we just let them fly."* TM4
Mode of Collection	"They can be easily collected through handpicking because they don't bite. If you need a few of them, then they can be handpicked but if I want to collect abundant Kmimi then I use salaf (net) and place it in the flowing water." TF5	*"Klowong can be handpicked. You have to quickly grab its wings, so it will not fly away. We also make improvised nets when collecting them*." TM13
Storage	"*In the past, we place the collected aquatic organisms in the bamboo container or woven basket (leban) for storage. We also use the hard-inner shell of the coconut or wrap it in a leaf. But nowadays, the collected Kmimi are placed in a tin can covered with plastic bag and glass bottles of Siok Tong (tonic wine) or Mallorca (gin).*" TM4	*"I only collect one Klowong and place it in a plastic container making sure that it is still alive." TM9*
Collectors	*"T'boli of all ages, male or female, who are living near the river go to the river to collect Kmimi.*" TF8 *"When we were still young, children in the community go to the river to collect Kmimi. We collect as a group and can fill one tin can. It is not easy to obtain Kmimi when you are alone."* TM6	*"Only elders who are farmers and are knowledgeable of using Klowong are the ones responsible in collecting it."* TM4
Rituals during collection	*"My father, a traditional healer (Tau Mulung), performs a demsu, a propitiatory offering to the spirit of the river Fu El Melel. We place eight pieces of sticky rice balls and boiled eggs near the river. Once the offered food is visited by animals like butterflies, it signifies that the spirit accepted our offering, allowing us to collect abundant resources. However, when the offerings vanished, it signals that we are not allowed to gather any resources in the river, implying that the spirit is angry and serves as a warning that disease or disappearance may inflict family members."* TM4 *"At present, we just throw a coin in the river that serves as a love gift to the spirit as a sign of respect."* TM11	*"We just utter a prayer in our minds to show respect to the owner of the place, Fu (spirit) where we collect Klowong." TM4*

At the end of the larval life, the larva finds support such in rocks or plant stems where it can shed its skin, and the winged adult emerges from the last larval stage (Paul and Kakkassery 2013). This was observed by the T'boli who mentioned that the adult Odonata emerges from the aquatic larvae and perches on the vegetation near the water bodies. The adult Odonata are encountered usually near water where they establish territories, find mate, and lay their eggs (Corbet 1999; Orr 2003). The T'boli participants also recognize the remarkable features of the adult Odonata, such as their large eyes and ability to fly. Adult Odonata have notably large compound eyes that consist of thousands of ommatidia, with the largest number of ommatidia over 28,000 in large dragonfly species (e.g. Aeshnidae) (Sherk 1978). Adult Odonates are known to be good fliers that disperse over large distances (Corbet 1999; Hardersen 2008) and easily reach habitats, even if those habitats are not suitable for reproduction (Hardersen 2008; Raebel et al. 2010). Dragonflies have impressive maneuverability, speed, visual guidance control (May 2019), and their synchronous locomotor flight systems is amazingly more similar to vertebrate musculoskeletal systems (Bybee et al. 2016).

The presence of Odonata corresponds largely with the climate in the area. The T'boli people believe that Odonata larvae are abundant during the wet or rainy season and their population declines during the dry season. The chance of wet season varies in the municipality of Lake Sebu throughout the year, but it usually starts in May and ends in November. As mentioned by Kalkman et al. (2008), areas near the equator particularly with high precipitation have high diversity of Odonates. Aside from this, the diversity of tropical Odonates is at least partly explained by the high diversity of aquatic habitats in tropical forests (Orr 2006). Asian rivers, for example, are highly dominated by the immature stages of aquatic insects such as the Odonates (Joshi et al. 2007; Flores and Zafaralla 2012). Although the T'boli people perceive that Odonata larvae are abundant in the rivers than in the lake, this is not a worldwide pattern. It is opposite in temperate region where the abundance of Odonates in terms of number of taxa and biomass in lentic habitat is higher (Khelifa 2019). Mashkova et al. (2018) added that the dragonflies' richness was greater for lakes with higher landscape diversity and more types of vegetation.

The collection of the larvae and adult Odonata is usually conducted during the day as shared by the T'boli participants. The adult dragonflies and damselflies can be observed basking under the sun in a sunny weather between 10 a.m. and 2 p.m. The larvae can be collected between 9 a.m. and 12 p.m. using nets (Giugliano et al. 2012; Mashkova et al. 2018; Khelifa 2019). Most large-bodied species of Odonata within the Libellulidae family are sun-loving (Luke et al. 2017). Although netting is the common method in capturing the dragonflies and damselflies, T'boli people of all ages collect them through handpicking and for them, the best time to collect the larvae is when the river is flooded after the rain. They also mentioned that abundant Odonata larvae can be netted when the river is flooded. Larvae that live on the bottom substrate or those buried in the sediment or detritus with cryptic habit and less active (Corbet 1999) are usually eroded when the sediments undergo weathering and these can be collected using kick nets.

The T'boli associate the decline in collected Odonata larvae with the excessive usage of pesticides in the farms. Pesticides are used to protect the crops from pests in the agricultural fields. However, their widespread use greatly affects the aquatic environment by reducing water quality and causing threat to aquatic ecosystem (Rahman 2004; Strayer 2006). Disposal of pesticides that are directly applied to the soil can be washed off in the rivers and other bodies of water. Consequently, pesticides may pose harmful effects to humans and many other aquatic and terrestrial organisms, either directly or indirectly through the food chain (Hasanuzzaman 2018). The effects of contaminants may be magnified in the presence of other stressors, such as predation risk (Relyea and Mills 2001) and higher temperatures (Noyes et al. 2009) causing considerable loss of aquatic biodiversity (Beketov et al. 2013; Malaj et al. 2014; Lakhani 2015). Odonates, which depend on the availability of suitable water bodies to complete their life cycle, are no exception to this trend. This leads to rising concerns about the status of their populations throughout Europe, America, Asia, and Africa (Clausnitzer et al. 2009; Bried and Mazzacano 2010; Kalkman et al. 2010).

Odonata as food

The larvae of Libellulidae (*Kmimi*) and Aeshnidae *(Ogong El)* serve as food source for the T'boli people. To further understand the practices of T'boli in consuming the Odonata larvae, their responses during the interview were categorized into subthemes as follows: reason for consumption, part of the insect consumed, method of preparation and preservation, perceived benefits in consuming the insect, persons who consumed it, its acceptability as food source, and rituals conducted.

Based on the anonymized quotes of the participants (Table 4), the Odonata larvae can be served as their viand or can be paired with the T'boli's traditional wine. Female and elder members of the household cook the entire part of the Odonata larvae using various methods, such as grilling (*tnete)*, wrapping them using banana leaves (*benalun)*, mixing them with vegetables for soup (s*bool*), or roasting (s*enla*) (Figure 7). They limit the quantity of the larvae collection based on what is enough to feed the family. They do not store or preserve these insects nor sell them in the market. In instances that they gather more than they needed for their family, they prefer sharing them with their neighbors.

The T'boli people inherited the consumption of Odonata larvae from their elders, but rituals are no longer performed. They believe that it has many benefits. It makes the person intelligent, prevents aging, and cures diseases. Odonata larvae are great sources of protein and are one of the reasons T'boli has a strong body. Aside from nourishing the body, the T'boli reason that Odonata larvae serve as an alternative food source. However, the availability of other food sources, such as Nile tilapia (*O. niloticus*), in Lake

Sebu caused infrequent gathering and the collection of insects has become time-consuming for them. Nowadays, T'boli children rarely eat Odonata larvae because, according to them, the larvae look and taste strange.

Insects utilized by indigenous peoples have been investigated as potential sources of food and medicine. The insect-eating practice or entomophagy is observed in 130 countries and among 3,071 ethnic groups (Ramos-Elorduy 2009). 1900 species of insects are known to be edible worldwide. Nearly 1700 insect species have been recorded as edible and 29 percent of these are found in Asia and Australia (Ramos-Elorduy 2009; Raheem et al. 2018). Specifically, it is estimated that there are 349 species eaten in Asia and 152 in Australia, of these 150 to 200 species of insects are consumed in Southeast Asian countries all year round (Ramos-Elorduy 2005; Raheem et al. 2018).

Table 4. Responses of the participants during the interview and focus group discussion on the use of Odonata larvae as food

Odonata as food	**T'boli participant's quotes**
Reason for consumption	*"Kmimi is an alternative food source for fish. If both fish and Kmimi are served in the table, I would still prefer consuming Kmimi."*TM9 *"Kmimi and Ogong el are served as viand and can be consumed during breakfast, lunch, or dinner. Nowadays, it can be paired with traditional wine, an influence by the Hiligaynon settlers."* TF8 *"In the past, tilapia (a type of fish) was not yet introduced in Lake Sebu. Our elders collect some available aquatic organisms such as Kmimi and Ogong El."* TM4 *"Ogong El lives in the water, so we believed that it is clean aside from being tasty and delicious."* TM3
Part of the insect consumed	*"The entire part of the Kmimi and Ogong El are consumed."* TM3
Method of preparation	*"I made a sbool (soup) Ogong El, with water, salt and vetsin (seasoning). If I don't have salt and other seasonings, I just get a banana leaf and wrap Ogong El in the leaf (benalun). I place it under the fiery coal for it to be cooked, just for few minutes."* TM2 *"We eat Kmimi, it can be cooked as senla (roasted) or sometimes mixed with fish with the combination of spices, such as lemon grass, and ginger or garlic, onion, salt, and a small amount of water (sbool). The said mixture is placed in a cauldron and cooked for five (5) to ten (10) minutes. I also prefer eating raw Kmimi when in the field and I get hungry. I bring some of the collected Kmimi home and it is cooked by the female members of the family."*TM7 *"When we go to the forest and stay there for a week, we wrap Kmimi in the leaf (benalun). We also cook it as tnete (grilled), Kmimi is placed one at a time in the charcoal for a minute and is immediately consumed."* TM4
Perceived benefits in consuming the insect	*"We consume Kmimi as a viand because it relieves us from dizziness with unknown causes. We eat it until such time that we no longer feel dizzy. Our elders, when they eat Kmimi they don't experience any illness."* TM4 *"My body becomes stronger when I eat Kmimi. Consuming Kmimi is one of the reasons that I was able to reach 70 years old and soon, I will turn 100 years old."* TM9 *"I attest that Kmimi and Ogong El serve as medicine and this is one of the reasons why we consume it. Most of the members of T'boli tribe don't experience high blood pressure. It makes the person intelligent and I also feel good after eating Kmimi and Ogong El."* TM11 *"I eat Kmimi and Ogong El because they are good sources of protein. Besides, we are used to eating them because of the influence of our elders. "* TF8*T'boli*
Persons who consumed it	*"Anybody can eat Kmimi and Ogong El, especially those who are living in the mountainous areas near the river. There are no restrictions in eating them."* TM1
Method of preservation	*"Most of the time, we do not preserve the collected Kmimi and Ogong El. It is just enough to feed our family. If it is more than enough, we share it to our neighbors, especially when their hearth does not emit smoke, indicating that they have nothing to eat. It is not sold in the market because they are small in size."* TF8
Acceptability as food source	*"T'boli children nowadays seldom consume Kmimi and Ogong El because, for them, both look weird and are like worms. And besides, there are a lot of available food here in the area such as the tilapia. They prefer consuming fish than Kmimi and Ogong El. Children of today's generation have a different way of life unlike before."* TM4
Rituals	*"We don't conduct rituals when preparing our food. But when it is consumed for medicinal purposes, we ask permission to fu (spirit) to heal us before eating it." TM4*

Figure 7. A and B. T'boli elder women of Barangay Lamlahak, Municipality of Lake Sebu who collect and cook *Kmimi*; C. *Kmimi* soup (sbool) that is served as a viand; D. newly collected *Kmimi* from the river

In a study conducted by Mmari et al. (2017), they found that the African population is largely dependent on edible insects like longhorn grasshopper (*Ruspolia differens,* Serville). Insects consumed in African countries are estimated to have been at 524 (Ramos-Elorduy 2005), and the preference to insect consumed varies greatly depending on their location, ethnic groups, and gender (Séré et al. 2018). Moreover, among the tribal groups in India, a total of 81 insect species are being used as food (Chakravorty et al. 2011a). In Argentina, coleopteran larva is reared as a food source (Araujo et al. 2018).

The T'boli mentioned that insects were grilled or roasted, which are also common methods of preparing insects in Thailand. For the T'boli, Odonata larvae are not sold but only shared in the community, unlike in Thailand where cooked insects are sold at roadside food stalls and markets in Bangkok (Chung 2010; Raheem et al 2018). In some parts of Africa, many families also process edible insects for a living (Balinga et al. 2004; Agbidye et al. 2009). It is also a practice among the T'boli to eat the larvae while gathering them in the field. As mentioned by Kouřimská and Adámková (2016), many countries of the world consume insects alive immediately after being caught.

For the T'boli people, the Odonata larvae are tasty and it might be due to the insects' sensory properties. Taste and flavor of insects are very diverse (Ramos-Elorduy 1998). Ants and termites have sweet and almost nutty flavor; the larvae of darkling beetles taste like whole meal bread; the larvae of wood-destroying beetles are like fatty brisket with skin; and the dragonfly larvae and other aquatic insects have fishlike taste. Flavor is mainly affected by pheromones occurring at the surface of the insect organism (Ramos-Elorduy 1998). It also depends on the environment where insects live and the feed that they eat. If insects are scalded, they are practically tasteless, because pheromones are washed off by rinsing. During cooking, insects take the flavor of added ingredients (Kouřimská and Adámková 2016).

The consumption of edible insects as food is seen to address malnutrition in developing countries as it is considered as a viable source of protein (Oibiokpa et al. 2018; Séré et al. 2018). Proteins play an important role in the body by providing amino acids required for growth and maintenance of body functions (Champe and Harvey 2008). Edible insects are reported to contain higher amounts of proteins compared to other protein sources, such as meat and dairy products (Banjo et al. 2006). In a study conducted by Oibiokpa et al. (2018), they found that the cricket has the highest protein quality compared to termite, grasshopper, and moth caterpillar, while the "witchetty grub" in Australia is said to contain 50% protein and 47% fat (Si and Turpin 2015; Turpin and Si 2017). In particular, adults and larvae of Odonata are reported to contain 46% to 65% of protein based on the protein content assessment of Xiaoming et al. (2008).

At present, the T'boli seldom consume Odonata larvae because most of them rely heavily on the food sources produced in the Lake such as the Nile tilapia (*O. niloticus)*. Nile tilapia has been reared in fish cages and is now considered as the driving force of the economy of Lake Sebu (Beniga 2001). Moreover, the non-consumption of insects is also related to the disgust factor that is usually acquired at ages two (2) to five (5) years old (van Huis 2016) and is often influenced by previous generations that stopped the consumption of insects (La Barbera et al. 2018). The insect-eating practice, then, is shaped by the members of the community. Parents and the elder members of the community are also influential in shaping the eating habits of the younger generation and in educating them about edible insects as a normal part of their daily diet (Looy et al. 2014).

One of the reasons mentioned by the participants for the non-consumption of the Odonata larvae as food by the younger generation is their perception that Odonata larvae are weird-looking animals similar to worms, which are dirty crawling organisms that might cause diseases. Many insects are carriers of undesirable and pathogenic microorganisms such as bacteria, fungi, and viruses that are not safe for human consumption (van Huis et al. 2013; Klunder et al. 2012). For example, Enterobacteriaceae and sporulating bacteria were isolated from raw insects, entering them most likely during contact with the soil (Reineke et al. 2012). If proper collection, preparation, storage, and transportation are not assured, edible insects may become dangerous from the microbiological perspective (van Huis et al. 2013; Bessa et al. 2017; Testa et al. 2017).

In addition, the T'boli expressed concerns on the declining population of the Odonata larvae due to the excessive use of pesticides in nearby farms. The use of these chemicals does not only affect the abundance of Odonata. Insects exposed to pesticides, herbicides, heavy metals, and other toxins can have high chemical concentrations making them perilous for human consumption (Rumpold and Schlüter 2013; Testa et al. 2017). It is therefore important to examine the toxicity level of Odonata larvae to ascertain whether they could pose any risk to human health.

Odonata as medicine

The Odonata larvae are also medicinal for the T'boli people. While consuming insects for food does not demand any ritual, utilizing these insects as medicine necessitates the conduct of ritual for them to be effective.

The most common preparation of Libellulidae larvae *(Kmimi)* as medicine is by boiling it with water to extract its flavor and its medicinal property. Then, the boiled water is ingested, and cooked larvae are consumed to cure high blood pressure, kidney problems, relapse due to pregnancy, beriberi, and dizziness. As shown in Table 5, the Libellulidae larvae can also be prepared using the following methods to cure various illnesses: liniment larva for toothache and paralysis; charred larva for stomachache, beriberi, headache, and gas and bloating in children; and alive larva as a salve. The Aeshnidae larvae, on the other hand, have less curative properties and are only used to control high blood pressure.

The T'boli believe that Odonata larvae can cure diseases because they thrive in freshwater. For them, water signifies cleanliness, which in turn cleanses the body and prevents illnesses. The flowing water in the river also symbolizes that their problems, such as illnesses, shall also pass.

One of the participants added that: *"Kmimi can cure certain conditions because of its ability to cling on the rocks. For us, the clinging of Kmimi means extracting and removing the disease from the sick person"* TM4.

Table 5. Medicinal preparation and assumed therapeutic value of the Odonata larvae

Odonata larvae	Treated disease/condition	Medicinal preparation and assumed therapeutic value
Libellulidae	Stomachache and Headache	The *Kmimi* is burnt. The residues are mixed with oil and applied in the affected areas once.
	High blood pressure	*Kmimi* is cooked to produce stew. The sick person drinks the stew and eats the insect. The curative property of Kmimi is from its white blood and a very thin body.
	Gas and bloating in young children	Alive *Kmimi* is rubbed into the belly resulting in the shrinkage of the bloated stomach. Another technique used is roasting (*senla*) the insect, and consuming thereafter.
	Kidney problems	*Kmimi* is cooked to produce stew. A person who has a kidney problem drinks the stew and eats the insect. The said process must be repeated until the person can no longer feel the pain when urinating and when there is no longer blood in the urine. *Kmimi* is believed to cleanse the kidney.
	Relapse due to pregnancy	*Kmimi* is cooked to produce stew. A woman who experienced relapse due to pregnancy drinks the boiled water and consumes the insect. It relieves the pain in the abdomen. It is also effective in preventing relapse among women who experience postpartum.
	Toothache	The charred *Kmimi* is mixed with 5 ml of coconut oil. The mixture is placed onto the affected tooth once. The liniment is said to relieve toothache after application.
	Paralysis	The charred *Kmimi* is mixed in 5 ml of coconut oil. The liniment is applied as a salve to the person's body. It enables the person to move his/her body and relieves pain.
	Beriberi	The *Kmimi* is boiled. A person who experiences beriberi consumes the mixture and eats the insect. The burnt *Kmimi* mixed with oil is also applied in the affected areas twice a day until the person is relieved from beri-beri.
	Dizziness	The *Kmimi* is stewed without salt. The person suffering from dizziness drinks the water and consumes the insect. The *Kmimi* can be eaten several times a week until recovery.
Aeshnidae	High blood pressure	*Ogong El* is boiled, and a sick person consumes the insect and drinks the water once until it lowers the blood pressure. It is said to normalize the blood pressure since the insect does not contain blood.

In using the Odonata larvae as medicine, the roles of *Tau Mulung* or *Mton Bù* or traditional healers are important. The *D'wata* communicates through the *Tau Mulung's* dreams, teaching them the exact herbs and insects to be used in healing certain diseases. *Mton Bù* commonly prepares the medication without informing the patient of their prescriptions. Such practice roots in the belief that the medication will be less effective if the patient is knowledgeable about it. But it was reiterated by a participant during the focus group discussion that: *"As a Tau Mulung (traditional healer) for around 30 years, I would prefer to share how I use Kmimi and Ogong El in treating the disease. I want to leave a legacy by empowering the members of the community in treating their conditions, especially that we are living in the remote areas and access to modern medicine is so limited"* TF6.

The T'boli consume Odonata larvae also because of the assumed therapeutic value. The use of edible insect as a remedy for illnesses has been recorded in many regions of the world (Srivastava and Gupta 2019). Costa-Neto (2005) added that insects and the substances extracted from them have been used as medicinal resources by human cultures worldwide. The T'boli rely on their traditional healers for treatment, as emphasized by Tiencheu and Womeni (2017) stating that traditional healers have used insects as medicine to treat various diseases in human beings and animals successfully. Some of these diseases include common fever, scabies, epilepsy, violent headaches, bronchitis, hemorrhage, and dog bite. Insects are also used to treat wounds, to prevent gangrene, and to increase milk supply for lactating women, among others (Tango 1994). Headache, which was also mentioned by the T'boli, can be cured by charring the Odonata larvae and is applied as liniment.

The curative property of the Odonata larvae could possibly be associated with the effect of the bioactive compound present in it, which are not yet known in the study. But several studies have been conducted on the extraction of insect products for medicinal purposes. For instance, pierisin, a protein purified from pupa of cabbage butterfly, exhibits cytotoxic effects against human gastric cancer. Cecropin has also been reported to be cytotoxic against mammalian lymphoma and leukemia cells (Srivastava and Gupta 2019). Another type of protein, resilin, that enables insects to jump, has been used in medicine to repair arteries because of its elastic properties (Elvin et al. 2005). Proteins from aquatic larvae, sericins are known to have antioxidant, moisturizing, UV-shielding, and also moderate antibiotic properties. It can also suppress tumor and provide protection against ulcer (Sehnal 2008). Chitin, common in aquatic insects like Odonata is also being explored for uses in the biomedical, pharmaceutical, and cosmetic industries (Muzzarelli 1996).

The information obtained from the participants on the use of Odonates as medicine is based on their long traditional medicine practice. The treatment of some diseases by the Odonata larvae-based remedies follows folk logic. One of the reasons used in folk logic in traditional medicine is based on the characteristics of an organism. For the T'boli, the clingy trait of the Odonata larvae enable them to draw away diseases, and the absence of blood among Odonates lowers blood pressure. This reasoning is also observed in Korean traditional medicine, centipede (*Scolopendra* spp.) with their numerous legs, feet, and articulated body segments are used for leg, foot, and joint problems. Likewise, the fireflies *(Luciola discicollis*) which possess bioluminescent abdomen, is used to treat myopia (Pemberton 1999; Meyer-Rochow 2017).

The most common Odonata larvae-based remedies preparations by the T'boli includes simmering it with water, roasting, and charring. It is not combined with other plant species or plant derivatives for the treatment of the disease. This type of preparation is recorded in the Nyishi and Galo tribes of India, however it is rarely done. Treatments involving animal material frequently contain plant component (Chakravorty et al. 2011b), which are also reported from other countries like Brazil (Alves and Rosa 2006). Oral and topical applications were the most common used routes of Odonata larvae based remedies application. This finding is also similar with the result of various zootherapy studies conducted worldwide (Meyer-Rochow 2017).

Magical-religious practices have been observed among the T'boli, specifically the traditional healer communicating with the spirits through their dreams for the medication. They believe that a distressed or angry spirit may bring omens in the form of diseases to the family members. This belief is also observed among the Yorùbá-Nago ethnic group who use invertebrates, such as insects for spiritual protection against evil spirit (Paul 2018). Particularly in the study of Loko et al. (2019), bees (*Apis mellifera*) and flies *(Musa domestica)* were used by the Yorùbá-Nago people for protection against evil spirits. The T'boli and Yorùbá-Nago people share a common belief that illnesses are caused by witchcraft, sorcery, a god, or an ancestor.

Odonata as a biocontrol agent

Dragonflies and damselflies have a significant role in the ecosystem. Odonates larval and adult stages serve as predators in the wetland ecosystem as biocontrol agents. Both adults and larvae extensively prey on mosquitoes, thereby making them effective predators of disease-carrying mosquitoes; these diseases include dengue and malaria (Orr 2003; Chandra et al. 2006; Jacob et al. 2017; May 2019). Results show that mosquito larvae are a favorite food of dragonfly nymphs (Chandra et al. 2006). The Odonata larva *Bradinopyga geminate* has been found to achieve a maximum consumption rate of mosquito larvae as compared to *Corcothemis servilia* and *Ceriagrion cerinorebellum* (Jacob et al. 2017). Meanwhile, adult Odonata are found to have a regulatory impact on agro-forestry by preying on harmful insects of crops, orchards, and forests (Das et al. 2012).

Within the T'boli community, the adult stage of dragonflies and damselflies, both regarded as *Klowong,* have been used as biocontrol agents. A participant from Brgy. Tasiman explained that he uses the adult Odonata as a biocontrol agent for birds preying on the rice field, which he called in T'boli, *Bulung la Nesit*. In *Bulung la Nesit*, farmers look for two *Klowong* ninety days after planting

the upland rice. The farmers erect a bamboo pole or *heteg* approximately two meters high in the east and west sides of the ricefield. The *Klowong* is tied in the *heteg* using an abaca fiber or any rope available. The farmer has to allow the *Klowong* to fly in order to prevent the sparrow or *nesit* from consuming the crops and totally destroying the ricefield. *Klowong* is left in the field until it dies.

From a scientific point of view, the adult Odonates do not prey on the birds. In fact, it is the opposite – the birds feed on the Odonata resulting in the high mortality rate of the insects (Orr 2003). The adult Odonates can actually control arthropod larvae and helminths, the parasites of birds especially of poultry and wild ducks (Subramanian 2005; Andrew et al. 2009; Tiple 2012). In Japan and Southeast Asia, several studies have shown that Odonates feed extensively on rice pests and are also abundant at certain times of year in rice paddies (Asahina 1972; Yasumatsu et al. 1975; Nakao et al. 1976; Corbet 1999). The T'boli's utilization of Odonata as a biocontrol agent, where they allow them to hover in the rice-fields to drive off sparrows, can be attributed to the territorial nature of the adult male Odonata during its mating period (Orr 2003).

Odonata in the folklore and lullaby of the T'boli

Expressive cultures, folk narratives, or narrative chants are indicators of the tradition of orality in various communities in the Philippines (Meñez 1999; Cruz-Lucero 2002; Eugenio 2007). These include heroic tales, creation and origin stories, trickster tales, lullabies, etiological legends about natural formations, ballads, lullabies, etc. that are performed through singing, chanting, or oration. The length of the storytelling depends on the form of the tale; epics can take relatively longer hours of chanting than folk songs. For example, a single episode of the *Ulahingan* epic, The Dream of Begyasan, consists of 4966 lines (Godinez-Ortega 2005) and the *Humadapnon* that is part of the narrative poem *Hinilawod* by the people in Panay Island consists of 53,000 lines (Cruz-Lucero 2005). On the other hand, folk songs are single-episode tales and can be sung from beginning to end (Eugenio 2007). Inscribed in these expressive cultures, folk narratives, or narrative chants are the peoples' motifs and patterns (Meñez 1999), including their history, cosmology, identity and personhood, adventures and migration, relationship with nature, etc. In a study conducted by Buenconsejo (2002), among the indigenous communities of Agusan Manobo, he found that "in songs they articulate and express their fundamental ideas of what a Manobo is," hence, songs express the Manobo's sense of personhood. In another study on the *duyuy nga traki* (narrative chants) among the Dulangan Manobo, Cruz-Lucero (2002) discusses the connection of these oral traditions to the peoples' sense of time and space, that refers to their history and physical environment. Her study also reflects how the contemporary *magduduyuy* (singer/chanter) modifies the content and adds his/her own *ad lib*. In this sense, narrative chants are historically constructed and serve as ways for the people to record their history and culture as well as its changes.

During the focus group discussion, a participant shared one of the *ingâ ngâ* or *dilong ngâ* (Table 6) or lullabies that features animals such as Odonata larvae (*Kmimi)* and crab (*Klenge)*. *Ingâ ngâ* and *dilong ngâ* use a soft and slow melody to bring a child to sleep. *Ingâ ngâ* and *dilong ngâ* are commonly sung by the female members of a household when rearing and caring for children, a domestic work dominated by women (Mora 2008).

The participant who shared the lyrics of the said lullaby described the interaction between freshwater organisms, which in the lullaby were a *Kmimi* and a *Klenge* (crabs). She also explained that: "*Kmimi is considered humble and respectful, while Klenge is known to have a crab mentality and is always jealous. Despite their differences, however, they agreed to collect food from the water. Then, Kmimi allowed Klenge to make decisions that led to their misunderstanding. But in the end, they were able to resolve their conflict and to maintain their harmonious relationship, Kmimi decided to just float on the water, leaving Klenge behind*" TF12. The story resonates with the T'boli's concept of *Hemung lel* or letting someone decide for you. The T'boli people place high respect for their elders and tribal leaders who serve as decision-makers and are always consulted to solve disputes among the members.

Moreover, the said *ingâ ngâ* or *dilong ngâ* illustrates the intimate, respectful, and harmonious relationship of the T'boli with the natural environment. Aside from the example above, other stories and music of the T'boli use the images of its wildlife. In a study done by Mora (1987), she discusses that the T'boli imitate animals and recreate the sound of nature through their music. As she eloquently puts it: "*…all animal birds and* ***insects*** *were once people who, unlike Boi Henwu (the first woman in one of the creation myths of the T'boli), could not ascend to the upper realm. Instead, these people directly transformed into the creatures of nature. And this is intertwined with an important feature of T'boli religion, namely, the practice of augury, or the foretelling of events from signs of omens. This practice hinges on sounds produced by birds, animals and* ***insects*** *which, by extension, are the voices of ancestors and spirit protectors*" (*emphasis ours*)."

Dragonflies figure quite commonly in various forms of Asian literature (May 2019), especially in Japanese haiku. Although it is less prominent in Western literature, Odonata still appears in their poems, such as "The Dragonfly" (Carvalho 2007). Dragonflies are also culturally important for some Native American groups. The Zuni tale of the creation of dragonflies is best known because of Tony Hillerman's children's book, *The Boy Who Made Dragonfly* (Hillerman 1972). Numerous book titles, both fictional and factual, also feature dragonfly such as *Dragonfly* (Golding 2014); *The Dragonfly Pool* (Ibbotson 2009); *On Dragonfly Wings* (Norris 2014); *Dragonfly: NASA and the crisis aboard Mir* (Burrough 1998); and *Dragonfly awakening* (Ford 2014).

Odonata and polygamy among the T'boli

Dragonflies exhibit various patterns of egg-laying behavior. Two of these, endophytic and exophytic oviposition, represent the most common strategies of recent

Odonata (Corbet 1980). In endophytic oviposition, females deposit their eggs within plant tissues by means of a well-developed ovipositor and is demonstrated by all damselflies and some families of dragonflies (e.g. Aeshnidae) (Bridges 1993). Alternatively, the eggs are either dropped freely into the water or attached superficially onto water plants or other periaquatic objects (i.e. stones, soil, tufts of grasses, pads of roots, etc). This derived egg-laying strategy is called exophytic oviposition (Carle et al. 2008) and is practiced by Anisoptera with reduced appendicular ovipositors, such as Libellulidae (St. Quentin 1962; Carle and Louton 1994). Odonates lay eggs in successive episodes, often within the same day (Corbet 1980). Zygoptera (damselflies) release 100-400 eggs per episode (Johnson 1966; Waage 1978). Anisoptera (dragonflies) usually lay several hundred and sometimes several thousand eggs per episode (Boehms 1971).

This characteristic of the *Kmimi* to produce many eggs in a single episode is associated with the polygamous practice of the T'boli, particularly the Datus, as shared by one of the FGD participants. One of the participants added that "*the characteristic of Kmimi is like a love potion cooked and eaten as viand by men to acquire multiple wives."*

The practice of polygamous relationship among the T'boli is reflected in the story of *Tudbulul,* the mythical hero of the ethnolinguistic group. Polygamy is a practice commonly observed among chieftain and wealthy members of the community. As added by the participant: "*I know some datus (traditional leaders) with multiple wives, such as Datu Odos who has thirteen wives, Datu Alas who has seven wives but is already separated from his four wives, and Datu Banas who has three wives. Most of the datus have multiple wives because they can provide a dowry, Sunggud, a price paid for the bride. I can still remember that Datu Alas married women aged 15-18 years old, and he gave their families 12-15 horses as dowry*" TM4. He further explained that being in a polygamous relationship entails the responsibility for the *Datu* to "*provide financial support and satisfactory lifestyle for all of his wives."*

Table 6. Lyrics of the *Kmimi* lullaby in the T'boli language and its English translation

T'boli lyrics	English translation
Woyon de Tedowi	Another kind of insect
Ne te ne heminggel sefi	Let us sit close together
Sefata Kut hitem nihi	Both of us have black teeth
Nete Kemti Langan sefuli	Let us fish in the river
Lemi-eg lieg kemgi	Wearing a tiny cut of gold necklace
Todo Tuno kmimi	I saw *Kmimi*
Demyol gono semo-i	Carrying a flatform of brass
Lemwot be hungul koti	From the island of vegetables
Semudu gono semaki	And carrying on hand a pot for *Tnalak* ironing
Mon kmimi be klenge	*Kmimi* told the crab
Bete kut sigi sfi	Let us not be close to each other
Kat temduk kon eket nihi	Your bite is really painful
Helayuki ne ni do ni	And I better go away from you
Nehe hemung lel ne dou ni	Now, I float and go with the running water

Polygamy is a widespread practice in many developing countries, and although it has been declining since the 1970s, it remains persistent especially in Sub-Saharan Africa (Fenske 2015, 2013). In 2000, the overall prevalence of polygamy is 28% in the 34 countries (Fenske 2015). Polygamy, which is also referred as polygyny, is defined as the marriage of a man to two or more women at the same time (Loue 2006). In the Philippines, polygamy is not a common norm but is practiced by the indigenous peoples in Mindanao, such as the T'boli and Manobo. It is also adopted by the Muslim populace under Shari'ah or Islamic Law (Ebrahim et al. 2017).

In conclusion, the T'boli ethnolinguistic group in Lake Sebu, Mindanao, Philippines evidently houses a repertory of traditional knowledge on Odonata. This hallmark allows them to continuously generate cognitive systems on their own circumscribed natural resources. It shows the T'boli's dependence to and harmonious relationship with nature. The T'boli's traditional knowledge on Odonata is the sum of attitudes, opinions, beliefs, and customs passed on from generation to generation of Odonata usage. Many members of the T'boli community still gather and consume the Odonata and they conduct rituals when collecting the insects to pay respects to the spirits of nature. The Odonata are also collected by many to cure and alleviate various illnesses, entrenched on the fact that the T'boli people have very limited access to modern commercial medicine. Other than for consumption and medicinal purposes, the Odonata are used as biocontrol agents and subjects of T'boli folklore and lullabies. The people also see a parallelism between the Odonata's egg-laying behavior and their marriage practices, being polygamous in nature. At present, the introduction of cultured species of tilapia (*O. niloticus*) in Lake Sebu might have brought about significant economic benefits to the entire community. However, this has and will further result in the gradual loss of their indigenous knowledge on the utilization of Odonata. Seeing that many of the collected adult Odonates are endemic in the country, future studies should be conducted for their conservation and sustainable use. Further studies must also be conducted to confirm the presence of bioactive compounds in Odonata larvae used in traditional medicine by the T'boli people.

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