

BIODIVERSITY OF FLORA AND FAUNA ASSOCIATED WITH SAWMILLS OF ABEOKUTA, SOUTH-WESTERN NIGERIA

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ABSTRACT: The biodiversity of flora and fauna was evaluated in five major sawmills of Abeokuta metropolis (7°03'N03°19'E) namely: Lafenwa, Sapon, Isale-Ake, Elewera and Kotopo sawmills. Fauna species present around the sawmills were assessed while structured interview schedule was also organised for 193 respondents comprising workers and owners of the sawmills to assess their knowledge of and animal species commonly encountered at the sites. Flora survey was conducted using line transect method as well as direct observation. Most of the respondents (95%-100%) were within age 26 and above. Forty-three different plant species were observed. Five of these plant species (*Synedrella nodiflora*, *Sida acuta*, *Euphorbia hirta*, *Commelina benghalensis* and *Amaranthus spinosus*) occurred in all the study sawmills. Pilot fauna survey of the sawmills revealed a total of twenty-three animal species including insects and other invertebrates, reptiles, amphibians, birds and mammals. Twenty-six animal species were identified by the respondents from the study sawmills. Lizard and earthworms were cited more by the users of each of the study sawmills. Over 50% of the total animal species identified within the study sawmills are preys to lizards and other secondary consumers. Hence, the sawmill environments could be regarded as a complete and interacting biotic community.

KEY WORDS: Biodiversity, flora, fauna, sawmill, ecosystem, environment, wood

Sawmilling is a major enterprise providing direct and indirect employment for thousands of people in the tropical rain forest region of Nigeria, where there is abundance of trees (Ihekweba et al., 2009). Due to the fast growth recorded in the construction sector, there has been high increase in the establishment of sawmills in different parts of the country to satisfy the growing demand for wood (Arofor, 2000). These industries are mainly located in the wood producing rain forest areas of the country with Lagos, Ekiti, Osun, Cross River, Akwa Ibom, Imo, Ogun and Delta States, accounting for 90% of all sawmills in the country (Dosunmu & Ajayi, 2002). Several wastes has been reported to be produced during sawmilling operations, some of which include tree barks, cut slabs, sawdust, plain shavings, and strips (Akachukwu, 2000).

The biotic and abiotic components of the environment function together as an ecological system. Several anthropogenic influence, most especially industrial activities of which sawmills are also a part, has been involved in environmental modification. Biodiversity has recently emerged as an issue of both scientific and political concern primarily because of an increase in extinction rates caused by human activities (Ehrlich & Wilson, 1991). Pausas & Austin (2001) submitted that species richness patterns in relation to the environment need to be understood before drawing conclusions on the effect of biodiversity in ecosystem processes. Lalthanzara et al. (2011) reported that different land use systems may affect the abundance and diversity of soil and litter fauna.

Sawmills are a very common industry in the south-western part of Nigeria (Bamidele et al., 2014). These sawmills which were originally situated on large areas of land away from residential areas are now almost enclosed about with

residential and commercial activities, isolating the sawmill areas from their original forest habitat. The ecosystem constituting several niches and habitats of the sawmill community has not been documented. As a unique ecosystem, there is need to identify and document the flora and fauna species associated with sawmills with a view to ascertain the organism biodiversity of the sawmills. This study therefore aims at conducting a survey of plants and animal species found in the vicinities of five major sawmills of Abeokuta, south-western Nigeria.

MATERIALS AND METHODS

Study sites

Five major sawmills located in Abeokuta, south-western Nigeria ($7^{\circ}03'N03^{\circ}19'E$) namely: Lafenwa, Sapon, Adatan, Elewera and Kotopo sawmills were selected and used for this study. These sawmills were about 25 to 40 years old. Each of the sawmills occupy a large area of land with several log processing and wood processing units, furniture workshops and plank markets. They are very busy in activities and supply most of the processed wood and wood products used in Abeokuta and neighbouring towns (Bamidele et al., 2014, 2015, 2016).

Fauna Survey

Pilot fauna survey: Animal species present around each of the sawmill locations were assessed. Places such as back of logs, within logs and planks, in the soil and on the vegetation around the sawmills were checked and noted. Some of the fauna species which could not be identified on the field were collected for identification in Zoology laboratory of the Federal University of Agriculture, Abeokuta.

Questionnaire based fauna survey: An assessment of animal species commonly cited around the study sawmills by users of the sawmills was also conducted through a structured interview schedule (questionnaire). A total of one hundred and ninety three (193) questionnaires were administered in all the study sawmills. Opinions of the sawmill owners and workers which include plank sellers, machine operators and furniture makers were noted. The respondents were allowed to express the names of the animal species in their local language (Yoruba).

Flora Survey

Plant species present in and around the study sawmills were sampled using line transect method. However, because of the arrangements of the sawmills where logs and planks were piled up and tents built all around for plank markets, line transect method was not so effective for an accurate plant survey on the study sawmills. Direct observation of plants growing freely around the sawmill factories, most especially within the plank markets and within the logs were therefore done to ensure a proper and more accurate plant survey.

The collected plant samples were identified in the Botany Laboratory, Department of Pure and Applied Botany and the herbarium of the Department of Forestry, Federal University of Agriculture, Abeokuta, Nigeria.

Statistical Analysis

Data obtained were subjected to statistical analysis, using the descriptive analysis of the Statistical Package for Social Sciences (SPSS) version 16.0. Charts were also constructed to present the sex and occupation of the respondents according to sawmill locations. Animal species were also classified based on their habitats.

RESULTS

Fauna Survey

Pilot fauna survey: A total of twenty-three animal species were cited in at least one of the five sawmills sampled. Fauna species observed in the study sawmills were good representative of the animal kingdom as they cut across the insect group, other invertebrates, reptiles, amphibians, birds and the mammals (Table 2). Ten (10) fauna species were noted to be common to each of the study sawmills. Among the fauna species common to the study sawmills, termites, ants, earthworms, lizards, spiders and springtails were observed to be more in abundance. The habitats from which the fauna species were found are presented in Table 4.

Questionnaire-based fauna survey

Demographic Characteristics of the Respondents: A higher percentage of the respondents (53.2% - 56.5%) from Sapon, Kotopo and Lafenwa sawmills were males while it was vice-versa in Eleweran and Adatan sawmills (Fig. 1). Almost all the respondents (95% - 100%) are above 26 years of age, while the age group 36-50 years had the highest number of respondents in all the sawmills except Adatan where the age group 50 years and above had the highest number of respondents (Table 1). The most common occupation among the respondents was plank selling (52.1-76.7%) and this was keenly followed by machine operators (8.5 - 34.2%), in the order Plank seller > Machine operators > Furniture workers > Food vendors (Fig. 2).

Questionnaire survey of fauna: A total of twenty-six (26) animal species was identified by the respondents to be present in the study sawmills. Only thirteen (13) of these animal species were observed to be common to each of the sawmills (Table 3). The frequency of occurrence of lizard (95%, 100%, 100%, 85% and 100% for Sapon, Eleweran, Kotopo, Adatan and Lafenwa sawmills respectively) was higher than those of the other animal species responded present in the study sawmills. This was followed by the earthworms which had 93.6%, 100%, 69.7%, 85% and 94.5% frequency of occurrences for Sapon, Eleweran, Kotopo, Adatan and Lafenwa sawmills respectively.

Flora survey

The highest diversity of plant was observed in Lafenwa sawmill with 28 plant species. This was followed by Adatan (23 plant species), Camp and Sapon (17 plant species) and Eleweran (13 plant species) sawmills (Table 5). Only five plant species (*Synedrella nodiflora*, *Sida acuta*, *Euphorbia hirta*, *Commelina benghalensis* and *Amaranthus spinosus*) were common to all the study sawmills while *Abutilon mauritianum*, *Axonopus compressus*, *Euphorbia hysoppifolia*, *Gomphrena celosoides* and *Sida rhombifolia* occurred in four of the five sawmill locations.

DISCUSSIONS

This study revealed that sawmills shelter a wide diversity of plant and animal. All the sawmills contain sheds and pack-up planks which prevent the direct evaporative effect of the sun on the soil, hence the soils were usually moistened even during the dry seasons (Bamidele et al., 2016). These conditions are suitable for the abundance of plants and animal species.

Of all the plant species observed in the sawmills, *Sida acuta*, *Synedrella nodiflora*, *Euphorbia hirta*, *Commelina benghalensis* and *Amaranthus spinosus*

were the plant species found common to the sawmills. These plants are weeds which have the ability to thrive and proliferate in disturbed areas and harsh environment including roadsides and waste places (Akobundu & Agyaka, 1987). Some of the plants observed in the sawmills during this study (*Sida acuta*, *Chromolaena odorata*, *Aspilia* spp. and *Ageratum conyzoides*) were earlier reported as dominant and common plant species around the sawmills of Isokan Area of Osun State, Nigeria (Oke & Oyedare, 2006). *Gomphrena celosoides*, *Chromolaena odorata*, *Euphorbia hysoppifolia*, *Tephrosia* spp., *Abutilon mauritianum*, *Sida rhombifolia*, *Mimosa* spp., *Physalis angulata* and *Axonopus compressus* also had higher occurrences in the study sawmills. These plants were also identified as weed by Akobundu & Agyakwa (1987), having the ability to withstand harsh environments including roadsides and waste places. The ability to withstand harsh environment could be of significant help in the proliferation of these plants on the sawmill soils.

The major component of an ecosystem is the plants. They are major modifiers of climate and providers of community structures and they are pathway through which energy enters the ecosystem (Purves et al., 1997). The plant forms a complex interaction between the biotic and abiotic entities of the environment (Lameed & Ayodele, 2010) by making use of the abiotic entities as food to produce food in form of biomass for the animal communities. High diversity of animal species within the sawmill vicinities as recorded in this study could therefore be connected to the observed high diversity of plant species.

Among the most abundant and important invertebrates which has close association with microbial symbionts in their gut for effective lignocelluloses (wood) digestion is the termites. Termites have been reported to play an important role in the turnover and mineralization of complex biopolymers, such as wood and other cellulose and hemicelluloses containing materials (Wenzel et al., 2002). Of all the insect species found on the sawmills, termites were observed to be more in abundance and also had the highest frequencies of occurrence among the respondents. The high abundance of termites on the sawmills could probably be as a result of their ability to effectively digest lignocellulose from wood dust, which is the major sawmill waste (Bamidele et al., 2014) through their gut microflora.

Earthworms were also observed to be abundant on the study sawmill soils. The respondents also noted the presence of earthworms especially in moist areas around the study sawmills. Bamidele et al. (2016) reported higher populations of earthworms (140 – 516 earthworms/m²) on sawmill soils than other soils. This was attributed to the moist nature of the sawmill soils particularly under sheds, beside and under piles of logs and planks awaiting processing most especially during the wet season. The activities of earthworms in sawmill soil could also be connected with their role in the degradation of sawdust as well as soil humidification and their pedobiological roles (Bamidele et al., 2014).

More than 50% of the total animal species observed around the study sawmills were arthropods. These arthropods can be predated upon by several higher animal species. Such animal species as observed in the sawmills include the agama lizard, toad, wall gecko, monitor lizards and birds. The abundance of arthropods within the vicinity of the sawmills as recorded in this study could therefore account for the high number of secondary consumers observed on the study sawmills, making the sawmills a food bank for the animals. The respondents also identified these secondary consumers among the animal species they usually encounter around the study sawmills. This could better explain the observation of some of the respondents from Sapon, Lafenwa and Kotopo

sawmills that monitor lizards do not stay permanently on the sawmills but migrate from their neighbouring bush habitats to the sawmills to feed. Monitor lizards feed on arthropods, reptile eggs and some amphibians (Weavers, 1989). According to Bennett (1995), the diets of monitor lizards include a variety of animals of different sizes and they are often regarded as generalized feeders that will consume anything they are able to catch.

This study has shown that sawmill environments have rich and abundant flora and fauna populations which could be regarded as a biotic community consisting the populations of different organisms interacting together. It also revealed that the activities on the study sawmills may not be completely detrimental to the existence of the organisms. Thus, if well maintained, sawmilling activities are not entirely unfriendly to the biotic community of the sawmills.

Although, it is not a common practice to base ecological research on questionnaire survey, this study has revealed that the opinion of people who have been used to a particular area over a long period of time on the fauna species usually encountered in such areas should not be discarded. However, there is the need for a field survey to backup verbal responses.

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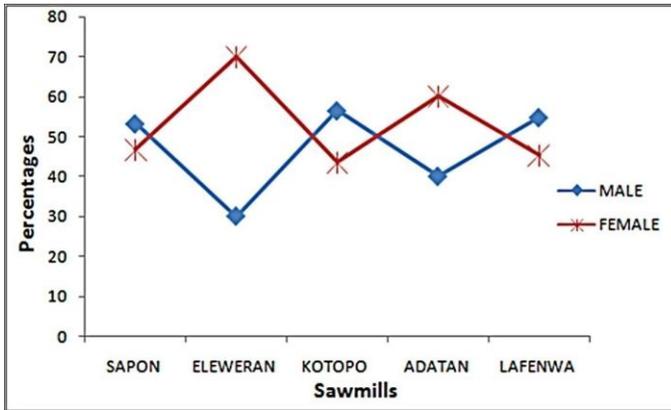


Figure 1: Sex of the respondents from the study sawmills, Abeokuta Nigeria.

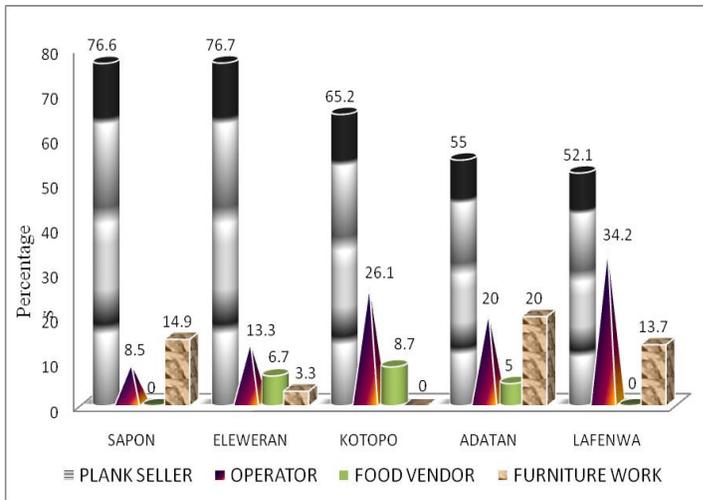


Figure 2. Occupation of the respondents from the study sawmill, Abeokuta Nigeria.

Table 1. Age (%) of the respondents from the study sawmills, Abeokuta Nigeria.

Age (Years)	Sawmill locations				
	Sapon	Eleweran	Kotopo	Adatan	Lafenwa
Below 26	0	0	0	5	0
26 – 35	36.2	23.3	13	25	30.1
36 – 50	42.6	50	52.2	20	50.7
Above 50	21.3	26.7	34.8	50	19.2
Total	100	100	100	100	100

Table 2. Animal species cited in the vicinity of sawmills of Abeokuta during field sampling.

ANIMAL GROUP	S/N	NAME OF ORGANISM	Scientific name	SAP.	ELE.	KOT.	ADA.	LAF.
Insects	1.	Termite	<i>Macrotermes spp.</i>	+	+	+	+	+
	2.	Caterpillar	<i>Passalus spp.</i>	+	-	+	-	+
	3.	Cockroach	<i>Periplaneta Americana</i>	+	+	+	+	+
	4.	Soldier ants	<i>Solenopsis spp.</i>	+	+	+	+	+
	5.	Grasshopper	<i>Zonocerus variegatus</i>	-	+	+	+	+
	6.	Butterfly	<i>Papilio spp.</i>	+	+	+	+	+
	7.	Honey bee	<i>Apis mellifera</i>	-	+	+	-	+
	8.	Housefly	<i>Musca domestica</i>	+	+	+	+	+
	9.	Red ant	<i>Solenopsis spp.</i>	+	+	+	+	+
	10.	Preying mantis	<i>Mantis religiosa</i>	-	-	-	-	+
Other Invertebrates	11.	Earthworm	<i>Eudrilus, Libyodrilus, Hypierodrilus spp.</i>	+	+	+	+	+
	12.	Spider	<i>Agelenopsis spp</i>	+	+	+	+	+
	13.	Antlion	<i>Distoleon tetragrammicus</i>	+	+	+	+	+
	14.	Millipede	<i>Trigonus spp.</i>	+	+	-	-	+
	15.	Centipede	<i>Scolopendra spp.</i>	-	-	-	-	+
	16.	Snail	<i>Archatina spp.</i>	+	-	+	-	+
Reptiles	17.	Lizard	<i>Agama agama</i>	+	+	+	+	+
	18.	Wall gecko	<i>Tarentola spp.</i>	-	+	-	-	-
	19.	Skink	<i>Eumeces spp</i>	+	-	+	-	+
Birds	20.	Hawk	<i>Accipiter spp.</i>	+	-	-	-	+
	21.	Cattle egret	<i>Bubulcus ibis</i>	-	-	-	-	+
Amphibians	22.	Toad	<i>Buffo spp.</i>	+	+	+	-	+
Mammalia	23.	Rats	<i>Ratus rattus</i>	-	-	+	-	+

Keys: + = Present, - = Absent, SAP. = Sapon; ELE. = Eleweran; KOT. = Kotopo; ADA. = Adatan; and LAF. = Lafenwa

Table 3. Frequencies of occurrence (%) of the animals in the vicinity of sawmills of Abeokuta, based on questionnaire survey.

ANIMAL GROUP	S/N	NAME OF ORGANISM	LOCAL NAME	FREQUENCY OF OCCURRENCE (%)					AVE (%)
				SAP.	ELE.	KOT.	ADA.	LAF.	
Insects	1.	Termite	Ikan	74.5	76.7	65.2	75	71.2	72.52
	2.	Caterpillar	Ogongo	10.6	13.3	30.4	30	38.4	24.54
	3.	Cockroach	Ayan	59.6	53.3	13	30	31.5	37.48
	4.	Soldier ants	Ijalo	29.9	23.3	13	10	46.6	24.56
	5.	Grasshopper	Tata	00	10	00	45	82.2	27.44
	6.	Butterfly	Labalaba	8.5	00	13	25	47.9	18.88
	7.	Honey bee	Oyin	00	6.7	47.8	00	46.6	20.22
	8.	Housefly	Esinsin	00	10	00	00	00	2.00
	9.	Red ant	Eera	00	13.3	8.7	00	00	4.40
	10.	Preying mantis	Dakodako	6.4	00	00	00	00	1.28
Other Invertebrates	11.	Earthworm	Ekolo	93.6	100	69.7	85	94.5	88.56
	12.	Scorpion	Akeekke	80.6	90	78.3	70	69.9	77.76
	13.	Spider	Alantakun	25.5	6.7	00	05	16.4	10.72
	14.	Antlion	Guluso	10.6	00	8.7	25	53.4	19.54
	15.	Millipede	Okun	8.5	13.3	13	00	26.0	12.16
	16.	Centipede	Taninsanko	00	13	00	00	26.0	7.80
	17.	Snail	Igbin	4.3	20	21.7	20	46.6	22.52
Reptiles	18.	Lizard	Alangba	95.7	100	100	85	100	96.14
	19.	Snakes	Ejo	57.4	86.7	91.3	55	89	75.88
	20.	Monitor lizard	Aleegba	8.5	00	47.8	00	39.7	19.20
	21.	Wall gecko	Omonile	00	3.3	00	00	00	0.66
	22.	Skink	Layonbere	40.4	36.7	17.4	35	60.3	37.96
Birds	23.	Hawk	Asa	17	00	8.7	00	00	5.14
Amphibians	24.	Toad	Opolo	91.5	90.3	95.7	65	79.5	84.40
Mammalia	25.	Rats	Eku	74.5	100	73.9	80	83.5	82.38
	26.	Pouch Rat	Okete	63.8	20	52.2	35	32.9	40.78

Keys: SAP. = Sapon; ELE. = Eleweran; KOT. = Kotopo; ADA. = Adatan; LAF. = Lafenwa and AVE. = Average

Table 4. Habitats of the animals in the vicinity of sawmill of Abeokuta.

S/N	Organism	Type of Habitat
1	Termite	Within planks, in temporary mounds made around dry woods and construction planks within the sawmill
2	Caterpillar	Inside decaying logs, bark of logs and within sawdust
3	Cockroach	Within planks, other wastes materials within the sawmill and at the bark of logs
4	*Scorpion	Within planks, bark of logs, and at every crannies
5	Earthworm	In moist soils, under planks and logs and beside streams
6	Lizard	Very wide spread within the sawmill
7	Rats	Under logs and planks.
8	Soldier ants/ants	In the spaces between planks and the ground, within planks and trailing freely during wet days
9	Toad	On wet soils under logs and planks
10	*Snakes	Under logs and planks, within log bark
11	Spider	On the roofs, within planks and bark of logs
12	Grasshopper	On grass and in areas within the sawmill, closer to where vegetation is.
13	Butterfly	Flying around the sawmill, most especially in areas closer to vegetation
14	Skink	Under planks and logs. Found all around the sawmill
15	Snail	In cool areas under logs, planks and abandoned materials. Comes out mostly after a rainfall
16	Antlion	In the soil
17	*Pouch Rat	Bore hole under logs and planks.
18	Honey bee	Mostly on flowers where vegetation is available
19	Housefly	All over the sawmill
20	Wall gecko	On planks and logs and wooden structures
21	Millipede	Under planks and logs
22	Centipede	Under logs and planks
23	*Monitor lizard	Within logs and planks
24	Hawk	Seen preying on lizards within the sawmill
25	Preying mantis	On grass and in areas within the sawmill, closer to where vegetation is.

*As stated by the respondents (not cited during field survey)

Table 5. Plant species identified in the vicinity of sawmills of Abeokuta.

	LAF.	KOT.	ADA.	ELE.	SAP.
<i>Abuliton mauritianum</i>	+	+	+	-	+
<i>Ageratum conyzoides</i>	-	+	+	-	-
<i>Albizia lebbekii</i>	+	-	-	-	-
<i>Alogaisus leucopus</i>	+	+	-	-	+
<i>Amaranthus spinosus</i>	+	+	+	+	+
<i>Aspilia africana</i>	+	-	-	-	-
<i>Axonopus compressus</i>	+	+	+	+	-
<i>Bambusa vulgaris</i>	-	-	-	-	-
<i>Boerhaavia coccinea</i>	-	-	+	-	-
<i>Chromolaena odorata</i>	+	-	+	+	-
<i>Commelinabengalensis</i>	+	+	+	+	+
<i>Conyza</i> spp.	+	-	+	-	-
<i>Digitaria horizontalis</i>	-	+	-	-	-
<i>Dryopteris</i> spp.	-	-	-	-	-
<i>Elates guineensis</i>	-	-	-	-	-
<i>Euphorbia hirta</i>	+	+	+	+	+
<i>Euphorbia heterophylla</i>	-	+	-	-	-
<i>Euphorbia hysopifolia</i>	+	-	+	+	+
<i>Ficus axasperata</i>	-	-	-	-	+
<i>Ficus sur</i>	+	-	-	-	+
<i>Gliricidia sepium</i>	+	-	-	-	-
<i>Gomphrenacelosoides</i>	+	+	+	+	-
<i>Laportea aestuans</i>	+	+	+	-	-
<i>Latanacamara</i>	-	-	+	-	-
<i>Luffa cylindrical</i>	+	-	-	-	-
<i>Melanthera scandens</i>	-	+	-	-	-
<i>Mimosa pigra</i>	+	+	+	-	-
<i>Noclialatifolia</i>	+	-	-	-	-
<i>Oryzabarthii</i>	+	-	-	-	-
<i>Panicum maximum</i>	+	-	-	-	-
<i>Parquetinani-grescens</i>	+	+	-	-	-
<i>Peperomia pelucida</i>	-	-	-	-	+
<i>Phyllanthus amarus</i>	+	+	-	+	-
<i>Physalis angulata</i>	+	-	+	+	-
<i>Physalis micrantha</i>	-	-	+	-	+
<i>Portulaca</i> spp.	-	-	+	-	+
<i>Rauwolfia vomitoria</i>	+	-	-	-	-
<i>Senna occidentalis</i> (L.)	-	-	-	-	+
<i>Sida acuta</i>	+	+	+	+	+
<i>Sida rhombifolia</i>	+	-	+	+	+
<i>Solanum americanum</i>	-	-	-	+	-
<i>Synedrella nodiflora</i>	+	+	+	+	-
<i>Telfaeria occidentalis</i>	-	-	-	-	+
<i>Telophrostiapedicellata</i>	+	-	+	-	+
<i>Tridax procumbens</i>	-	-	+	-	-
<i>Vermia</i> spp.	-	-	+	-	-

Keys: + = Present, - = Absent

SAP. = Sapon; ELE. = Elewera; KOT. = Kotopo; ADA. = Adatan; and LAF. = Lafenwa