# Abundance of food plant species and food habits of *Rhinoceros unicornis* Linn. in Pobitora Wildlife Sanctuary, Assam, India

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**Abstract:** Food habits and abundance of food plant species of *Rhinoceros unicornis* in Pobitora Wildlife Sanctuary were studied from January 1999 through December 2001. Totally 32 numbers of Rhino food plants were identified, of which 15 were grasses, four shrubs, five aquatic hydrophytes and eight tree species (21 terrestrial and 11 aquatic). During the dry season, the Rhino feeds on almost 90% food items from *Hemarthria compressa*, *Arundo donax*, *Phragmites karka*, *Cerex rubro-brumee* etc. The other short grasses such as *Cynodon dactylon*, *Andropogon* ssp., *Cenchrus ciliaris, Chrysopogon aciculatus* and tender and young shoots and twigs of *Schelristechya fuesche, Saccharum spontaneum, Lagerstroemia flosreginae* etc. are consumed in limited portions. The rhino consumes 11 cultivated crops and vegetables, viz., *Ricinus communis*, *Oryza sativa, Solanum melongena, Lycopersicon esculentum, Solanum tuberosum, Brassica nigra, Luffa cylindrica, Luffa acutangula, Cucurbita moschata, Cucumis sativus* and *Ipomoea batatas* etc. Highest density of food plant species observed in the study area were *Cynodon dactylon* (167.5/m$^2$), *Hemarthria compressa* (73.75/m$^2$), *Vetiveria zizanioides* (56/m$^2$), *Saccharum ravannae* (51.5/m$^2$), *Pharagmites karka* (50.75/m$^2$), *Leersia hexandra* (46.75/m$^2$), *Brachiarea pseudointerrupta* (40/m$^2$) and *Eichhornia crassipes* (35/m$^2$).

**Keywords:** Food habit, food-plant status, Pobitora Wildlife Sanctuary, *Rhinoceros unicornis*, Rhino.

## Introduction

This study is on the food habits of the Indian Rhinoceros *Rhinoceros unicornis* and the status of food plant species in Pobitora Wildlife Sanctuary (PWS), which holds the second largest concentration of rhinos in Assam. As per 1999 census in Assam, there were about 1800 *Rhinoceros unicornis* out of which 1771 were distributed in three protected areas, viz., Kaziranga National Park (1649), Orang National Park (46), and Pobitora Wildlife Sanctuary (76). The rhinos have disappeared from the other previously known sites in Assam.

### Study Area

Pobitora Wildlife Sanctuary is located between 26°12'-26°15'N & 92°02'-92°05'E and 50km east of Guwahati City on the south bank of the river Brahmaputra within Morigoan District of Assam. Although PWS is the smallest (only 38.83km²), it supports the highest density of rhinos in comparison to other areas of Assam. The population census indicated the presence of 54 rhinos in 1987, 56 in 1993, 58 in 1995 and 76 in 1999. The unit density of rhino in PWS is 4.62/km², whereas it is 3.60/km² in Kaziranga National Park.

Pobitora Wildlife Sanctuary was a grazing reserve for cattle before 1971. During that time a few rhinos strayed out of Lawkhowa and Orang wildlife sanctuaries and gradually became resident. Two such grazing reserves comprising 38.83km² were declared as reserve forests in 1971. In 1987, Pobitora was declared a wildlife sanctuary covering an area of 16km². Presently the sanctuary is surrounded by 20 villages, the farmlands of which are frequented by rhinos. Although, a proper study of habitat characteristics of PWS is yet to be done, the gross constituents are 80% grassland, 18% woodland and only 1% wetland. According to Islam & Rahmani (2004), and Talukdar (1996), forestland covers only 2%, thatch with *Albizia* regeneration 8%, pure thatch 40%, thatch with *Phragmites karka* and *Arundo donax* etc. 20% and perennial waterlogged area 5% and swampy area 25.5%.

The climate is subtropical moist with average maximum temperature 38°C and minimum 9°C, humidity ranges between 75% and 95%. Rainfall occurs throughout the year and annual rainfall is 3000mm. Maximum rainfall is during the months of July & August and the driest month is January.

**Table 1. List of natural food plant species of rhinos in Pobitora Wildlife Sanctuary**

| | Family | Scientific Name | Local Assamese Name | Habitat types |
|---|---|---|---|---|
| 1 | Araceae | *Pistia stratiotes* Linn. | Barpuni | Aquatic |
| 2 | Asteraceae | *Enhydra fluctuans* Lour. | Helonchi | Aquatic |
| 3 | Combretaceae | *Terminalia chebula* (Gaertn.) Retz. | Silikha | Terrestrial |
| 4 | Convolvulaceae | *Ipomoea aquatica* Forssk. | Kalmou | Aquatic |
| 5 | Cyperaceae | *Cenchrus ciliaris* (Retz.) Koel | Harkata bon | Aquatic |
| 6 | Euphorbiaceae | *Antidesma ghaesembilla* Gaertn. | Helas | Terrestrial |
| 7 | Lemnaceae | *Lemna perpusilla* Torrey. | Harupuni | Aquatic |
| 8 | Lythraceae | *Lagerstroemia flosreginae* Linn. | Azar | Terrestrial |
| 9 | Marantaceae | *Schumannianthus dichotomus* (Robx.) Gangnep. | Patidoi | Aquatic |
| 10 | Moraceae | *Ficus glomerata* Roxb. | Dimoru | Terrestrial |
| 11 | Moraceae | *Ficus religiosa* Linn. | Ahot gach | Terrestrial |
| 12 | Moraceae | *Streblus asper* Lour. | Kharua gach | Terrestrial |
| 13 | Myrtaceae | *Syzygium fruticosum* DC. | Khatia Jamuk | Terrestrial |
| 14 | Poaceae | *Arundo donax* Linn. | Nal | Aquatic |
| 15 | Poaceae | *Hymenachne pseudointerrupta* Linn. | Dal ghanh | Aquatic |
| 16 | Poaceae | *Leersia hexandra* Swartz. | Erali | Aquatic |
| 17 | Poaceae | *Saccharum arundinaceum* Retz. | Meghela | Aquatic |
| 18 | Poaceae | *Bambusa tulda* Robx. | Jati banh | Terrestrial |
| 19 | Poaceae | *Cynodon dactylon* (Linn.) Pers. | Dubari Ban | Terrestrial |
| 20 | Poaceae | *Hemarthria compressa* (Linn. & F.) | Locosa ghanh | Terrestrial |
| 21 | Poaceae | *Imperata cylindrica* (Linn.) Beauv. | Ulukher | Terrestrial |
| 22 | Poaceae | *Phragmites karka* (Retz.) Trin ex Steud | Khagori | Terrestrial |
| 23 | Poaceae | *Pollinia ciliata* Trin. | Hankher | Terrestrial |
| 24 | Poaceae | *Saccharum elephantinus* Robx. | Borota kher | Terrestrial |
| 25 | Poaceae | *Saccharum ravannae* (Linn.) Murray | Ekora | Terrestrial |
| 26 | Poaceae | *Saccharum spontaneum* Linn. | Kahua | Terrestrial |
| 27 | Poaceae | *Vetiveria zizanioides* (Linn.) Nash. | Birina | Terrestrial |
| 28 | Pontederiaceae | *Eichhornia crassipes* (Mart.) Solms. | Bih meteka | Aquatic |
| 29 | Rhamnaceae | *Ziziphus jujuba* Lamk. | Bogori gach | Terrestrial |
| 30 | Solanaceae | *Solanum ferox* Linn. | Ban bengena | Terrestrial |
| 31 | Zingiberaceae | *Alpinia allughas* (Roxb.) | Toragach | Terrestrial |
| 32 | Zingiberaceae | *Costus speciosus* (Koen.) Smith. | Jom lakhuti | Terrestrial |

**Table 2. List of cultivated food plant species consumed by rhinos in Pobitora Wildlife Sanctuary**

| | Family | English / Local Assamese Name | Scientific Name |
|---|---|---|---|
| 1 | Brassicaceae | Mustard plant / Hariah | *Brassica nigra* (Linn.) Koch. |
| 2 | Convolvolaceae | Mitha alu / Ronga alu | *Ipomoea batatas* (Linn.) Lamk. |
| 3 | Cucurbitaceae | Cucumber / Tioh | *Cucumis sativus* Linn. |
| 4 | Cucurbitaceae | Pumkin / Rangalaw | *Cucurbita moschata* (Duch. & Lam) Desh. Ex. Poir. |
| 5 | Cucurbitaceae | Jika | *Luffa acutangula* (Linn.) Roxb. |
| 6 | Cucurbitaceae | Bhol | *Luffa cylindrica* (Linn.) M. Roem. |
| 7 | Euphorbiaceae | Castor plant / Ara goch | *Ricinus communis* Linn. |
| 8 | Poaceae | Rice / Dhan | *Oryza sativa* Linn. |
| 9 | Solanaceae | Tomato / Bilahi | *Lycopersicon esculentum* Mill. |
| 10 | Solanaceae | Brinjal / Bengena | *Solanum melongena* Linn. |
| 11 | Solanaceae | Potato / Alu | *Solanum tuberosum* Linn. |

## Methods

The study was carried out from January 1999 to December 2001. Various methods were applied for collecting the food habit data of *R. unicornis* and distribution status and abundance of food plant species in PWS. The methods were: (A) Food habits of rhino by direct observation and sampling of freshly deposited rhino dung-pile; and (B) Status and abundance of food plants in the study site.

### A. Food habits of rhinos

#### a. Direct observation

(i) Natural plants: To identify the food habits of rhinos in PWS, sites were monitored extensively from elephant back and the data of food plant species of rhinos were collected by the methods of Wallmo et al. (1973), Neff (1974), and Riney (1982). Apart from direct sighting of food plant species consumed, the browsing plant species were collected and identified in the field and laboratory. Herbarium sheets were prepared for reference and confirmation of identification of food plant species with Kanjilal et al. (1934, 1936, 1938, 1939), Kanjilal (1940), and Kanjilal & Bor (1940).

(ii) Cultivated food plants: During the survey, forest personnel, elephant mahouts and elderly persons from the village were interviewed to understand the overall cultivated food plant species consumed by the rhinos.

**b. Sampling rhino dung-pile:** As the consumed food plant materials were not completely digested this method was used to identify the food items, at least up to the generic level. Fresh faecal matter of rhinos was collected from dung heaps, washed with tap water, sieved and analysed as per methods of Korschgen (1980), Holechek et al. (1982), and Cooperrider (1986).

### B. Status and abundance of Food plants

To estimate frequency, density and abundance of food plant species, 50 stratified quadrates of size 1×1 m were laid

**Table 3. Distribution status of terrestrial grasses and trees consumed as food by rhinos in Pobitora Wildlife Sanctuary**

| | Scientific Name | Frequency (%) | Density / m² | Abundance |
|---|---|---|---|---|
| 1 | *Cynodon dactylon* | 70 | 167.50 | 239.28 |
| 2 | *Saccharum ravannae* | 30 | 51.50 | 171.66 |
| 3 | *Phragmites karka* | 30 | 50.75 | 169.16 |
| 4 | *Hemarthria compressa* | 47 | 73.75 | 163.88 |
| 5 | *Imperata cylindrical* | 25 | 39.50 | 158.00 |
| 6 | *Vetiveria zizanioides* | 40 | 56.00 | 140.00 |
| 7 | *Pollinia ciliata* | 5 | 5.00 | 100.00 |
| 8 | *Saccharum spontaneum* | 5 | 5.00 | 100.00 |
| 9 | *Costus speciosus* | 10 | 3.25 | 32.50 |
| 10 | *Sachumannianthus dichotomous* | 5 | 1.50 | 30.00 |
| 11 | *Alpinia allughas* | 15 | 2.35 | 15.66 |
| 12 | *Lagerstroemia flosreginae* | 5 | 0.05 | 1.00 |
| 13 | *Solanum ferox* | 5 | 0.05 | 1.00 |
| 14 | *Ziziphus jujuba* | 5 | 0.05 | 1.00 |

**Table 4. Distribution status of aquatic vegetation consumed as food by rhinos in Pobitora Wildlife Sanctuary**

| | Scientific Name | Frequency (%) | Density / m² | Abundance |
|---|---|---|---|---|
| 1 | *Arundo donax* | 5 | 25.00 | 500.00 |
| 2 | *Eichhornia crassipes* | 10 | 35.00 | 350.00 |
| 3 | *Leersia hexandra* | 15 | 46.75 | 311.66 |
| 4 | *Lemna perpusilla* | 5 | 15.00 | 300.00 |
| 5 | *Hymenachne pseudointerrupta* | 15 | 40.00 | 266.66 |
| 6 | *Pistia stratiotes* | 5 | 10.00 | 200.00 |
| 7 | *Ipomoea aquatica* | 15 | 15.00 | 100.00 |
| 8 | *Cenchrus ciliaris* | 15 | 9.25 | 61.66 |
| 9 | *Enhydra fluctuans* | 5 | 2.50 | 50.00 |

randomly in PWS. In all the successive quadrates, each plant species was separately counted. Herbarium sheets for particular plants were prepared only once even if they occurred in more than one quadrate. The required parameters were estimated with the formulae used by Krebs (1985), Arumugam (1998), and Southwood & Henderson (2000).

## Results

### Food habits of rhino:

(a) Natural plants: The Great Indian One-horned Rhinoceros consumed 32 naturally occurring plant species - 15 grasses, four shrubs, eight trees and five aquatic hydrophytes (Table 1). Out of these plants, 21 species were terrestrial and 11 were aquatic. During the dry season, about 90% of rhino food constituted *Hemarthria compressa*, *Arundo donax*, *Phragmites karka*, *Cerex rubro-brumee* etc. Other short grasses such as *Cynodon dactylon*, *Andropogon* ssp., *Andropogon aciculatus* and *Cenchrus ciliaris* tender and young shoots and twigs of *Saccharum spontaneum*, *Lagerstroemia flosreginae*, etc. were consumed to a limited extent.

(b) Cultivated food items: Rhinos in Pobitora also consumed 11 different cultivated food plants (Table 2), which grow in the periphery of the sanctuary during dry (winter) and pre-monsoon seasons. Plants such as *Ricinus communis*, *Oryza sativa*, *Solanum melongena*, *Lycopersicon esculentum*, *Solanum tuberosum*, *Cucumis sativus*, *Luffa acutangula*, *Luffa cylindrica*, *Cucurbita moschata*, *Brassica nigra* and *Ipomoea batatas* were common in and around the boundary of the study area. The rhinos frequently raided the village farmlands for food.

### Status of food plant species

Grass species recorded in high density are *Cynodon dactylon* (167.5/m²), *Hemarthria compressa* (73.75/m²), *Vetiveria zizanioides* (56/m²), *Saccharum ravannae* (51.5/m²), *Pharagmites karka* (50.75/m²), *Leersia hexandra* (46.75/m²), *Hymenachne pseudointerrupta* (40/m²) and Water Hyacinth-*Eichhornia crassipes* (35/m²) (Table 3 & 4).

The *Cynodon dactylon*, *Hemarthria compressa* and *Imperata cylindrica* (sprouting stages) are the most commonly used food plants of the rhinos at PWS. Entire portion of these plants above the ground level was consumed. Only small twigs and younger leaves of *Vetiveria zizanioides*, *Saccharum ravannae*, *Phragmites karka*, *Imperata cylindrica*, *Pollinia ciliata*, *Saccharum spontaneum*, *Costus speciosus*, *Alpinia allughas*, *Ziziphus jujuba*, *Lagerstroemia flosreginae*, *Sachumannianthus dichotomus* and *Arundo donax* were consumed.

According to the mahouts of Pobitora, during high-flood, rhinos consume the leaves of *Ficus religiosa*, *Schelristechya fuesche*, *Syzygium fruticosum*, *Fleminigia* ssp., *Bambusa tulda* and *Thysanolaena agrostis*. Rhinos swim out to eat grass tops sticking out of water. The top of these tall grasses and reeds are not soft and not preferred under normal conditions. Rhinos and Water Buffaloes go under water and eat the submerged grasses too. When they surface they have mouthfuls of vegetation, chew and swallow above the water level. Rhinos sometimes enter paddy fields around the sanctuary and eat sprouting plants. Observations on feeding by night-raiding rhinos were not made.

## Discussion

Grasses play a major role in the food requirements of the Indian Rhino to maintain its body weight of over 200kg. It needs approximately 150kg of fodder per day (Dutta 1991). The Indian Rhinoceros grazes during early morning, late afternoon and through the night. During heavy floods and dry

season, rhinos consume Water Hyacinth (*Eichhornia crassipes*) that occasionally causes purging. Rhinos normally eat the tender sprouts of tree species and sprouting stages of tall grasses such as *Saccharum ravannae*, *Phragmites karka* and *Arundo donax*. Our Observations are similar to Dutta (1991). Food intake, about 90% comes from *Hemarthria compressa*, *Arundo donax*, *Pharagmites karka*, *Cerex-rubro brumee* during the dry season as these species occur in the habitat in abundance at this time. Rhinos eat floating and creeping plants species such as *Ipomea aquatica*, *Enhydra fluctuans*, *Pistia stratiotes*, *Lemna perpusilla*, *Eichhornia crassipes*, also, which grow in marshy areas. Food habits of rhinos differ locality-wise. Verbanacious shrubs are rejected as food in PWS, but in Kaziranga they eat the apical parts of verbanacious shrub, *Lippia geminata*.

Although grasses constitute the favorite fodder, the Indian Rhino is not averse to eating occasional delicacies like brinjal, capsicum and tomato; they avoid legumes like peas. During the season when food is plenty, rhinos do not eat bushy vegetation even if the saplings are invitingly young and tender. Within the surroundings of permanent forest camps inside a protected area, very often discarded mature seeds attached to parts of vegetables such as gourd, pumpkin etc. grow to new plants; such plants seem to be relished by the rhinos (Dutta 1991, Vigne & Martin 1994). During short periods of high-flood, when there is food scarcity, rhinos generally congregate on high land where limited number of natural plants other than grasses and herbs are available. At this time the rhinos are observed to eat the bark of trees, cane, leaves of *Flemingia* sp. and *Albizzia* sp. (Dutta 1991). During the time of food scarcity, rhinos eat whatever vegetation is available, and local forest guards report that *Ficus religiosa*, *Zizyphus jujuba*, *Lagerstroemia flosreganae* are also eaten. The animal is known to eat pulses, mustard plants, potatoes, gourd and other vegetables (Dutta 1991; Villagers pers. inter. 2001).

Monsoon flood regularly affects the distribution pattern of rhino food-plant species in the sanctuary every year (Forest Department Officials pers. comm. 2001). The other major problem of the rhinos at Pobitora is the invasion of grasslands by woodland species like *Albizia procera*. This serious threat needs to be controlled by uprooting the exotic alien species. Presently, poaching and encroaching are other major problems adding to scarcity of food plant species.

**Conservation problems and recommendation**

1. Grazing by 2500-3000 cattle every day is one of the major problems in PWS. This drives 20-25 rhinos every night to raid croplands as far as 7km away in the adjacent villages.

2. Illegal collection of thatch grasses, firewood and fishing by people throughout the year.

3. Entire area gets inundated by high-flood during the monsoon and consequent silt deposit. The swamp areas and 'beels' are gradually becoming shallow. A few highland platforms need to be created to protect the rhino population during flood.

In view of the incremental rise in rhino population density, it may become necessary to increase the cover area of PWS, where the highest rhino density in relation to total area is noted. Regular conflicts between the immigrant ethnic groups and forest officials, have to be resolved in the interest of rhino conservation, by joint efforts of people and the government.

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