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Evaluation of Snags Density and Utilisation by Fauna at Bazza Forest in Michika Local Government Area, Adamawa State

*Bode[1] A. S., Adamu[2] M. Y., Garandi [3] I. D., Tishe V. S.[4].,
[1] Department of Zoology, Adamawa State University, Mubi, Adamawa State, Nigeria.
[2] Department of Crop Protection, Modibbo Adama University, Yola, Adamawa State, Nigeria.
[3] Department of Geography and Environmental Sciences, Adamawa State University, Mubi, Adamawa State, Nigeria. [4] Department of Zoology, Adamawa State University, Mubi, Adamawa State, Nigeria.
*Corresponding Author's E-mail: saiduahmedbode@gmail.com

Abstract
Snags (standing dead trees) have numerous ecological functions and contribute to structural complexity and biodiversity in terrestrial habitats. A wide variety of wildlife depends on snags for survival and reproduction. A study conducted to evaluate snag density and utilization by wildlife species at Michika Local Government of Adamawa State. A total of 40 sample plots measuring 50 by 50 feet were obtained randomly using stratified random sampling technique. The density of snags was determined by counting from each of the plots, while organisms visible on or within the snags were recorded. Data was analysed using descriptive statistics. A total of 50 snags were recorded from the 40 sample plots, that is an average of 1.25 snags per 50 by 50 feet plot, while 24 species/categories of living organisms were found inhabiting the snags. Species of insects (ants and termites), and mushrooms were the most occurring organisms found inhabiting the snags, while small mammals such as bats, reptiles such as snakes and arthropods (centipedes and millipedes) were rarely found. The organisms identified on the snags have successfully carved niches for their sustenance. They depended on the snags for shelter (habitat), reproductive activities, roosting/resting, feeding and hiding/refuge. Though, the snag density was not adequate, minimal use of the snags by birds such as woodpeckers was observed. This may be attributed to hunting pressure or other environmental factors. It is recommended that Michika Local Government Area of Adamawa State should sustain efforts in ensuring that snags are protected from being exploited for other uses.

Introduction: Snags (standing dead trees) refers to a dead or dying tree that remains standing or has fallen into a body of water, such as a river, lake, or wetland or even on ground. Snags have numerous ecological functions and contribute to structural complexity and biodiversity in terrestrial habitats (Joseph *et al*., 2020). The process leading to the formation of snags begins with the death of a tree, which can occur due to various factors such as disease, injury, drought, insect infestation, or natural events like storms or lightning strikes (McDonald *et al.*, 2019). Once a tree dies, it starts to decay, and the structural integrity of the tree weakens. However, it can remain upright for several years, depending on environmental conditions, such as climate, temperature, and humidity, as well as the tree species and its resistance to decay (Barton *et al.*, 2020). James and Tailor (2019) reported that snags are important components of forests that contribute to ecological processes and provide habitat for many life forms. Snags provide habitat for numerous species of wildlife, wildlife use of snags depends on size and decay stage, snag density estimation without any information about snag quality attributes is of little value for wildlife management decision makers (Rose *et al*., 2017). Dead trees, known also as snags, are an essential factor in maintaining biodiversity in forest ecosystems. Combined with their role as carbon sinks, this makes for a compelling reason to study their spatial distribution (Polewski *et al*., 2018).

Colonization of dead trees by subcortical insects proceeds in two successional "waves." The first wave occurs when insects colonize standing snags soon after tree death. The second wave occurs with epigeic species that utilize snags after they have fallen (Saint-Germain, *et al*., 2004). The ecological roles and importance of dead and dying wood in forest ecosystems has been the subject of increasing interest over the past decades. As the recognition of the importance of snags has become more apparent, forest management regulatory bodies have developed minimum snag stocking requirements to help ensure that biodiversity is maintained or restored (Wing *et al*., 2017). Providing adequate snag densities is an important aspect of managing forests for wildlife. The fundamental pre-condition for protecting biodiversity and the sustainable functioning of forest types is to maintain snags and coarse woody debris in suitable relative abundance across all decay classes (De Long *et al.*, 2018). However, snags are systematically removed. The concept of ecosystem management calls for greater retention of snags and other biological legacies in managed forests (Dudley and Vallauri, 2005). Snags provide critical nest, roost and den habitat for myriad of vertebrate species (Wing *et al*., 2017). A wide range of vertebrates use snags for shelter, including bats (Chioptera), rodents, bears, and herpetofauna (Holloway and Malcolm, 2017; Foster and Kurta, 2019). In the Blue Mountains of Oregun and Washington, for example, 62 species of birds and mammals use snags for roosting, feeding, or related life functions (Thomas *et al*., 1979). The authors further stated that most snag-dependent birds and mammals are insectivorous and represent a major portion of the insectivorous forest fauna, and are important factors in controlling forest insect populations. There are many instances in which birds reduced outbreak of populations of forest insects. Woodpeckers are often referred to as indicator species. It is assumed that if woodpecker populations are maintained at viable levels, secondary cavity-nesting populations also will be present at viable levels.

Despite the factors that elicit the formation of Snags, recently some studies has reported a way to sabotage some of the factors which includes forest practices such as shorter rotations, fire wood removal, timber stand improvement and insect and disease control efforts have limited the number of snags and downed logs available for wildlife habitat (Ganey *et al*., 2016). The density of snags in any given area can be influenced by several environmental factors, including climate conditions, forest composition, disturbance regimes, and human activities. Miller *et al*., (2022) found that temperature fluctuations, rainfall patterns, and overall climatic conditions significantly affect tree mortality, which, in turn, influences snag density. For example, in regions with frequent droughts or extreme temperature fluctuations, higher tree mortality rates can lead to an increased number of snags

Materials and Methods: Area of Study: Michika Local Government Area of Adamawa State is located in the northern axis of the state on latitude 10° 37' 00"N, 10^0 617'N of the equator and longitude 13°23' 00" E, 13^0 383'E, of the Greenwich meridian and it is bounded by Madagali Local Government Area to the North, Mubi North Local Government Area to the South, Borno State to the West and Cameroun Republic to the East (Adebayo and Tukur 2020).

The temperature regime of the area is warm to hot throughout the year, because of high radiation income which is relatively evenly distributed throughout the year. However, there is usually a slightly cold period between November and February. There is a gradual increase in temperature from January to April with seasonal maximum occurring in April. Temperature drops slightly at the onset of rains due to the effects of cloudiness. It increases again a bit after the cessation of rains (October-November). This is followed by the hamattan period when temperature drops to the possible minimum. Although, temperature is very low in some uphill settlements (example, Bazza, Tilijo, Futu, Za, Vi and Garta). Generally, the mean annual temperature is about 27°c; the hottest month is May with about 35°c and the coldest month is January with less than 12.7°c, Nyong,E. E. &Nweze,N.J (2012) (Adebayo and Uyi, 2016).

April is a month of transition between the wet and dry seasons in the area. During this period, there is scanty rainfall in most part of the area. The months of May to September constitute the wet season in Michika Local Government. Monthly rainfall increases steadily from May to August which has the highest amounts. Rainfall decreases from September to October at a very sharp rate. The mean annual rainfall ranges from 900mm to 1050mm. Generally, planting of crops begins earlier in mountainous areas than the low land areas due to the orographic factor earlier mentioned (Adebayo, 1997). Relative humidity between January and March is low. It starts rising as from April and reaches the maximum in August, the peak of the raining season. Relative humidity starts decreasing as from October following the cessation of rainy season (Adebayo *et al*., 2017).

Research Design: Sample Selection and Sample Size: The study was conducted at Bazaa forest in Michika Local Area. A 50 by 50 feet sample plot of land was measured in the field, and the procedure was repeated for 40 consecutive times, that is 40 plots were obtained randomly by adopting the stratified random sampling technique as described by Bate *et al.,* (1999).

Data Collection/Sampling Procedures: Snag sampling and analysis method in estimating standing dead tree density at a desired scale, was conducted to evaluate the density of snag in the study area. The following procedures of data collection was carried out:

A 50 by 50 feet plot of land was measured manually in the field.

Demarcation was made by tying rope around the measured plot.

Record of the density of snag on the demarcated plot was taken.

Living organisms on each snag on the plot was noted.

The use or benefit of snag to the living organisms was recorded.

Visible organisms on the snags and those that form their colonies behind the tree bark was recorded.

Method of Data Analysis" Data was analyzed using descriptive statistics which includes the use of tables and frequencies as outlined by Perry *et al.*, (2021).

Results: Density of Snags and living organisms found on them per sample plot in the study area.: The result in the table 1 below depicts the organisms found utilizing the snags in different sample plots. Total of 50 snags were recorded from the 40 sample plots. Also, 24 species of organisms were found inhabiting the snags at some parts in the study area as presented in the table. In all the sample plots insects (such as ants, termites), and fungi (mushroom) were the most occurring living organisms on the snags while small mammals such as bats, reptiles such as snakes and arthropods (centipedes and millipedes) were rarely found on the snags. Nyong,E. E. &Nweze,N.J (2012)

From the table above, a variety of living organisms were observed utilizing the snags. These organisms include: **Insects**: Termites, ants, bark beetles, boring insects, insect larvae, bees, wasps, butterflies, spiders, centipedes, grasshoppers, etc. **Reptiles and Amphibians**: Lizards, snakes, frogs. **Birds and Bats**: Hawks, birds, bats. **Mammals**: Mice. **Fungi**: Mushrooms and fungus. Insects were the most frequently observed group across the plots, with **ants, termites, and wasps** appearing repeatedly. This reflects the ecological value of snags in harboring a wide array of small fauna. The presence of **birds, bats, reptiles**, and **small mammals** also illustrates the role of snags as essential components of microhabitats for vertebrates. Additionally, fungi presence suggests decomposition and nutrient cycling are ongoing. Nyong,E. E. &Nweze,N.J (2012)

Evaluation of how snags are utilized by Organisms: **The result in table 2 depicts how snags were utilized. Shelter and Nesting Sites**: Birds, bats, mice, and reptiles were observed either nesting in or using the snags as temporary shelter. **Feeding Grounds**: Termites, ants, and bark beetles feed on the decaying wood. Insect larvae and spiders also utilize the snags for capturing prey. **Breeding Grounds**: Insect larvae and fungi (such as mushrooms) show that snags are also used as breeding or spore germination sites. **Protection and Camouflage:** Some animals such as lizards and snakes likely use the snags for hiding from predators or harsh weather. The data reveals that snags serve **multi-functional roles** in the ecosystem ranging from food sources, shelters, and nesting areas to breeding and reproductive sites. This emphasizes the importance of preserving snags as they significantly contribute to **biodiversity support** and **ecological balance** in the study area.

Discussion : This study was conducted to evaluate the density of snags and their ecological utilization by fauna at Bazza Forest in Michika Local Government Area of Adamawa State. A total of 50 snags were recorded from 40 sampled plots during the field survey. This is not in line with Nyong,E. E. &Nweze,N.J (2012) Joseph *et al*; (2020) who reported that 161 snags recorded from 30 plots during the field survey at the Mayo-Selbe Range of Gashaka Gumti National Park, this implies that 5.36 snags were the average density per each 50 by 50 feet sample plot. While in this study 1.25 snags were the average density per each 50 by 50 feet sample plot. The difference between the two results is that the aforementioned was conducted in National park while the latter is a community forest which is not under strict protection. Human activities, particularly deforestation and forest management practices, can either decrease or increase snag densities. Miller *et al*., (2022) concluded that forests subjected to intensive logging or land conversion for agriculture often have reduced snag densities, as trees are typically removed before they can naturally die and become snags. Conversely, conservation efforts such as establishing protected areas or reducing the frequency of logging can help maintain or increase snag density in forested areas. Furthermore, **James and Taylor (2020)** found that the availability of snags can be influenced by land use policies. For example, areas with a history of human intervention, such as agricultural expansion or urbanization, tend to show reduced snag density due to tree clearance, forest fragmentation, and land development. However, regions where forestry practices emphasize sustainability and long-term forest health often show higher snag densities because trees are allowed to reach maturity and die naturally.

Different organism were found utilizing the snags in different ways. Organisms such as the Birds and insects uses it as their source of food and reproduction (nest and insects larvae) and some use it as their hiding place examples are the snakes. The reptiles such as snakes and the lizards were found feeding on the insects and ants within the snags. The amphibian example the frogs and the mammals such as mice and the bats, all utilized the snags for different purposes. The snags observed in the field were of various sizes and stages of decay / decomposition. The snags came as a result of many biotic factors, and also abiotic factors example lightening, diseases and old ages. The results indicate a diverse array of fauna utilizing the snags. Various insects such as termites, ants, beetles, moths, spiders, grasshoppers, and bees are commonly found on the snags. This variety of fauna highlights the importance of snags as a valuable resource for different wildlife species. The snag density observed aligns with findings by Nyong,E. E. &Nweze,N.J (2012), **Grayson *et al*. (2019),** who emphasized that snag availability depends heavily on forest structure and human interference. Snags are often underrepresented in areas subjected to frequent tree harvesting or urban development. Thus, the density found in this study reflects both natural decay processes and anthropogenic pressures. A wide variety of organisms were recorded on the snags, including insects (ants, termites, bark beetles, larvae), arachnids (spiders), myriapods (millipedes, centipedes), reptiles (lizards, snakes), amphibians (frogs), birds (hawks, other small birds), mammals (bats, mice), and fungi (mushrooms). These findings confirm that snags serve as **critical microhabitats** supporting biodiversity in terrestrial ecosystems. Similar studies by Wisdom *et al.*, (2016) and **Cline *et al.*, (2018)** demonstrated that dead wood structures like snags are instrumental in maintaining ecological balance, particularly for cavity-nesting birds, decomposers, and small mammals. This work also mirrors the findings of Nascimbene *et al*., (2018) whom stated that Snags provide micro habitats for many living organisms, including fungi, epixyliclichens, bryophytes, invertebrates, birds, mammals, reptiles and amphibians. A similar research conducted by Wing *et al*., (2015) revealed that snags provide critical nest, roost and habitat for myriad of vertebrate species. The repeated observation of ants, insects, and wasps indicates that invertebrates dominate snag usage. Moreover, the presence of secondary consumers such as birds and reptiles suggests a **complex food web** centered on snags. The study observed that snags are used in various ways: **Sheltering and Roosting:** Birds, bats, and mice were seen roosting or nesting in cavities within snags. **Feeding and Foraging Grounds:** Termites, larvae, and fungi were actively feeding on the decaying wood, while insectivorous species (like lizards and birds) foraged for food. **Reproductive Grounds:** Insects such as beetles and ants used snags for breeding and laying eggs. **Camouflage and Protection:** The irregular structure of snags provided concealment for species like snakes and lizards. These uses are consistent with ecological principles outlined by Nyong,E. E. &Nweze,N.J (2012) ,**Harmon *et al.* (1986),** who stated that snags contribute to habitat complexity and are essential in the life cycles of many forest-dwelling species. The multi functionality of snags in this study area reinforces their importance as keystone features in terrestrial ecosystems.

Conclusion: This study evaluated the density and ecological significance of snags in Bazza Forest. The findings highlight the essential role that snags play in maintaining biodiversity and supporting ecological processes. From the analysis, a total of 50 snags were recorded across 40 plots, showing a moderate presence and uneven distribution. The presence of a wide variety of organisms including insects, birds, reptiles, mammals, and fungi demonstrates the ecological importance of snags in providing shelter, breeding sites, feeding grounds, and protection. The study concludes that **snags are valuable ecological resources,** contributing significantly to species survival, biodiversity conservation, and ecosystem health. Their presence enhances forest structure and serves as vital habitats, especially in areas increasingly affected by human activity and environmental change.

Recommendations: Based on the findings from this study the following recommendations are made:;The Local Government should sustain efforts in ensuring that snags are protected from being exploited for other uses. ;The relatively low level of utilization of the snags by wildlife, particularly birds and reptiles indicates low population density of the species. As such there is the need to sensitize the populace on the need to conserve biodiversity.

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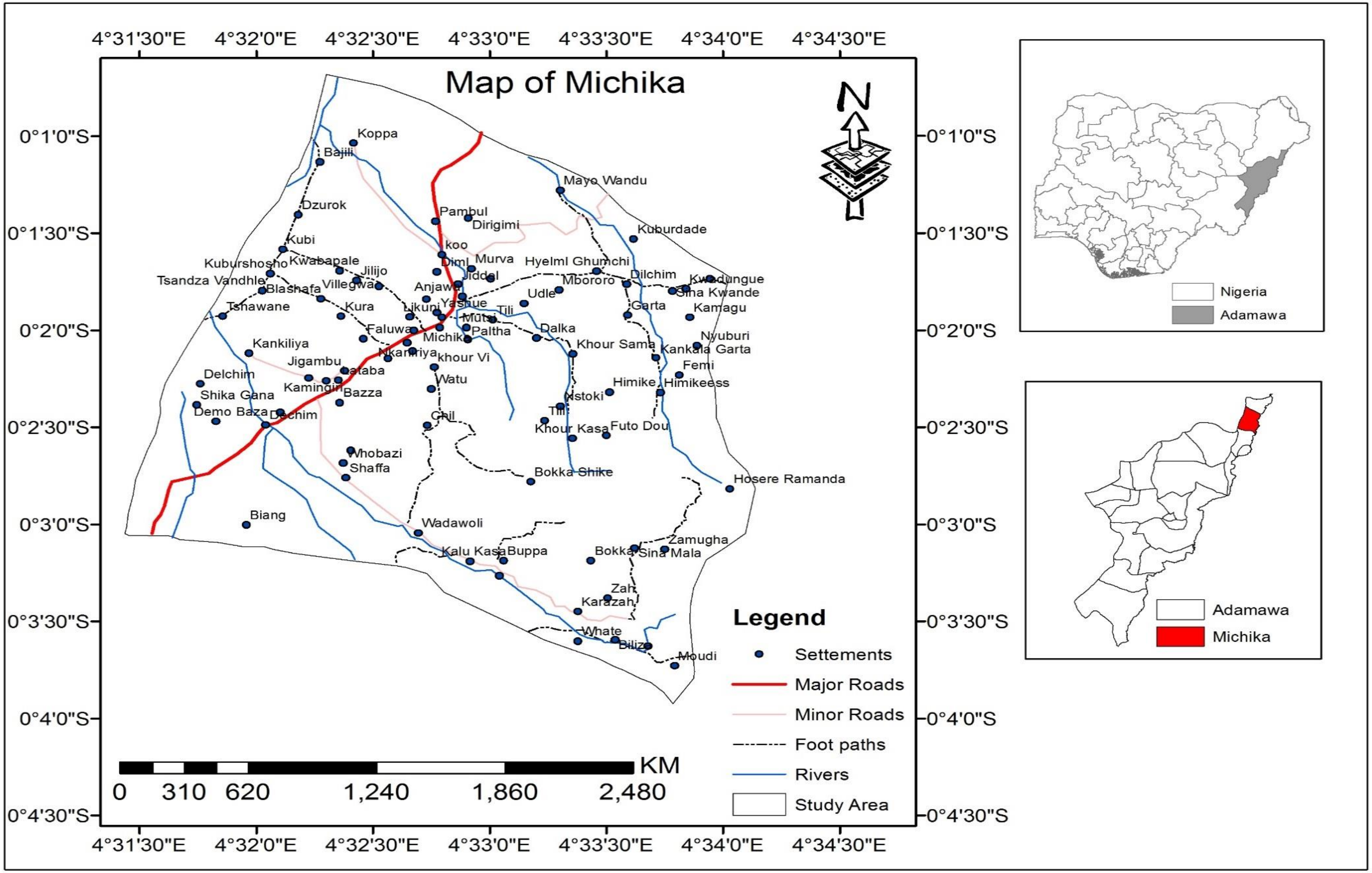
Table 1: Snag density per sample plot and organisms present at Bazza Forest in Michika local Government Area.

Plot Number	Number of snags	Living organisms present/found on the snag(s)
1	2	Millipede, ants, wasp, hawk, Termites,
2	1	Bark beetle, fungus, insect larvae
3	11	Insects, wasp, lizard
4	2	Insect, larvae, millipede, mushroom, termites
5	1	spider, centipede, ants
6	3	Birds, insects, grasshoppers, ants, bees, wasp
7	0	
8	0	
9	1	Boring, insects, beetle, ants, centipede
10	2	Spider, insects, bees, ants, birds
11	0	
12	1	Ants, mushroom, centipede, wasp
13	1	Insect, snake
14	2	Mice, insects, mushroom, centipede, wasp
15	2	Butterflies, ants, grasshoppers, insects
16	1	Birds, insects, bark beetle, millipede
17	2	Bats, insects, ants, centipede, wasp
18	2	Insects. Lizard, grasshoppers, centipede
19	0	
20	1	Bees, insect larvae ,millipede
21	1	Millipede, insects, mice, ant
22	2	Bats, frog, ants, mushroom, centipedes
23	2	Spider, bird, grasshoppers, insects, larvae
24	1	Insects, centipede, wasp, ants, bats
25	2	Boring, insects, bark beetles, wasp, ants
26	1	Ant, termites, lizards, bird
27	0	
28	3	Insects, ants, centipede, Bird, bees, millipede
29	1	Insects larvae, boring, insects, ants, lizard
30	1	Grasshopper, Mushroom, insects, spirogyra
31	1	Mice, insects, mushroom, centipede, wasp
32	1	Butterflies, ants, grasshoppers, insects
33	2	Birds, insects, bark beetle, millipede
34	1	Bats, insects, ants, centipede, wasp
35	1	spirogyra, Insects. Lizard, grasshoppers, centipede
36	1	Spider, bird, grasshoppers
37	1	Bees, insect larvae ,millipede
38	1	Millipede, insects, mice, ant
39	1	Bats, frog, ants, mushroom, centipedes
40	1	Spider, bird, grasshoppers, insects, larvae
Total	50	

Source: Field survey, 2025.

Table 2: how Snags are utilized

S/N	how snags are Utilized	*Organisms*
1	**Shelter and Nesting Sites,**	Birds, bats, mice, and reptiles were observed either nesting in or using the snags as temporary shelter
2	**Feeding Grounds**	Termites, ants, and bark beetles feed on the decaying wood. Insect larvae and spiders also utilize the snags for capturing prey
3	**Breeding Grounds**	Insect larvae and fungi (such as mushrooms) show that snags are also used as breeding or spore germination sites.
4	**Protection and Camouflage**	Some animals such as lizards and snakes likely use the snags for hiding from predators or harsh weather


Map of Michika
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