Patterns of salt lick use by mammals and birds in northeastern Cambodia

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Paper submitted 15 September 2014, revised manuscript accepted 3 May 2016.

មូលន័យសង្ខេប

អំបិលធម្មជាតិ ឬខនិជលិត (mineral licks) ជាធនធានមានតម្លៃ ប៉ុន្តែមានដោយកម្រ និងដោយកន្លែងសម្រាប់សត្វព្រៃ។ សត្វមួយចំនួនធំទៅកន្លែងដីប្រាប (salt lick) ដើម្បីស៊ីដី ដែលវាទទួលបាននូវខនិជបន្ថែមជួយសម្រួលបញ្ហាក្រពះ ពោះវៀន និងទប់ស្កាត់ឥទ្ធិពល ជាតិពុលដែលមានក្នុងអាហារ។ ដូច្នេះដីប្រាបត្រូវបានចាត់ទុកជាធនធានដ៏មានប្រយោជន៍ក្នុងរបបអាហារ ជាសារធាតុចិញ្ចឹម និងសម្រាប់សុខភាពសត្វដែលប្រើប្រាស់វា។ តំបន់អភិរក្សវ៉ឺនសៃ សៀមប៉ាងនៃប្រទេសកម្ពុជាតំបន់ដែលមានតម្លៃជីវចម្រុះខ្ពស់ រាប់បញ្ចូលទាំងតំបន់ដីប្រាបមួយចំនួនផងដែរ។ តាមរយៈការដាក់ម៉ាស៊ីនថតរូបស្វ័យប្រវត្តិ (camera trap) នៅប្រាំទីតាំងដីប្រាបនៃតំបន់អភិរក្ស យើងបានស្វែងយល់ពីដំណើរនៃការប្រើប្រាស់ដីប្រាបរបស់សត្វ ក្នុងគោលបំណងវាយតម្លៃពីសារៈសំខាន់នៃធនធានទាំងនេះក្នុងស្ថានប្រព័ន្ធ។ ក្នុងរយៈពេលជាង៥៣០ថ្ងៃនៃការដាក់ម៉ាស៊ីនថតរូបស្វ័យប្រវត្តិ មានថនិកសត្វប្រាំបួនប្រភេទ និងសត្វស្លាប៣ប្រភេទត្រូវបានប្រទះឃើញនៅទីតាំងដីប្រាប ប៉ុន្តែមានតែថនិកសត្វប្រាំមួយប្រភេទប៉ុណ្ណោះ (ស្វាពីរ សត្វកកេរមួយ និងសត្វចតុប្បាទបី) ដែលត្រូវបានឃើញច្បាស់ថាបានស៊ីដីប្រាប។ អត្រាធ្វើដំណើរ (visitation rate) ប្រេកង់នៃការជួប (encounter frequency) និងរយៈពេលស្ថិតក្នុងទីតាំង គឺខុសគ្នារវាងប្រភេទទាំងនេះ ដូចគ្នាដែរចំពោះលំនាំនៃការផ្តុំជាក្រុម និងពេលវេលាទៅដីប្រាបប្រចាំថ្ងៃ។ ពួកស្វា និងខ្ទីងចំណាយពេលវែងនៅកន្លែងដីប្រាប បង្ហាញថាវាជាអេកូឡូស៊ី សំខាន់សម្រាប់ប្រភេទនេះ។ ខ្ទីង និងឈ្លូសក្រហមត្រូវបានប្រទះឃើញនៅពេលយប់នៅទីដីប្រាប ដែលនេះជាសកម្មភាពខុសប្រក្រតីរបស់ពួកវា។ ទោះបីជាសារៈប្រយោជន៍នៃការស៊ីដីមិនត្រូវបានបញ្ជាក់នៅក្នុងការសិក្សានេះ ប៉ុន្តែប្រេកង់ និងលំនាំនៃការប្រើដីប្រាបដោយក្រុមសត្វរងគ្រោះ (endangered species) និងងាយរងគ្រោះ (vulnerable species) បង្ហាញពីសារៈប្រយោជន៍ចាំបាច់នៃការលិតដី និងឆ្លុះបញ្ចាំងពីតម្រូវការចាំបាច់ឲ្យមានការខិតខំប្រឹងប្រែងការអភិរក្ស និងការការពារតំបន់ទាំងនេះ។

Abstract

Natural salt or mineral licks are valuable, yet spatially limited resources for wild animal populations. Many animals visit salt licks to engage in geophagy, which may serve to supplement mineral intake, ease gastrointestinal issues or buffer the effects of dietary toxins. This makes salt licks beneficial resources for the diet, nutrition and health of the animals that use them. Veun Sai–Siem Pang National Park in Cambodia is an area of high biodiversity value, and includes a number of salt lick sites. By placing camera traps at five salt lick locations within the conservation area, we

CITATION: King, A., Behie, A.M., Hon N. & Rawson, B.M. (2016) Patterns of salt lick use by mammals and birds in northeastern Cambodia. *Cambodian Journal of Natural History*, 2016, 40–50.

investigated the patterns of lick use by animals to assess the importance of these resources within the ecosystem. Over 530 camera-trap days, nine mammal and three bird species were found to visit the salt licks, but only six mammals (two primates, one rodent and three ungulates) clearly engaged in geophagy. Visitation rate, encounter frequency and duration of visits differed between these species, as did grouping patterns and daily timing of lick visits. Both primates and gaur spent prolonged periods of time at the salt licks, suggesting such sites are an important part of their ecology. Gaur and red muntjacs were found to be nocturnal salt lick visitors, which is atypical of their normal activity patterns. Although the functional benefits of geophagy were not confirmed by this study, the frequency and pattern of use by a variety of Endangered and Vulnerable species demonstrates the significance of the licks and highlights the need to focus conservation efforts on their protection.

Keywords

Camera trap, geophagy, mineral lick, primates, salt-lick.

Introduction

Geophagy, the deliberate ingestion of soil or clay, is a common practice for many animals. Among vertebrates, it has been documented in numerous mammals, including humans (Abrahams & Parsons, 1996), ungulates (Houston *et al.*, 2001; Ayotte *et al.*, 2008; Tobler *et al.*, 2009), primates (Krishnamani & Mahaney, 2000; Ferrari *et al.*, 2008; Rawson & Bach, 2011), bats (Bravo *et al.*, 2008; Voigt *et al.*, 2008), and rodents (Matsubayashi *et al.*, 2007a); as well as in birds (Diamond *et al.*, 1999; Gilardi *et al.*, 1999; Brightsmith & Muñoz-Najar, 2004). Several hypotheses exist to explain the functional benefit of geophagy for animals. One common proposition is that animals use geophagy to supplement minerals that are otherwise lacking in their diets (Ganzhorn, 1987; Moe, 1993; Powell *et al.*, 2009; Dudley *et al.*, 2012). Another suggestion is that geophagy can help alleviate gastrointestinal issues, such as neutralising gastric acidity (Oates, 1978), acting as an antidiarrhoeal agent (Mahaney *et al.*, 1995), or buffering the effects of dietary toxins (Johns & Duquette, 1991; Gilardi *et al.*, 1999). Geophagy might also be used to combat the negative effects of endoparasite infestations (Knezevich, 1998) or increase the pharmacological properties of certain plants (Klein *et al.*, 2008). Currently, no single theory fully explains the occurrence of geophagy; rather, it seems likely that animals consume soil for a number of reasons, which vary with diet, reproductive status, geography, environment and season (Davies & Baillie, 1988; Krishnamani & Mahaney, 2000; Voigt *et al.*, 2008).

Mammals and birds that engage in geophagy often seek out natural mineral or salt licks in their environment. Such licks are spatially-limited resources with soil, clay or ground water rich in minerals (Klaus & Schmid, 1998). They are mostly frequented by herbivorous and omnivorous species, presumably as a consequence of their predominately plant-based diets (Kreulen, 1985). Unlike carnivores that gain sodium from their prey, the intrinsically low sodium in plant tissue means phytophagous species must seek this vital nutrient elsewhere (Dudley *et al.*, 2012). As such, sodium deprivation is often considered a key driver of natural lick visitation (Holdø *et al.*, 2002; Powell *et al.*, 2009; Bravo *et al.*, 2012), but other elements such as calcium and magnesium may also constitute motivating factors (Ayotte *et al.*, 2006; Matsubayashi *et al.*, 2007b), especially in tropical environments where soils (and therefore, plants) are depleted of major cations (Emmons & Stark, 1979; Vitousek & Sanford, 1986).

Maintaining mineral homeostasis is not the only dietary challenge herbivorous species might seek to overcome by visiting natural licks. The consumption of clay has been linked to the adsorption of deleterious chemicals such as tannins, alkaloids or other plant secondary compounds (Gilardi *et al.*, 1999; Dominy *et al.*, 2004), which are especially high in mature leaves and unripe fruit (de Souza *et al.*, 2002; Bennett & Caldecott, 2012). It also adsorbs organic molecules such as fatty acids, which can decrease stomach pH and cause acidosis (Oates, 1978; Kreulen, 1985). Thus, for folivorous and frugivorous species in particular, geophagy at mineral licks may allow animals to exploit potentially harmful plants in greater quantities than they otherwise could, or consume new plant types (Gilardi *et al.*, 1999; Houston *et al.*, 2001; Dominy *et al.*, 2004). The limited nature of salt lick sites can also be advantageous for carnivores, with the increased prey density providing productive hunting grounds (Matsubayashi *et al.*, 2007a).

While mineral licks can provide benefits to animals, their use is not without risk (Klaus & Schmid, 1998). As mentioned, predators (including humans) are known to target lick sites, making visits inherently dangerous (Moe, 1993; Matsuda & Izawa, 2008). The consumption of soil at mineral licks can also expose animals to additional parasites and disease if they eat soil contaminated by faeces or urine (Henshaw & Ayeni, 1971). Animals may also be forced to leave their typical niche to access the resource such as arboreal species spending unusually prolonged periods on the ground (Klaus & Schmid, 1998). Additionally, animals that pursue these resources outside their home ranges can incur energetic costs and lose corresponding feeding and foraging time (Klein & Thing, 1989; Powell *et al.*, 2009). The fact that many species seek out these resources despite the risks and costs suggests that they are of high ecological importance (Montenegro, 2004; Blake *et al.*, 2011).

Given the potential value of lick sites to animals and the potential anthropogenic risks associated with accessing them, it is imperative that such sites are appropriately protected (Matsubayashi *et al.*, 2007b; Matsubayashi *et al.*, 2011; Molina *et al.*, 2014). However, to develop appropriate plans, it is first necessary to understand the diversity of species that use these resources as well as how they are used and their relative importance (Klaus & Schmid, 1998). While such patterns have been widely documented in Africa and the Americas, there are fewer studies from Southeast Asia (Matsubayashi *et al.*, 2007a). In this study, we use camera traps to document species diversity at five salt lick sites within Veun Sai–Siem Pang National Park (VSSPNP, northeastern Cambodia) and describe their patterns of use, with the aim of clarifying the importance of these resources from a dietary and conservation perspective.

Methods

Study Site

Veun Sai–Siem Pang National Park (14°01′ N, 106° 44′ E) consists of approximately 55,000 ha of evergreen and semi-evergreen forest located within Ratanakiri Province, Cambodia (Fig. 1). It borders the larger 320,000ha Virachey National Park and is part of the Indo-Burma Hotspot, a region of global importance for conservation due to its biodiversity values and high threat levels (Myers *et al.*, 2000). Initial surveys have reported 60 species of mammals, 130 species of birds and 60 species of reptiles within the reserve (Conservation International, unpublished data). Cambodia has two distinct seasons: the wet season, which occurs from May through October and the dry season from November to April (Thoeun, 2015). It has a mean annual temperature of 28°C (ranging from an average maximum of 38°C in April to an average minimum of 17°C in January) while the mean annual precipitation ranges from 1,200–2,000mm and is governed by monsoons (Thoeun, 2015). To date this site has been managed by the Forestry Administration with support from Conservation International.

Mineral Lick Sites

Five natural mineral licks within the VSSPNP were monitored for this study. These mineral licks represent a small subset of sites involved in a larger camera trap survey that is investigating species diversity in the region. The salt lick sites were selected based on reports from local community members that animals congregate at these locations to eat soil. Five camera traps were placed at these sites and their use as salt licks was confirmed from photographs. Location 1 was a clay bank infiltrated with the roots of trees, while locations 2, 3, 4 and 5 consisted of muddy depressions that were sometimes filled with water. All were surrounded by evergreen forest, except for location 5, which was situated within deciduous forest. All camera traps were located within largely undisturbed forest, but were in relatively close proximity to local ethnic minority villages who know and access these areas (see Fig. 1).

Camera Trap Monitoring

Reconyx PC85 RapidFire™ camera traps were used to document activity at the five mineral lick sites. One camera was placed at the edge of each lick. Cameras were triggered by integrated Passive InfraRed (PIR) motion detectors (with sensitivity on 'high') and were set to record three pictures per trigger, with a one second pause between pictures. There was no delay between trigger events. The exact time of each photograph was recorded by the cameras and logged in a database. Species were then identified from the photographs. Cameras were active from January to October 2010 and from January to April 2011. The units were checked approximately once a month for battery condition and damage as well as to download the photos. The total survey effort was 530 camera-trap days.

Data Analysis

Encounter frequencies and relative abundance indices were calculated for each species. Encounter frequencies were calculated by dividing the total number of camera-trap days (total survey effort) by the number of independent records for each species. They are thus expressed as one visit per x number of camera-trap days. Relative abundance indices were calculated by dividing the number of independent records (across all sites) by the total number of camera-trap days (total survey effort) then multiplying by 100, being expressed as the number of independent visits per 100 days. A camera-trap day