EVALUATION OF SNAG DENSITY AND UTILIZATION BY WILDLIFE IN MAYO-SELBE RANGE OF GASHAKA GUMTI NATIONAL PARK, NIGERIA

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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 Mayo-Selbe Range of Gashaka Gumti National Park. A total of 30 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 161 snags were recorded from the 30 sample plots, that is an average of 5 snags per 50 by 50 feet plot, while 26 species/categories of living organisms were found inhabiting the snags. Species of insects (ants and termites), green alga such as spirogyra 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 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 the management of the Park should intensify effort to ensure that the snags are allowed to thrive and not exploited for fuelwood (firewood) or other purposes. In addition, efforts need to be made in ensuring the protection of biological resources of the Gashaka Gumti National Park.

Keywords: Snag, density, ecosystem, wildlife, habitat

INTRODUCTION

Snags are an important structural component in forest communities, making up 10–20% of all trees present in old-growth tropical, temperate, and boreal forests (Nilsson *et al*., 2002). Snags are important habitat components for numerous wildlife species (Perry *et al*., 2017) and they have been classified as key habitat components for many threatened and forest health indicator species (Harmon, 2002). Snags are important environmental elements which are essential for maintaining biodiversity in forest ecosystems (Wisdom and Bate, 2008). In recent years, recognition of the essential roles snags play in forest ecosystems has increased (Wing *et al*., 2015). Snags provide important roosting, nesting and foraging substrate for numerous species of wildlife (Britzke *et al*., 2003; Perry and Thill, 2007). Snags provide micro habitats for many living organisms, including fungi, epixylic lichens, bryophytes, invertebrates, birds, mammals, reptiles and amphibians (Nascimbene *et al*., 2013; Mason and Zappani, 2015). Snags with internal pockets of decay provide insulated and protected nest, roost or den sites (Rose *et al*., 2001).

Snags provide critical nest, roost and den habitat for myriad of vertebrate species (Wing *et al*., 2015). A wide range of vertebrates use snags for shelter, including bats (Chioptera), rodents, bears, and herpetofauna (Holloway and Malcolm, 2007; Foster and Kurta, 1999). 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). Woodpeckers (*Picidae*) are an especially important group of species that depends on snags and large trees, and whose role in forested ecosystems is integral to the continued health of such systems. As primary cavity-nesters, woodpeckers excavate nest and roost sites for themselves and many other species. In other words, primary cavity nesting bird species often construct cavities that are subsequently exploited by secondary cavity-nesting species (e.g., wood duck, *Aix sponsa*; *American kestrel, Falco sparverius*). An absence of viable woodpecker populations in fact, means an uncertain future for secondary cavity-nesters, or nonexcavators. A minimum of 2.2 snags per hectare is considered ideal (Bates *et al*., 1999).

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 (Thomas *et al*., 1979). Also, songbirds (e.g., black-capped chickadee, *Poecile atricapillus*) excavate cavities and forage for insects on decaying trees. The nesting and roosting needs of woodpeckers and other cavity-nesters are assumed to be met by controlling only the density of snags on public lands (Thomas *et al*., 1979).

Snags are optimal habitat for primary cavity nesters such as woodpeckers which create the majority of cavities used by secondary cavity users in forest ecosystems. As primary cavity-nesters, the role of woodpeckers is integral to healthy forest ecosystems because these species excavate cavities in decayed portions of snags or live trees for nest and roost sites. These cavities are subsequently used by secondary cavity-nesting or non-excavating vertebrates (Thomas *et al*., 1979). In addition, water hunting birds like the osprey or kingfishers can be found near water, perched in a snag tree, or feeding upon their fish catch. Furthermore, dying trees increase availability of resources such as light, nutrients, and water (Bergeron *et al.*, 1998, Drever *et al*., 2006). 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 affect outbreaks of southern hardwood borers and Engelmann spruce beetles (Thomas *et al*., 1979).

Other types of snags, colonized by invertebrates, provide a rich foraging resource (Wisdom and Bate, 2008). Dead, decaying wood supports a rich community of decomposers like bacteria and fungi, insects, and other invertebrates. A diversity of fungi, plants, and animals utilize snags and downed wood throughout their life cycles (Lonsdale, 2008). Snags are used by a variety of invertebrates, including subcortical insects that complete a portion of their life cycle beneath the bark of woody plants. Many of these insects colonize certain tree species or utilize trees at specific stages of decay (Saint-Germain, 2007). According to Boulanger and Sirois (2007), 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, 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*., 2015). Often, a certain density or volume of snags are required to be maintained over time in order to provide continuous habitat support and ecosystem sustainability (Holloway *et al*., 2007). Thus, land management agencies often have guidelines for providing target densities of snags during harvest entries (e.g. 5 snags/ha> 30cm dbh) (Ouachita National Forest, 2005), and 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*., 2008). However, snags are systematically removed. Forest practices such as shorter rotations, firewood removal, timber stand improvement and insect and disease control efforts have limited the number of snags and downed logs available for wildlife habitat (Perry and Thill, 2013).

The concept of ecosystem management calls for greater retention of snags and other biological legacies in managed forests (Dudley and Vallauri, 2005). Such management maintains structural complexity and biodiversity (Franklin *et al*., 2002, Lindenmayer and Noss, 2006). Recognizing the importance of retaining or augmenting the abundance or volume of snags in forests, previous studies have investigated methods for creating snags such as girdling and topping of trees, herbicide application, and/or inoculating trees with fungi (Hallett *et al*., 2001; Brandeis *et al*., 2002, Shea *et al*., 2002; Filip *et al*., 2004).

Ecosystem degradation proceeds at alarming rates in many parts of Nigeria, including some protected areas. Many protected areas are experiencing high level of resource extraction (Onoja, 2014, Gilby and Connor, 2010). The decline of wildlife populations and consequent reduction of biodiversity in Gashaka Gumti National Park can be related to three forces of destruction, viz; hunting for bush meat and pet trade, fire damage to forests and cattle grazing (Sommer and Ross, 2009). Degradation of wildlife habitats has necessitated the need for effective and holistic conservation and management policy that requires among others efforts, a comprehensive data gathering on the evaluation of the diversity of snag found in the park. Therefore, the objectives of the study are to determine the density of snags in Mayo Selbe range of Gashaka Gumti National Park and to investigate snag use by animal species.

MATERIALS AND METHODS

Study Area

Gashaka Gumti National Park (GGNP) is located in remote mountainous region of north-eastern Nigeria, between the boundaries of Adamawa and Taraba States. Geographically, the park lies between 6^o55^1-8^o $13N^1$ and 11^o-13^o – $12E^1$ with an estimated landmass of 6,731km^2 of undulating terrain and deep rolling valley (Akinsoji, 2003). Ecologically, the park is situated in the sub-Sahara Guinea Savannah Zone of Africa, in the sub-Tropical Zone of the south-eastern highlands of the savannah area of Nigeria, south of the Benue River. The park is the main watershed catchment area of the Taraba River, the major tributary of the Benue River. It also shares international boundary with the Republic of Cameroon, adjacent to Faro National Park, Cameroon. Immediately to the south of the park is the awe-inspiring Mambilla Plateau (Franklin, 1988). The mean annual rainfall varies from 1200mm in the northern part to about 3000mm in the Southern part of the park. The rainy season begins in March or early April and ends in mid November (Dunn, 1993).

Study Design

Sample selection and sample size

A 50 by 50 feet sample plot of land was measured in the field, and the procedure was repeated for 30 consecutive times, that is 30 plots were obtained randomly by adopting the stratified random sampling technique as described by Sutherland (1997).

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 were carried out:

i) A 50 by 50 feet plot of land was measured manually in the field.
ii) Demarcation was made by tying rope around the measured plot.
iii) Record of the density of snag on the demarcated plot was taken.
iv) Living organisms on each snag on the plot were noted.
v) The use or benefit of snag to the living organisms was recorded.
vi) Visible organisms on the snags and those that form their colonies behind the tree bark were recorded.

Statistical Analysis

Data were analyzed using descriptive statistics which includes the use of tables and frequencies as outlined by Runyon *et al*. (1994).

RESULTS

Density of Snags and Organisms Present on them per Sample Plot

A total of 161 snags were recorded from the 30 sample plots. Also, 26 species of organisms found inhabiting the snags at Mayo-Selbe Range of the Gashaka Gumti National Park as presented in Table 1. In all the sample plots insects(such as ants, termites), spirogyra (green alga) 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.

Table 1: Snag density and organisms present

Plot number	Number of snag(s)	Living organisms present/found on the snag(s)
1	3	Ant, termites, epiphyte, mushroom, boring insects, cocoon,
2	5	Earthworm, fungus, spirogyra, termite, insect larvae, insect eggs, ants, millipede, epiphyte
3	4	Ants, termites, mushroom, spirogyra, epiphyte, reptiles
4	6	Millipede, spirogyra, epiphyte, termites, ants, mushroom
5	8	Algae, mushroom, boring insects, termites, woodborer, millipede, epiphyte, beetle, ants, grasshopper
6	3	Grasshopper, woodborer, ants, termites, mushroom, spiders, spirogyra
7	5	Brown backed head woodpecker, spirogyra, fungus, termites, ants, climber
8	5	Termites, epiphyte, spirogyra, fungus, ants, woodpecker, woodborers
9	6	Beetle, termites, ants, spirogyra, epiphytes, woodborers, insect eggs, fungus, finny flying insect
10	4	Insect eggs, termites, fungus, orchids, ants, spirogyra, epiphyte
11	3	Termites, fungus, ants, orchids, spirogyra, wasp
12	6	Mushroom, termites, spirogyra, ants, epiphytes, beetle, woodborers, centipede
13	4	Termites, ants, spirogyra, epiphyte, wasp, spider
14	6	Termites, ants, spirogyra, centipede, epiphyte, snake, fern, fungus
15	6	Ants, termites, fungus, spirogyra, epiphyte, beetle, bat, woodborers
16	8	Termites, ants, woodpecker, wasp, fern, snake, epiphyte, bat, spirogyra, beetle
17	5	Spirogyra, ants, termites, orchids, spider, fern, bees, epiphyte
18	7	Spirogyra, termites, ants, centipede, mushroom, epiphyte, wasp, bird nest, orchids
19	5	Termites, ants, woodborers, spirogyra, beetle
20	6	Spirogyra, bats, climber, centipede, epiphyte, mushroom, termites, ants, hooded vulture
21	5	Spirogyra, epiphyte, bird nest, mushroom, termites, ants, hooded vulture
22	4	Hood bird, spirogyra, ants, orchids, termites, mushroom, bird nest
23	7	Epiphyte, spirogyra, mushroom, termites, bees, birds, climber, ants, insect eggs
24	4	Termites, ants, wasp, spirogyra, mushroom, cocoon, epiphyte, earthworm
25	6	Birds, termites, ants, climber, spirogyra, orchids, fern, cocoon
26	7	Epiphyte, spirogyra, termites, wasp, ants, centipede, fern, climber, insect eggs, fungus, grasshoppers
27	4	Termites, ants, spirogyra, wasp, spider, centipede, epiphyte, mushroom, fern
28	5	Fern, spirogyra, termites, ants, fungus, climber
29	4	Spirogyra, fern, termites, bird nest, moths, climber, ants
30	10	Climber, fungus, orchids, wasp, termites, bees, ants, spirogyra, woodpeckers, insect cocoon
Total	161	

Use of snags by the identified organisms

The organisms identified on the snags have successfully utilized the snags for their sustenance. Most of the insects use the snags for reproductive activities, e.g. egg laying. Bird species such as the woodpeckers and hooded vultures utilize the snags for roosting and feeding. In addition, reptiles such as snakes use the burrow on snags as resting and hiding places.

DISCUSSION

Snag density at Mayo-Selbe Range

The 161 snags recorded from 30 plots during the field survey at the Mayo-Selbe Range of Gashaka Gumti National Park implies that 5.36 snags was the average density per each 50 by 50 feet sample plot. This can be extrapolated to mean there were 35.5 snags per hectare (10,000m^2). Bates *et al.* (1999) reported that a minimum of 2.2 snags per hectare is considered to be ideal in a terrestrial ecosystem. Therefore,the snag density is adequate to support living organisms that rely on availability of snags for survival such as some insect species, birds e.g. woodpeckers, reptiles such as lizards and snakes, fungi, algae, mammals such as bats and rodents.

The results obtained from the field study have indicated that the density of snags at the Mayo-Selbe Range was adequate. The snags were also utilized by various species of plants, animals, algae and fungi. Expectedly, different species of organisms were found on or within the snags in the study area. These include insects such as ants, termites, wasps, beetles and grasshoppers; millipedes, centipedes; reptiles (such as snakes); birds (vultures and woodpeckers); bats; rodents; orchids, algae; spiders; epiphytes and ferns. These groups of organisms occupy different trophic level in the ecosystem, as such, they are important for the ecosystem to function properly**.** However, the rare occurrence of some organisms that are known to inhabit snags such as the woodpeckers indicates that there are possible environmental factors that have lead to decimation of their population size.

The snags observed in the study area were of various sizes and stages of decay/decomposition. In addition, the snags came about as a result of many biotic and abiotic factors. A relatively high proportion of the snags were produced as a result of effects of wildfire. Others were as a result of lightening, old age and diseases. Nonetheless, the Management of the National Park should make efforts to protect the snags from being exploited for firewood and other uses.

Recommendations

Based on the findings from this study the following recommendations are made:

i. The Management of the Gashaka Gumti National Park should sustain efforts in ensuring that snags are protected from being exploited for other uses by those who encroach the Park.

ii. The relatively low level of utilization of the snags by wildlife, particularly birds and reptiles indicates low population density of the species. As such, the Park Management should intensity protection measures through efficient and regular patrols in the Park.

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