

**MINISTRY OF EDUCATION  
AND TRAINING**

**VIETNAM ACADEMY OF  
SCIENCE AND TECHNOLOGY**

**GRADUATE UNIVERSITY SCIENCE AND TECHNOLOGY**

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**STUDY ON SPECIES COMPOSITON AND DISTRIBUTION OF  
CICADAS (HEMIPTERA: CICADIDAE) IN THE NORTHWEST,  
VIET NAM**

**SUMMARY OF ENTOMOLOGY DOCTORAL THESIS**

**Code: 9 42 0106**

**Hanoi - 2023**

The dissertation is completed at: Graduate University of Science and Technology, Vietnam Academy Science and Technology:

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The dissertation will be defended before the Doctoral Examination Board of Graduate University of Science and Technology - Vietnam Academy of Science and Technology at.....Date...../..... /2023

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## INTRODUCTION

### 1. The necessity of the thesis

Insects play an important role in nature as well as humans, they are the most diverse group of animals on the planet with an estimated 30 million to 80 million species, accounting for more than half of all known species on the planet. Earth. More than a million species of insects have been described on earth, of which the hemipteran has recorded more than 42,000 species with more than 5,000 species of cicadas in the family Cicadidae.

The family Cicadidae is known as cicadas, belonging to the order Hemiptera. In 2009, Pham & Yang recorded in Vietnam the presence of all 3 subfamilies Tettigadinae, Cicadettinae, and Cicadinae with about 130 species, while the estimated number of species present in Vietnam is more than 200 species.

The family Cicadidae are important to nature and humans. Cicadas have a role in balancing the ecosystem, and bring many economic and medical values such as using the cicada's molt as medicine. Famous Vietnamese physicians such as Hai Thuong Lan Ong, Tue Tinh all recorded methods of using the cicada exuviae as a medicine to treat a number of diseases such as blurred vision, headache, dizziness, and measles.

In addition to the beneficial aspects some cicada species are also harmful to plants such as: *Macrotristria dorsalis* Ashton, 1912, *Dundubia nagarasagna* Distant, 1881, *Purana pigmentata* Distant, 1905, *Purana guttularis* (Walker, 1858), *Pomponia daklakensis* Sanborn, 2009, *Haphsa bindusa* (Distant, 1881), but these works have not been studied in different ecological regions.

The Northwest is the western mountainous of Northern Vietnam, sharing the border with Laos and China, including 6 provinces: Hoa Binh, Son La, Lai Chau, Dien Bien, Lao Cai, and Yen Bai. It has a total natural area of 5.068.500 ha. Northwest of Vietnam includes many nature reserves and national parks. There are many studies on flora and fauna, such as amphibians - reptiles, birds, large mammals, some families of molluscs and some families of insects. However, studies on species composition, taxonomy, biogeography and phylogenetic of cicadas of the family Cicadidae in the Northwest, Vietnam have only been conducted in several national parks and nature reserves. In this thesis, we conduct the study "Study on species composition and distribution of cicadas (Hemiptera: Cicadidae) in the Northwest, Vietnam"

## **2. Objectives**

- Provide a list of cicada species of the family Cicadidae and their distribution in the Northwest, Vietnam;
- Describe new species to science, new records for Northwest, Vietnam;
- Give a key to the genus and species of the Cicadidae family in the Northwest, Vietnam.

## **3. Contents**

- Research on species composition of cicadas (Cicadidae) in the Northwest, Vietnam.
- Research on the distribution of species composition of cicadas by region, habitat, and altitude in the Northwest, Vietnam
- Research to evaluate the richness and similarity of species in the Northwest, Vietnam. Building a distribution map of cicada species in the Northwest, Vietnam.
- Description of new species for science and construction of key

classification to subfamily, genera and species for all species of cicadas of the family Cicadidae in the Northwest, Vietnam.

#### **4. New contributions of the thesis**

- Provide a checklist of cicada species of the family Cicadidae in the Northwestern Vietnam.

- Describe 02 new species for science, 03 species may be new species, record 13 new species for the Northwestern Vietnam.

- Provide data about distribution characteristics of family Cicadidae by habitat, elevation and geozoology in the Northwestern Vietnam.

- Building a key to identify species of the family Cicadidae in the Northwestern Vietnam.

### **CHAPTER 1. LITERATURE REVIEW**

#### **1.1 Overview of research situation in the world**

There have been many studies on the species composition of Cicadidae in the world. For the first time, Linnaeus (1758) was study of species of this suborder and named for 42 species and he placed them in a group called "Cicada", and many of them are still in use at the moments. In 1906, Distant based on the size, color of the body, the degree of coverage of the radio organs of the male, the color of the wings, he classified the family Cicadidae into 3 subfamilies. In 1929, Mayer based on the morphological of the pronotum, mesonotum and metanotum, he classified the family Cicadidae into 5 subfamilies. In 1954, Kato based on the structure of the foreleg femur to classify cicadas into 4 families, in which the family Cicadidae has 2 subfamilies (Cicadinae and Tibicininae). Metcalf, 1963 based on the color, size, and external morphology of the cicada's body, wing veins of the forewing and hind wings, he classified cicadas into 2 families in which the family Cicadidae includes 3 subfamilies. Boulard, 1976 based on male sound organ

coverage, color, body size divided cicadas into 5 families in which family Cicadidae has 2 subfamilies (Platypleurinae and Cicadinae). Hayashi (1984) and Chou et al (1997) based on seven main characteristics divide cicadas into 2 families Cicadidae and Tettigarctidae, in which family Cicadidae includes 6 subfamilies.

In 1998, Boulard divided cicadas into 2 families Cicadidae and Tettigadinae, of which the family Cicadidae includes 3 subfamilies (Cicadinae, Tibicininae and Plautillinae). Moulds, 2005 based on 107 morphological characteristics of color, structure of the genital organs, divided cicadas into 2 families Cicadidae (including 3 subfamilies Cicadettinae, Cicadinae and Tettigadinae) and family Tettigarctidae.

Around the world, there have been studies on the species composition and distribution of Cicadidae of each region or of individual countries, such as: studying the composition and distribution of Cicadidae of China, India, and Japan, Korea, Thailand, Taiwan; study on the Cicadidae of Europe, Africa, Australia and America. Many new species are still discovered and published in countries around the world.

### ***1.2 Study of family Cicadidae in Vietnam***

Studies on the species composition and distribution of the Cicadidae family of Vietnam have been conducted by foreign authors since the late 19th century. These are studies describing new species, taxonomy of some species in certain geographical area. In the 20th century, there were more studies on the species composition of the Cicadidae family in a larger area such as a national park or a nature reserves. Thus, it can be seen that the taxonomic research of the family Cicadidae in Vietnam is divided into 3 stages, the first phase before 1954 in this period was mainly the research works of Distant (1878; 1881-1883; 1887, 1888-1920), Jacobi (1902, 1905), Schmidt (1918) in this period the authors recorded 88 species. Phase II

from 1954 to 1975, including the research works of Moulton (1923), Metcalf (1963a,b,c), Overmeer & Duffels (1967) in the period recorded in Vietnam with about 101 species. The third phase from 1975 to now is mainly the research works of Pham & Yang (2009), Pham (2019, 2020)... has recorded 146 species of cicadas in Vietnam. In particular, the studies on the distribution characteristics of Cicadidae in the Northwest region of Vietnam have not been conducted, but only the distribution studies of some species or the results of a survey of the general distribution of the insects in a national park ornature reserves. Up to now, there have only been studies on the distribution characteristics of the high altitude belts of the family Cicadidae in the Northeast region of Nguyen Thi Huyen (2022) without any research on biodiversity and the distribution characteristics by habitat and altitude in the Northwest region of Vietnam.

## **CHAPTER 2. RESEARCH SUBJECTS, SITES, CONTENT AND METHODS**

### **2.1. Research subjects:**

Adult cicadas of family Cicadidae, suborder Auchenorrhyncha, order Hemipterain the northwest of Vietnam.

### **2.2. Research sites:**

The Northwest includes 6 provinces: Lao Cai, Lai Chau, Dien Bien, Yen Bai, Son La and Hoa Binh. However, within the scope of the study, it is only limited to conducting research and collecting samples in Hoang Lien National Park, Lao Cai province; Muong Nhe Nature Reserve, Dien Bien province; Ngo Luong Ngoc Son Nature Reserve, Hoa Binh province; Thuong Tien Nature Reserve, Hoa Binh province and Muong Te Nature R, Lai Chau province.

### **2.3 Methods:**

#### *2.3.1 Inheritance method*

- Collect, analyze and synthesize references that related to the research object and field.

### *2.3.2. Methods of investigation and collection of specimens*

We collected specimens with insect net during the day and used light traps in each location at night.

### *2.3.3. Methods of handling, preservation and storage of specimens*

Using chemicals Ethyl Acetate to kill and preserve specimens in the wild. In the laboratory, pin, drying, labeling and storage were carried out in a drawer.

### *2.3.4. Specimen identification method*

The Chou et al. (1997) and Beuk (1998) are used for identification. The key to subfamily, tribe, genus, species is built in the form of a dichotomous key. Nomenclature for family, subfamily and tribal classification follows that of Moulds (2005).

### *2.3.5. Methods of studying the distribution characteristics of the Cicadidae family in the Northwest, Vietnam*

#### *2.3.5.1 Study on the distribution of family Cicadidae by geographical region*

In the study to determine the geographical distribution of the species, information on the distribution by country and the location of specimen collection was used, thereby determining their distribution according to Kuo et al. (2014) and Le Vu Khoi.

#### *2.3.5.2. Study on distribution characteristics of family Cicadidae by habitat*

Based on the classification of Vietnamese forest vegetation subtypes (from the ecological point of view) (Thai Van Trung, 1999):

- Natural closed forest habitat:
- Secondary forest habitat:



- Forest habitat for human recovery:

2.3.5.3. Study on distribution characteristics of the Cicadidae family according to the altitude in the Northwest, Vietnam

According to Vu Tu Lap (1976, 1999), the altitude in the Northwest region, Vietnam are divided as follows.

- Altitude from 0m to 600m.
- Altitude from 600m to 1,000m.
- Altitude from 1,000m to 1,600m.
- Altitude over 1,600m.

2.3.6. *Biodiversity assessment of the family Cicadidae*

- Frequency index (C%); - Abundance n' (%);
- Shannon-Weiner species diversity index (H' index);
- Margalef species diversity index (d);
- Simpson Diversity Index (D);

2.3.7. *Data analysis and processing methods*

- Using Microsoft Office Excel software in Windows 10 and Primer V6 software to store and calculate data

- To test statistical hypotheses using online software at <https://www.socscistatistics.com/tests/>

2.3.8. *Methods to build distribution maps of species*

A map of the site of specimen collection as well as the distribution of species in this study will be generated by CFF software (Barbier & Rasmont, 2000).

## **CHAPTERS 3. RESULTS AND DISCUSSION**

### **3.1 Composition of Cicadidae in the Northwest, Vietnam**

Through the analysis of specimens and reference to the literature, there are 64 species of cicadas belonging to 30 genera and 11 tribes belonging to 3 subfamilies, the subfamily Cicadinae has 54 species, 24

genera, 5 subfamilies, 7 tribes, the subfamily Cicadettinae has 9 species, 5 genera, 3 tribes and subfamily Tettigadinae with 10 species, 1 genus, 1 tribe in the Northwest region. Of the 64 species recorded in the Northwest, 13 species of cicadas have been reported previously, but we have not collected samples. In contrast, there are 19 species have collected samples and added to the list of species composition of cicadas in the Northwest region, of which 2 species are new to science: *Platylomia minhi* Luu, Pham & Constant, 2022; *Macrosemia sapaensis* Luu, Pham & Constant 2022; 3 species may be new species; 14 species are new records for the Northwest; 12 endemic species in which 4 species are endemic to the cicada fauna of Vietnam, including: *Cryptotympana nitidula* Hayashi, 1987; *Haphsa conformis* Distant, 1917; *Sinapsaltria annamensis* Kato, 1940 and *Huechys tonkinensis* Distant, 1917, 8 species are endemic species to the cicadas in the Northwest, including species: *Platypleura nigrosignata* Distant, 1913; *Eopycna indochinensis* (Distant, 1913); *Gaeana vitalisi* Distant, 1913; *Terpnosia chapana* Distant, 1917; *Terpnosia rustica* Distant, 1917; *Terpnosia mesonotalis* Distant, 1917; *Haphsa nana* Distant, 1913 and *Karenia hoanglienensis* Pham & Yang, 2012. (Table 3.1).

**Table 3.1. List of cicada species in the Northwest and Northeast, Vietnam**

No	Taxon	Northwest		Northeast
		Research results	Referred	
	<b>Cicadinae</b>			
	<b>Platypleurini Schmidt, 1918</b>			
	<b><i>Platypleura</i> Amyot &amp; Serville, 1843</b>			
1	<i>Platypleura kaempferi</i> (Fabricius, 1794)	+	+	+

2	<i>Platypleura hilpa</i> Walker, 1850	+	+	+
3	<i>Platypleura badia</i> (Distant, 1888)		+	
4	<i>Platypleura nigrosignata</i> Distant, 1913♣		+	
5	<i>Platypleura</i> sp. ☐	+		
	<b><i>Eopycna</i> Sanborn 2020</b>			
6	<i>Eopycna indochinensis</i> (Distant, 1913)♣		+	
	<b>Cryptotympanini Handlirsch, 1925</b>			
	<b><i>Chremistica</i> Stål, 1870</b>			
7	<i>Chremistica sueuri</i> Pham & Constant, 2013♦	+	+	+
8	<i>Chremistica viridis</i> (Fabricius, 1803)			+
	<b><i>Salvazana</i> Distant, 1913</b>			
9	<i>Salvazana mirabilis</i> Distant, 1913			+
	<b><i>Cryptotympana</i> Stål, 1861</b>			
10	<i>Cryptotympana nitidula</i> Hayashi, 1987♣♦	+		
11	<i>Cryptotympana atrata</i> (Fabricius, 1775)	+	+	+
12	<i>Cryptotympana holsti</i> Distant, 1904	+	+	+
13	<i>Cryptotympana mandarina</i> Distant, 1891	+	+	+
14	<i>Cryptotympana recta</i> (Walker, 1850)	+	+	+
	<b>Polyneurini</b> <b>Amyot &amp; Audinet-Serville, 1843</b>			
	<b><i>Angamiana</i> Distant, 1890</b>			

15	<i>Angamiana floridula</i> Distant, 1904	+	+	
	<b><i>Formotosena</i> Kato, 1925</b>			
16	<i>Formotosena seebohmi</i> (Distant, 1904)	+	+	+
	<b>Tộc Gaeanini Schmidt, 1919</b>			
	<b><i>Gaeana</i> Amyot &amp; Servilla, 1843</b>			
17	<i>Gaeana vitalisi</i> Distant, 1913 ♣		+	+
18	<i>Gaeana maculata</i> (Drury, 1773)	+	+	
19	<i>Gaeana</i> sp. ◻	+		
	<b><i>Balinta</i> Distant, 1905</b>			
20	<i>Balinta delinenda</i> (Distant, 1888)		+	
21	<i>Balinta tenebricosa</i> (Distant, 1888)			+
	<b>Talaingini (Jacobi, 1902)</b>			
	<b><i>Becquartina</i> Kato, 1940</b>			
22	<i>Becquartina electa</i> (Jacobi, 1902)	+	+	+
23	<i>Becquartina bleuzeni</i> Boulard, 2005			+
	<b><i>Talainga</i> Distant, 1890</b>			
24	<i>Talainga binghami</i> Distant, 1890	+		
	<b><i>Paratalainga</i> He, 1984</b>			
25	<i>Paratalainga yunnanesis</i> Chou & Lei, 1992 ♦	+		+
26	<i>Paratalainga distanti</i> (Jacobi, 1902)			+
	<b>Cicadini Latreille, 1802</b>			
	<b><i>Cicadina</i> Latreille, 1802</b>			
	<b><i>Semia</i> Matsumura, 1917</b>			

27	<i>Semia majuscula</i> (Distant, 1917)		+	
28	<i>Semia magna</i> Emery, Lee & Pham, 2017 ♦	+		
29	<i>Semia spiritus</i> Emery, Lee & Pham, 2017 ♦	+		
30	<i>Semia pallida</i> Emery, Lee & Pham, 2017 ♦	+		
	<b><i>Terpnosia</i> Distant, 1892</b>			
31	<i>Terpnosia chapana</i> Distant, 1917 ♣		+	
32	<i>Terpnosia rustica</i> Distant, 1917 ♣		+	
33	<i>Terpnosia mesonotalis</i> Distant, 1917 ♣		+	
34	<i>Terpnosia posidonia</i> Jacobi, 1902			+
35	<i>Terpnosia mawi</i> Distant, 1909			+
	<b><i>Pomponia</i> Stål, 1866</b>			
36	<i>Pomponia linearis</i> (Walker, 1850) ♦	+		+
37	<i>Pomponia piceata</i> Distant, 1905	+	+	+
38	<i>Pomponia backanensis</i> Pham & Yang, 2009	+	+	+
	<b><i>Purana</i> Distant, 1905</b>			
39	<i>Purana guttularis</i> (Walker, 1858)	+		
40	<i>Purana dimidia</i> Chou & Lei, 1997		+	+
41	<i>Purana samia</i> (Walker, 1850)		+	+
42	<i>Purana pigmentata</i> Distant, 1905			+
43	<i>Purana parvituberculata</i> Kos & Gogala, 2000*			+

	<b>Cosmopsaltriina</b>			
	<b><i>Inthaxara</i> Distant, 1913</b>			
44	<i>Inthaxara flexa</i> Lei & Li, 1996			+
	<b><i>Meimuna</i> Distant, 1905</b>			
45	<i>Meimuna subviridissima</i> Distant, 1913	+	+	+
46	<i>Meimuna tripurasura</i> (Distant, 1881)			+
	<b><i>Cochleopsaltria</i> Pham &amp; Constant, 2018</b>			
47	<i>Cochleopsaltria duffelsi</i> Pham & Constant, 2018			+
	<b>Dundubiina</b>			
	<b><i>Haphsa</i> Distant, 1905</b>			
48	<i>Haphsa nana</i> Distant, 1913 ♣	+	+	
49	<i>Haphsa scitula</i> (Distant, 1888)	+	+	+
50	<i>Haphsa conformis</i> Distant, 1917 ♣	+	+	+
51	<i>Haphsa opercularis</i> Distant, 1917			+
52	<i>Haphsa karenensis</i> Ollenbach, 1929			+
	<b><i>Sinapsaltria</i> Kato, 1940</b>			
53	<i>Sinapsaltria annamensis</i> Kato, 1940 ♣		+	+
	<b><i>Macrosemia</i> Kato, 1925</b>			
54	<i>Macrosemia tonkiniana</i> (Jacobi, 1905)	+	+	
55	<i>Macrosemia sapaensis</i> Luu, Pham & Constant 2022 ▣	+		
56	<i>Macrosemia</i> sp. ▣	+		
	<b><i>Megapomponia</i> Boulard, 2005</b>			
57	<i>Megapomponia intermedia</i> (Distant 1905) ♦	+		

	<b><i>Platylomia</i> Stål, 1870</b>			
58	<i>Platylomia bocki</i> (Distant, 1882)	+		+
59	<i>Platylomia operculata</i> Distant, 1913	+		+
60	<i>Platylomia minhi</i> Luu, Pham & Constant, 2022 	+		
	<b><i>Dundubia</i> Amyot &amp; Audinet-Serville, 1843</b>			
61	<i>Dundubia spiculata</i> Noualhier, 1896 ♦	+		
62	<i>Dundubia feae</i> (Distant, 1892)	+	+	
63	<i>Dundubia nagarasingna</i> Distant, 1881	+	+	
64	<i>Dundubia hainanensis</i> (Distant, 1901)			+
	<b>Tosenina</b>			
	<b><i>Tosena</i> Amyot &amp; Audinet-Serville, 1843</b>			
65	<i>Tosena melanoptera</i> (White, 1846)	+	+	+
66	<i>Tosena splendida</i> Distant, 1878	+		+
	<b><i>Ayuthia</i> Distant, 1919</b>			
67	<i>Ayuthia spectabile</i> Distant, 1919			+
	<b><i>Aolina</i> Boulard, 2012</b>			
	<b><i>Sinotympana</i> Lee, 2009</b>			
68	<i>Sinotympana caobangensis</i> Pham & Sanborn, 2019			+
	<b><i>Hyalessa</i> China, 1925</b>			
69	<i>Hyalessa maculaticollis</i> (Motschulsky, 1866)			+
	<b>Tộc Moganniini Distant, 1905</b>			
	<b><i>Mogannia</i> Amyot &amp; Serville, 1843</b>			

70	<i>Mogannia saucia</i> Noualhier, 1896	+	+	+
71	<i>Mogannia hebes</i> (Walker, 1858)	+	+	+
72	<i>Mogannia oblique</i> Walker, 1858	+	+	+
73	<i>Mogannia effecta</i> Distant, 1892			+
74	<i>Mogannia cyanea</i> Walker, 1858			+
75	<i>Mogannia conica</i> (Germar, 1830)			+
76	<i>Mogannia aliena</i> Distant, 1920			+
77	<i>Mogannia funebris</i> Stal, 1865			+
78	<i>Mogannia caesar</i> Jacobi, 1902			+
	<b><i>Nipponosemia</i> Kato, 1925</b>			
79	<i>Nipponosemia guangxiensis</i> Chou & Wang, 1993			+
	<b>Cicadettinae Latreille, 1802</b>			
	<b>Taphurini Distant, 1905</b>			
	<b><i>Lemuriana</i> Distant, 1905</b>			
80	<i>Lemuriana apicalis</i> (Germar, 1830)	+	+	
	<b><i>Abroma</i> Stal, 1866</b>			
81	<i>Abroma reducta</i> (Jacobi, 1902)			+
	<b><i>Hea</i> Distant, 1906</b>			
82	<i>Hea yunnanensis</i> Chou & Yao, 1995 ♦	+		+
	<b>Sinosenini Boulard, 1975</b>			
	<b><i>Karenia</i> Distant, 1888</b>			
83	<i>Karenia hoanglienensis</i> Pham & Yang, 2012♣	+	+	
	<b><i>Scolopita</i> Chou &amp; Lei, 1997</b>			
84	<i>Scolopita lusiplex</i> Chou & Lei, 1997			+
85	<i>Scolopita</i> sp.			+



	<b>Huechysini Distant, 1905</b>			
	<b><i>Huechys</i> Amyot &amp; Audinet-Serville, 1843</b>			
86	<i>Huechys beata</i> Distant, 1892	+	+	+
87	<i>Huechys tonkinensis</i> Distant, 1917 ♣	+	+	
88	<i>Huechys sanguinea</i> (De Geer, 1773)	+	+	+
	<b><i>Scieroptera</i> Stål, 1866</b>			
89	<i>Scieroptera splendidula</i> (Fabricius, 1775)	+	+	+
90	<i>Scieroptera formosana</i> Schmidt, 1918	+	+	+
91	<i>Scieroptera delineate</i> Distant, 1917		+	
92	<i>Scieroptera orientalis</i> Schmidt, 1918			+
93	<i>Scieroptera crocea</i> (Guérin Méneville, 1838)			+
	<b>Tettigadinae</b>			
	<b>Tibicinini Distant, 1905</b>			
	<b><i>Katoa</i> Ouchi, 1938</b>			
94	<i>Katoa chlorotiea</i> Chou & Lu, 1997	+	+	
<b>Tổng cộng</b>		<b>51</b>	<b>45</b>	<b>62</b>
		<b>64</b>		

Notes: ♣: endemic species; ♦: new record for Northwest, ◻: new species for science.

### 3.1.2. Structure of cicada composition species in the Northwest

A result of investigating the cicada family (Cicadidae) in the Northwest, there are 64 species belonging to 30 genera, 11 tribes and 3 subfamilies (Cicadinae, Cicadettinae and Tettigadinae) have obtained. Diversified

segregation and adaptability to the environment of the 3 subfamilies are not the same.

**Table 3.2. Structure of cicada composition species in the Northwest, Vietnam**

No	Subfamily	Tribe		Sub-tribe		Genus		Species	
		Qty	%	Qty	%	Qty	%	Qty	%
1	Cicadinae	7	63,6	5	100	24	80	54	84,38
2	Cicadettinae	3	27,3	0	0	5	16,7	9	14,6
3	Tettigadinae	1	9,1	0	0	1	3,3	1	1,56
<b>Total</b>		<b>11</b>	<b>100</b>	<b>5</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>64</b>	<b>100</b>

Of the total of 11 cicada tribes in the Northwest, the number of tribes belonging to the subfamily Cicadinae accounted for more than two-thirds (ie 63.6%). The tribes of the subfamily Cicadettinae and Tettigadinae did not have a division to the subfamily. Of the total of 30 varieties of cicadas in the Northwest, the Tettigadinae subfamily has only 1 genus (accounting for 3.3%), the Cicadettinae subfamily has 5 genera (16.7%), the rest of the genera belong to the Cicadinae subfamily. There are 24 genera, accounting for 80% of the total genera in the Northwest region. Similar to the number of cicada species, there are 52 species (84.38%) belonging to the subfamily Cicadinae; Cicadettinae subfamily has 9 species (accounting for 16.6%) and Tettigadinae subfamily has only 1 species (accounting for 2%) (table 3.2).

### **3.2. Distribution of cicada species of the Cicadidae from Northwest Vietnam**

#### **3.2.1. Distributed by Zoogeographic**

Of the 64 species recorded in the Northwest region, Vietnam has 2 species distributed in Oriental and Palaearctic region: *Platypleura*

*kaempferi* (Fabricius, 1794) and *Cryptotympana atrata* (Fabricius, 1775), accounting for 3.13%, 40 species distributed in the Orient, 4 species (accounting for 6.25%) distributed in South China are *Purana dimidia* Chou & Lei, 1997, *Hea yunnanensis* Chou & Yao, 1995 and *Scieroptera orientalis* (Schmidt, 1918) and *Katoa chlorotiea* Chou & Lu, 1997 accounted for 6.25% of species, 18 species (28.13%) distributed in Vietnam, of which 13 species are endemic to Vietnam, of which 8 species are found only in the Northwest (in Table 3.3).

**Table 3.3: Distribution of cicada species of family Cicadidae in the region Northwest, Vietnam by Zoogeographic**

No	Zoogeographic	Number of species	Rate (%)
1	Oriental region, Palaeartic region	2	3.13
2	Oriental region	40	62.50
3	South China	4	6.25
4	Vietnam	17	28.13
-	New species publish	2	3.13
-	May be new species	3	4.69
-	Endemic to Northwest	8	12.5
-	Endemic to Vietnam	5	7.8
		<b>64</b>	<b>100</b>

### 3.2.2. Distribution of cicada species composition by habitat

The survey results collected in 3 habitats: primary forest, secondary forest and restored forest showed that in the primary forest, the highest number of cicada species were obtained, including 47 species out of 51 species present in the Northwest (92.1%). Next, there are 35 species

in secondary forest habitat (68.6%) and at least in restored forest, only 19 species (37.2%).. There are 16 species (31.4%), ie only 1/3 of the total 51 species have the ability to grow and develop in all 3 habitats. The composition of cicada species in the Northwest region is very diverse, with 9 genera (accounting for 34.62% of the total number of varieties obtained in the study area) with 1 to 5 species; 7 genera appeared in all 3 habitats. There are 10 genera (accounting for 38.46%) with 1 to 3 species occurring in 2 habitats and only 7 genera (accounting for 26.92%) with 1 species occurring in 1 habitat.

### ***3.2.3. Distribution of cicada species composition by altitude***

The survey results show that at the altitude <600m, 16 species of cicadas have been confirmed; at an altitude of 600 - 1,000m, there are 31 species; At an altitude of 1,000 - 1,600m there are 40 species and at an altitude of >1,600m there are 19 species. Thus, it can be seen that the most abundant species of cicadas are concentrated in the altitude > 600m and <1,600m. There are 4 genera recorded in all 4 altitude. There are 6 genera with all 3 belts recorded. There are 9 genera with 1 species recorded in 1 altitude belt. At the altitude < 600m, 16 species were collected (accounting for 31.37% of the total number of species) belonging to 9 genera; At the altitude from 600 to 1,000m, 31 species (accounting for 60.78% of total species obtained) of 17 genera were obtained; At the altitude of 1,000 - 1,600 m, 40 species were recorded (accounting for 78.43% of the total number of species) of 23 genera and at the altitude > 1,600 m, 19 species were recorded (accounting for 37.25% of the total number of species) of 12 genera. Thus, the limit of 1,000m can be viewed as divided into 2 areas in terms of altitude to reflect the diversity and abundance of cicadas of the family Cicadidae.

### 3.2.4 Developing a distribution map cicadas of the family Cicadidae in the Northwest, Vietnam

To illustrate the distribution points of cicada species, we built a distribution map of cicadas of the family Cicadidae in the Northwest region, Vietnam based on the method of Barbier Y and P. Rasmont, 2000 and background maps are available to include distribution points of species in the study area.

### 3.3. Biodiversity characteristics of cicadas in the Northwest, Vietnam

#### 3.3.1. Abundance, species similarity by habitat in the Northwest, Vietnam.

There are 483 adult cicadas specimens of 47 species have obtained in the natural forest; In the secondary forest habitat, 319 individuals of 35 species were obtained and in the forest of reviving agents habitat 70 individuals of 18 species were obtained. The habitats are shown in Table 3.7.

**Table 3.7. Number of species, number of individuals and number of individuals/species rate in the habitats**

No	Habitat	Quantity				Rate/ Species
		Tribe	Genus	Species	Individual	
1	Natural forest	11	24	47	483	10.27
2	Secondary forest	7	20	35	319	9.11
3	Forest of reviving agents	5	10	18	70	3.89
<b>Total</b>		<b>11</b>	<b>26</b>	<b>51</b>	<b>872</b>	<b>17.09</b>

In order from natural forest habitat, secondary forest, and recovery forest, the number of species of cicadas of the Cicadidae family gradually decreased from 47 to 35 and 18 species, respectively, with average

abundance, while the proportion of very dominant species, dominant and potential dominant species gradually increased (40.43%, 42.85% and 66.67%) and the group of non-dominant species decreased. The results of table 3.9 show that natural forest habitats have the highest biodiversity index of Simpson (D), Shannon - Weiner (H'), Margalef (d), followed by secondary and low forest habitats, especially in human-rehabilitation forest habitats. Thus, in general, the natural forest habitat has the highest biodiversity, followed by secondary forests and lastly protected forests. This result partly reflects the reality that is consistent with our above study and is consistent with many comments of other authors.

**Table 3.8. Average abundance of cicada species of family Cicadidae in habitats in the Northwest, Vietnam**

No	Habitat	Average abundance n' (%)			
		The most advantageous	Advantage	Potential advantage	Medium
1	Natural forest	10.97	6.83	3,11	6.97
2	Secondary forest	12.64	5.33	3.48	7.15
3	Forest of reviving agents	16.19	7.14	3.58	8.97

### **3.3.2 Richness and similarity of species according to elevation belt in the Northwest**

In each altitude to determine the abundance of a species, we calculate the percentage of individuals of that species over the total number of individuals of all species collected in the studied altitude.

At the altitude below 600m, the species group is very dominant with 2 species ( $n' > 10\%$ ), 5 species are evaluated as dominant ( $n' = 5 - 10\%$ ). Potentially dominant species group ( $n' = 2-3\%$ ) has 7 species. The average abundance of the set of potentially dominant, dominant and very dominant species in the altitudet below 600m is 7.25%.

**Table 3.11: Biodiversity index of the family Cicadidae by altitudedcao**

No	Altitude (m)	Biodiversity Index		
		Margalef (d)	Shannon - Weiner (H')	Simpson (D)
1	< 600	3,76	2,59	0,93
2	600 – 1.000	5,74	3,06	0,94
3	1.000 – 1.600	5,74	3,22	0,95
4	> 1.600	6,23	2,58	0,91

At the altitude of 600 - 1,000m, there are 2 species belonging to the very dominant species group ( $n' > 10\%$ ). There are 4 species belonging to the dominant species group ( $n' = 5 - 10\%$ ). The group of potentially dominant species ( $n' = 2 - 5$ ) has 10 species, the rest are non-dominant species. The average richness of the set of potentially dominant, dominant and very dominant species at the altitude of 600 – 1,000m is 5.1%.

At the altitude of 1,000 - 1,600m, the dominant species group has 1 species ( $n' > 10\%$ ). The dominant species group ( $n' = 5 - 10\%$ ) has 5 species. There are 13 potential dominant species ( $n' = 2-5$ ), the remaining 21 species are not dominant. The average richness of the set of potentially dominant, dominant and very dominant species at the altitude of 1,000 - 1,600m is 4.47%.

At the altitude above 1,600m, there are 2 species belonging to the very dominant group ( $n' > 10\%$ ). There are 5 dominant species ( $n' = 5 - 10\%$ ) and 5 potentially dominant species ( $n' = 2-5$ ) and 7 non-dominant species. The average abundance of the set of potentially dominant, dominant and dominant species at the altitude  $> 1,600m$  is 7.2%.

Biodiversity indices at high altitude are shown in Table 3.11. It shows that at two altitudes of 1,000 - 1,600m and at altitudes above 1,600m, there is the highest Simpson base (both  $D = 0.95$ ) and the highest Shannon - Weiner field (H') ( $H' = 2.96$  and  $2.96$ ). 3.04). Two altitudes

below 600m and >1,600m have lower Simpson base ( $D = 0.91$ ) and ( $D = 0.94$ ).

As a general rule, with the family Cicadidae, biodiversity indexes such as  $d$ ,  $H'$  and  $D$  will change at different altitudes.

### **3.4 Description of new species of family Cicadidae in Northwest region, Vietnam**

In this study, two new species for science, *Platylomia minhi* Luu, Pham & Constant, 2022 and *Macrosemia sapaensis* Luu, Pham, Bui & Constant, 2022 are described and the three possible new species are: *Macrosemia* sp., *Gaeana* sp. and *Platyleura* sp.

### **3.5. Development of a key classification to subfamily, genus and species for all species of cicadas in the Northwest, Vietnam.**

Based on the morphological characteristics of the species (Moud, 2005), we have built: 01 identification key to the subfamily Cicadidae in the Northwest, Vietnam; 3 key classifications to the tribes and subfamily Cicadinae, Cicadettinae in the Northwest region, Vietnam; 8 keys to identify genus; 15 keys for identification to species. The identification keys are constructed in a binary manner. The taxonomy keys are presented after the taxon. The subfamilies, tribe, genus with 1 species we do not construct the key to identify.

## **CONCLUSTION AND SUGGESTION**

### **Conclusion:**

1. There are 64 species, belonging to 30 genera, 11 tribes in the family Cicadidae have identified in the Northwest region, Vietnam, identified 2 new species for science as *Platylomia minhi* Luu, Pham & Constant, 2022; *Macrosemia sapaensis* Luu, Pham & Constant 2022; 14 species are new records for the Northwest region, Vietnam; There are 12



endemic species in which 5 species are endemic to the cicada fauna of Vietnam, and 8 species are endemic species to the cicada species in the Northwest.

2. In natural forest habitats, secondary forests, and recovery forests, the number of species of cicadas of the family Cicadidae gradually decreased from 47 to 35 and 18 species, respectively, the average abundance increased, at the same time the ratio. The proportion of very dominant species, dominant and potential dominant species gradually increased (40.43%, 42.85% and 66.67%) and the group of non-dominant species decreased. In natural forest habitats, the biodiversity index Simpson (D), Shannon - Weiner (H'), Margalef (d) is highest, followed by secondary forest habitats, and the lowest is in restored forest habitats. agent recovery. Thus, in general, in the natural forest habitat, biodiversity is the highest, followed by secondary forest and lastly protected forest.

3. The species composition of the Cicadidae family at the altitude above 1000 m is more diverse than that at the altitude below 1000 m (the difference is statistically significant). The difference in the number of species of cicadas of the family Cicadidae between the two belts at the same altitude above 1000 m or below 1000 m was not statistically significant. The limit of 1,000m can be viewed as divided into 2 areas of altitude to reflect the diversity and abundance of cicadas of the family Cicadidae. The average richness of the set of dominant, very dominant and potentially dominant species increased at altitude below 1000m and >1600m. The percentage (%) of dominant and very dominant species/group of dominant, very dominant and potential dominant species decreases with altitude from low to high. Diversity indices d, H' and D changed at different altitudes, belts of 1000 - 1600 m high and belts over

1600 m had the highest Simpson's base (both  $D = 0.95$ ) and Shannon-Weiner ( $H'$ ) LCs have the highest ( $H' = 2.96$  and  $3.04$ ). Two belts with altitudes below 600 m and  $>1600$  have lower Simpson ER ( $D = 0.91$ ) and ( $D = 0.94$ ).

4. Develop 01 identification key to the subfamily of cicadas Cicadidae in the Northwest region, Vietnam; 3 classification keys to the clan and subfamily of the subfamily Cicadinae, Cicadettinae; 8 keys to identify varieties; 15 taxonomic keys to species of the family Cicadidae in the Northwest region of Vietnam. All of the keys are built in a binary method, presented after the taxon with pictures illustrating taxonomic characteristics.

### **Suggestion**

1. Using the results of the thesis to expand the research on the diversity of species composition of the Cicadidae family in the South of Vietnam.

2. We also identified 13 species of cicadas that are endemic to the cicada fauna of Vietnam. It should be studied carefully in biology and ecology to serve as a scientific basis for biodiversity conservation, to be included in the list of species to be protected or in the Red Book of Vietnam. In fact, currently in our country, the cicada group has not been interested in research and conservation, commensurate with its value to nature and humans.

## THE LIST PUBLICATION RELATING THE DISSERTATION

1. Luu Hoang Yen, Pham Hong Thai, Bui Thu Quynh., 2022. Research to assess the abundance and similarity of cicadas (Hemiptera: Cicadidae) in the Northwest region, Vietnam Science and Technology Journal. : 64 (1): 23-31;
2. Luu, Pham & Constant (2022), A new species of *Platylomia* Stål, 1870 (Hemiptera: Cicadidae) from Vietnam, with a key to species genus *Platylomia* Stål, 1870. Journal of Biology; 41(1):23-31
3. Luu, Pham, Bui & Constant (2022), A new species of the Cicada genus *Macrosemia* Kato, 1925 (Hemiptera) Vietnam Journal of Science and Technology: 64(1):82-85
4. Luu Hoang Yen, Pham Hong Thai, Bui Thu Quynh., 2022. Composition and distribution of cicadas (Hemiptera: Cicadidae) in the Northwest region, Vietnam Science and Technology Journal: 64 (6) : 24-27
5. Luu Hoang Yen, Pham Hong Thai., 2017. Research on composition and distribution of cicadas of the family Cicadidae (Hemiptera: Auchenorrhyncha) in Hoang Lien National Park, Scientific Report of the Global Entomological Conference 9th National, Agricultural Publishing House, Hanoi: 374-380;
6. Pham Hong Thai, Nguyen Thi Huyen, Luu Hoang Yen., 2017. Checklist of the Cicadidae (Hemiptera: Auchenorhycha) from north Vietnam, Proceedings of the 7th national scientific conference on ecology and biological resources, Natural Science and Technology Publishing House: 375-381;
7. Luu Hoang Yen, Bui Thu Quynh, Pham Hong Thai., 2020. List of species composition of cicadas of the family Cicadidae (Hemiptera: Auchenorrhyncha) in Hoa Binh province, Vietnam, Scientific Report of the National Entomological Conference 10th, Agriculture Publishing House, Hanoi: 214-221;
8. Luu Hoang Yen, Pham Hong Thai., 2020. Course of identification of the Cicadidae family (Hemiptera: Auchenorrhyncha) in the Northwest, Scientific Report of the 10th National Entomology Conference, Agriculture Publishing House, Hanoi: 222-242;