

Diet and Nurturing Behavior of Asian Elephant (*Elephas maximus* Linn.) in Some Selected Habitat of Northern Odisha, India

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ABSTRACT

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The Asian elephant's (*Elephas maximus*) nurturing behavior with food fondness was deliberate in Northern land of Odisha during February 2017 to December 2019. The foremost objective of the existing survey is to document the forage plant species intake by Asian elephants. Though the respective study area harbors a noble quantity of plant types, only 146 species were identified as fodder plants which have been consumed by elephants in this survey period. The food path of elephant was identified as branch flouting, bark flaking, twig infringement, flower tugging and stem twisting and uprooting in different regions of study area throughout altered seasons. Adaptation of principally browsing strategy with that of grazing around the year was related to seasonal variation of diet plants as per the availability. This survey elucidates that total 146 species of forest plants belongs to 55 Families and 19 species of non-forest plant belongs to 8 Families. The extensive consumable plant species by elephants i.e. *Aegle marmelos* (Bel), *Careya arborea* (Kumbhi), *Bauhinia racemosa*, *Kydia calycina*, *Bauhinia vahli* (Siali), *Helicteres isora* (Orola), *Madhuca indica* (Mahulo), *Zizyphus mauritiana* (BaraKoli), *Artocarpus heterophyllus* (Panasa), *Shorea robusta* (Sal), *Limonia acidissima* (Kendu), *Smilax zeylanica* (Muturi) and *Dioscorea* species. They were affectionate fruits of *Mangifera indica* and *Artocarpus heterophyllus* in summer, bamboo during rainy and *Madhuca indica* during winter. Minuscular analysis of elephant's dung showing an extraordinary variation in typical dicot- monocot proportion recommended that the food plant collection of elephant was extremely seasonal and unscrupulous.

Keywords : Odisha, fodder, seasonal, dicot- monocot

I. INTRODUCTION

Elephants regarded as mega herbivores and consumed diet upto 150kg/day as per body mass (Samansiri and Weerekoon 2007, Mohapatra *et al* 2012). The carrying capacity of elephant directly implies the availability of plant species and this factor create a suitable habitat for mega herbivore. In their seasonal movement, elephants travel long distances, which offers them clear ecological reimbursements. Various Factors as nutritive value and toxicity are basic key which influences the selection of nutrition plants by elephants. Every animal has definite biological characteristics and ecological demands of their existence. At birth, an elephant weights approximately 90 kilograms and stands at a height of approximately 1 meter. The average adult elephant stands 2.2 meters to 3.4 meters at the shoulder. It weighs between 2000 and 4990 kilograms. Elephants do not have specialized diets and browse a variety of plants. An ideal elephant habitat should harbors variety of natural food species. Elephants may spend up to 11-19 hours a day eating, depending on the habitat and season. Different plant types contribute to different percentages of their diets (Pradhan *et al* 2015). However the elephant is a non-ruminant, it is still capable of exploiting microbial action for the digestion of cellulose in its caecum and colon (Clemens and Maloiy 1982). Due to this massive food requirement, the elephant cannot afford to be a selective feeder like minor herbivores, and thus consumes enormous quantities of available forage without paying much attention to and spending energy on collection. The trunk acts as an efficient screening and scooping instrument to distinguish between palatable and non-palatable forage. The fast rate of passage through the gut enables consumption of large quantities of forage (Roy 2009). Distribution of trees is also a crucial element of forest diversity and attracts many species to inhabit (Sarvanan *et al* 2019).

Frequent studies on the diet plants of Asian and African elephants have shown that the magnitudes of

innumerable varying plant species in the diet observed from one province to another (Sukumar 1989, Sukumar 1990, Pradhan *et al* 2015). The present study aim to document fodder species in Northern land of Odisha which is a major migratory route and home for resident Asian elephant.

II. MATERIALS AND METHODOLOGY

A. Study Area

Odisha is located on the east coast of the Indian subcontinent having 155,707 km² geographical areas which constitutes 4.74% area of the country. It lies in the tropical zone between Latitudes of 17°47'N and 22°34'N and longitudes of 81°22'E and 81°22'E. Physiographically, the state can be divided into four regions, *viz.*, Eastern Ghats, Northern, Plateau, Coastal Plains and Central Tableland. The northern land of Odisha owing its peculiar geographical location and wide range of physical range, embraces a diversified floristic composition and consequently a vast economic potential. This land harbors tropical moist deciduous forest comprises mainly, Sal, Asan, Teak, Piasal, Arjun, bamboo etc. This northern land surrounded by neighboring state of West Bengal and Jharkhand. The current study has been surveyed in five selected forest land of Kuldiha (21°25'57"N, 86°36'58"E), Nilagiri (21°28'59"N, 86°46'06"E), Krishnachandrapur (21°49'42"N, 86°52'28"E), Badampur (21°44'21"N, 86°59'42"E), and Bhattchar (21°54'59"N 59'13"E). The temperature ranges from 38°C to 41°C during summer and in winter the temperature goes below 7°C. The annual rainfall measure in Baleswar about 1565mm/year and Mayurbhanj is comes under North central plateau agro climatic region, recorded about 1648.20mm/year. The northern land harbors magnificent number of flora and fauna.

B. Methodology

We used both direct and indirect techniques during this research project during 2017 to 2019.

Direct Sighting

By direct sighting in above said forest land and searched for elephant for about 8-10 hours, from early in morning and in the afternoon before dusk. The movement of elephant herd sighted by (Nikon 8 x42) binocular. Physical features such as size, shape of the holes in the ears, back posture, cuts, swellings on the body, or the form of the tail are used to identify the animal (Moss, 2001), Goswamy *et al.* 2007). After a herd of elephants has left, all the plants on which they fed are collected. I follow an elephant's food trail and collect all the plants on which the elephant feeds, footprints, fresh dung, and feeding signs were used to track the movement of elephants at night to the locations at which they had been spotted the previous day. Plant Species among the fodders were identified by some field guides, Forest Survey of India reports, and Botanical survey of India and by Botanist of Biodiversity board, Odisha and by plant Taxonomist. A sample of fruit, bark, stem and leaf is fed during direct observation.

Dung Pile Examination

Fresh dung piles were examined to identify the fruit species consumed by the elephants. Undigested fruit remains such as seed, pericarp were vividly identified the fruit species ingested.

III. RESULT AND DISCUSSION

A total 146 species of forest plants (tree, herbs and shrubs) belongs to 55 Families and 19 species of non-forest plant (vegetables and fruits) belongs to 8 Families were recorded along with the part consumed by the Asian elephant. This study indicated that the variation among dicotyledons with monocotyledons is 93% and 7%, which indicates the elephants are fond of dicotyledons plant species.

According to observations, bulls used their tusks to remove bark, whereas cows wrapped their trunk around tree branches and knocked the tree down so the bark could be removed. They also investigated for fruits of different species to fulfill their nutrient requirements. They were so fond of mango, jackfruit, Blackberry that often they assembled to eat the ripe fruits. Elephant showed desire love for *Madhuca indica* (Mahula). Primarily they consume grasses by the arrival of rains, bamboos, ripe palm fruit, roots and various tubers. They broke the whole preferences plants like (*Dalbergia sisso*, *Aegle marmelos*, *Petrocarpus marsupium*), peeled off bark of few plant species (*Shorea robusta*, *Terminalia arjuna* and *Ficus bengalensis*), uprooted the plants with their trunks and forefoot, ate succulent grass species along with their roots and consumed extensive amounts of mixed vegetation, including trees, grasses and shrubs.

Monsoon crop raiding from connecting area by elephants during March-April and November – December was a collective surveillance. The significant crops include *Zea mays* (Maka), *Oryza sativa*, *Musa paradisiaca* (Kadali) and *Saccharum officinarum*. Elephants frequently leave the forest to feed adjacent villages' crops, generally in the evenings and at night. They travelled to tribal settlements in the late evening and returned to their jungle camps before morning. Crop raiding by the same herd or single bull has been documented on several occasions. Ingesting of warehoused crops, Salts, rice beer and country made liquor from forest nearby houses by the elephants remained similarly recounted. The dung boli analysis showed the presence of eight fruit seeds of mango, jackfruit, bel, jastimadhu, mahula, palm, tamarind and blackberry.

Asian Elephants are acknowledged to feed on a widespread diversity of fodder plant species (Sukumar 1990, Samansiri 2007, Mohapatra *et al* 2012,) it is assumed that the digestive system of elephants are very poor so they integrate about 50% of the food

what they consumed. When I microscopically scrutinized elephant's dung boli I found the same result. More than 150 kg/day plant based diets required to fulfill elephant's nutrient deficiency. In 1976 Guy recorded 133 fodder species belonging to 41 families and 95 genera at Reserve of Sengwa of Zimbabwe. Sukumar in 1990 recorded 112 plant species, out of which 25 species (85%) as elephants foraging behavior. According to Joshi and Singh (2008), elephants consume 74% of tree species, 14% of grass species, 8% of shrub species, and 4% of climber species out of a total of 262 flowering plant species in Rajaji National Park., Mohapatra *et al* 2012 reported 71 plant species consumed by elephant in Kuldiha Wildlife Sanctuary, Odisha. Pradhan *et al* surveyed 110 plant species in Satkosia Tiger reserve and recorded that feeding of grass species (55%) was topped the list as compared to shrubs (5%), herbs (3%) and trees (37%). In the dry season of Manas National Park shows Elephants have been discovered to eat 18 different flowering plant types (Lahkar *et al.*, 2007).

The Chunati Wild Life Sanctuary in Bangladesh has 143 species of plants, Only 17 of them are used by elephants, accounting for 12% of the total number of plants in the area. (IUCN, 2007). The nutrition and foraging ecology of Asian elephants were also studied in the Shangyong National Natural Reserve in Xishuangbanna, China, and it was discovered that they ate 106 plant types. (Chen *et al.*, 2006). In Udawalawe National Park elephants were gathered in grassland i.e 69.7%, elephants were assembled in grassland during the day period and in the eve they move to seasonal vegetation habitat (Alahakoon *et al* 2017).

IV. CONCLUSION

Tree species are an important dietary component of Asian elephants, according to an existing study. The deviation in elephants' food choices is highly opportunistic and seasonal, according to the average dicot and monocot ratio obtained by direct and dung analyses.

Table 1 : Forest Plant Species

Scientific Name	Local Name	Parts Consumed	Family
<i>Aegle marmelos</i>	Belu	L,F	Rutaceae
<i>Citrus SP.</i>	Jungli Lemon	L,F	
<i>Chloroxylon swietenii</i>	Bheru	L	
<i>Limonia acidissima</i>	Kaitho	L,F	
<i>Antidesma ghaesembilla</i>		L	Phyllanthaceae
<i>Antidesma acidum</i>		L	
<i>Artocarpus heterophyllus</i>	Panasa	L,S,F	Moraceae
<i>Buchanania lanzan</i>	Bana Badam	L,F	Anacardiaceae
<i>Buchanania cochinchinensis</i>		L	
<i>Briedelia retusa</i>		L	Phyllanthaceae
<i>Acacia ferruginea</i>		L,S	Fabaceae
<i>Albizia odoratissima</i>	Tantra	Young Shoots, S	
<i>Bauhinia vahli</i>	Siali lata	L	

<i>Butea Superba</i>	Budhuli	L	
<i>Butea monosperma</i>	Palasho	L	
<i>Dalbergia sissoo</i>	Sisoo	L	
<i>Dalbergia latifolia</i>		L,S	
<i>Dalbergia paniculata</i>	Barbakuliaa	L, S	
<i>Desmodium oojeinensis</i>	Bandhana	L,S	
<i>Cassia fistula</i>	Sunari	L	
<i>Caesalpinia digyna</i>		L	
<i>Cajanus cajan</i>	Harada	L,S,B,F	
<i>Millettia racemosa</i>	Gaharani lata	L	
<i>Mimosa pudica</i>	Lajkuli Lata	Entire plant	
<i>Pterocarpus marsupium</i>	Bijaa	L	
<i>Senegalia catechu</i>	Khairo	L	
<i>Soymida febrifuga</i>	Ruhini	L	
<i>Senna siamea</i>	Chakunda	F	
<i>Petrocarpus marsupium</i>	Piasal	L,S,B	
<i>Pongamia pinnata</i>		L	
<i>Tamarandus indica</i>	Tentuli	L,S	
<i>Vigna SP.</i>	Bana Biri	L	
<i>Arthraxon hispidus</i>		Entire plant	Poaceae
<i>Arundinella setosa</i>		Entire plant	
<i>Arundinella pumila</i>		Entire plant	
<i>Bothriochloa bladhii</i>		Entire Plant	
<i>Bothriochloa pertusa</i>		Entire Plant	
<i>Brachiaria ramosa</i>		Entire Plant	
<i>Brachiaria reptans</i>		Entire Plant	
<i>Chloris barbata</i>		Entire Plant	
<i>Chrysopogon fulvus</i>		Entire Plant	
<i>Coix lacryma-jobi</i>		Entire Plant	
<i>Cymbopogon flexuosus</i>		Entire Plant	
<i>Cyrtococcum patens</i>		Entire Plant	
<i>Oryza sativa</i>	Dhana	Entire Plant	
<i>Saccharum officinarum</i>	Aakhu	Entire Plant	
<i>Sehima nervosum</i>		Entire Plant	
<i>Setaria palmifolia</i>	Talo Ghaso	Entire Plant	

<i>Thysanolaena maxima</i>	Phuljharu	Entire Plant	
<i>Themeda triandra</i>		Entire Plant	
<i>Vetiveria zizanioides</i>		Entire Plant	
<i>Zea mays</i>	Makka	Entire Plant	
<i>Alstonia scholaris</i>	Genduli	L	Apocynaceae
<i>Cosmostigma cordatum</i>		L	
<i>Holarrhena pubescens</i>	Kureyi	L	
<i>Ichnus frutocarpescens</i>	Paso	L	
<i>Chionanthus ramiflorus</i>		L	Oleaceae
<i>Anogeissus latifolia</i>		L	Combretaceae
<i>Combretum decandrum</i>		L	
<i>Getonia floribunda</i>		L	
<i>Croton persimilis</i>		L	Euphorbiaceae
<i>Cleistanthus collinus</i>	Gurikanthi	L	
<i>Mallotus Philippensis</i>	Kmalagundi	L	
<i>Macaranga peltata</i>		L,S	
<i>Diospyros montana</i>		Entire Plant	Ebenaceae
<i>Diospyros melanoxylon</i>	Kendu	L,F,B	
<i>Dillenia pentagyna</i>	Raii	L, F	Dilleniaceae
<i>Ficus benghalensis</i>	Bara	L,F	Moraceae
<i>Ficus glomerata</i>	Dumburi	L,F	
<i>Streblus asper</i>	Jeleri	L	
<i>Flacourtia indica</i>		L,S	Salicaceae
<i>Ipomoea aquatica</i>	Kalama	Entire Plant	Convolvulaceae
<i>Litsea glutinosa</i>		L	Lauraceae
<i>Litsea monopetala</i>		L	
<i>Memecylon umbellatum</i>	Nireso	L	Melastomataceae
<i>Annona squamosa</i>	Aato	L,S,F	Annonaceae
<i>Miliusa tomentosa</i>		L	
<i>Polyalthia cerasoides</i>		L, S	
<i>Ochna obtuse</i>		Leaf	Ochnaceae
<i>Helicteres isora</i>	Orola	L	Malvaceae
<i>Sterculia villosa</i>	Odal	L	
<i>Bombax ceiba</i>	Simili	L	
<i>Kydia roxburgianna</i>	Ban Kapasia	L	
<i>Grewia tiliaefolia</i>	Dhamana	L	
<i>Pterospermum acerifolium</i>	Kanaka Champa	L	
<i>Ixora perviflora</i>	Lohajhuri	L	
<i>Ixora pavetta</i>	Telkurma	L	
<i>Mitragyna parvifolia</i>	Kadamba	L,S	
<i>Pavetta indica</i>		L	
<i>Psychotria adenophylla</i>		L	

<i>Gardenia gummifera</i>		L	
<i>Morinda citrifolia</i>	Noni	L	
<i>Tamilnadia uliginosa</i>		L	
<i>Schleichera oleosa</i>	Kusumo	L,S	Sapindaceae
<i>Shorea robusta</i>	Salo	L,S,R,B	Dipterocarpaceae
<i>Sterospermum colais</i>		L	Bignoniaceae
<i>Syzygium cumini</i>	Jambu	L, S, B,F	Myrtaceae
<i>Ziziphus jujube</i>	Bar Koli	L,S,F	Rhamnaceae
<i>Ziziphus oenoplia</i>	Char koli	L,S,F	
<i>Ziziphus xylopyrus</i>	Ghonta	L,S,F	
<i>Casearia tomentosa</i>		L	Salicaceae
<i>Casearia graveolens</i>		L	
<i>Flacourtia jangomas</i>	Bhaincha	L	
<i>Madhuca indica</i>	Mahulo	L,F	Sapotaceae
<i>Manilkara zapota</i>	Sapeta	L,S,F	
<i>Xantolis tomentosa</i>	Jasti Madhu	L,R	
<i>Smilax zeylanica</i>	Muturi	L	Smilacaceae
<i>Leea indica</i>	Pitchkundi	L	Solanaceae
<i>Ampelocissus latifolia</i>	Pani Lahara	L	Vitaceae
<i>Cissus quadrangulari</i>	Hadabhanga	L	
<i>Lannea coromandelica</i>	Moi	L	Anacardiaceae
<i>Mangifera indica</i>	Ambo	L,S,F	
<i>Semecarpus anacardium</i>	Valia	L	
<i>Phoenix acaulis</i>		L	Arecaceae
<i>Borassus flabellifer</i>	Talo	L,R,F	
<i>Cocos nucifera</i>	Nadia	L,F	
<i>Areca catechu</i>	Gua	L,F	
<i>Anogeissus latifolia</i>	Dhaure	L, Shoots	Combretaceae
<i>Combretum decandrum</i>	Atundi	L	
<i>Terminalia arjuna</i>	Arjun	L,S	
<i>Terminalia tomentosa</i>	Asana	L	
<i>Terminalia blirica</i>	Bahada	L,S, F	
<i>Terminalia chebula</i>	Harada	L,S, F	
<i>Careya arborea</i>	Kumbhi	L	Lecythidaceae
<i>Phyllanthus emblica</i>	Anala	L, S, F	<u>Phyllanthaceae</u>
<i>Cordia macleodii</i>	Koksa Dumuar	L	Boraginaceae
<i>Caesalpinia cucullata</i>	Pursinga	L	Caesalpiniaceae
<i>Alpinia Sp.</i>	Kiya	Entire Plant	<u>Zingiberaceae</u>
<i>Ananas comosus</i>	Sapuri	Entire Plant	Bromeliaceae

<i>Cyperus Sp.</i>	Mutha ghaso	Entire Plant	Cyperaceae
<i>Symplocos racemosa</i>	Budhikunthi	L	Symplocaceae
<i>Homalium nepalense</i>		L	Flacourtiaceae
<i>Typha Sp.</i>		L	Typhaceae
<i>Eria bambusifolia</i>	Parijata	Entire Plant	<u>Orchidaceae</u>
<i>Dendrobium Sp.</i>	Parijata	Entire Plant	
<i>Miliusa tomentosa</i>	Gadha Sal	L	Annonaceae
<i>Costus speciosus</i>	Baspara Ghaso	Entire Plant	<u>Costaceae</u>
<i>Garuga pinnata</i>		L	Burseraceae
<i>Protium serratum</i>		L	
<i>Michelia champaca</i>	Champa	L	<u>Magnoliaceae</u>
<i>Musa paradisiaca</i>	Kadali	Entire Plant	Musaceae
<i>Dillenia indica</i>	Oou	L,F	<u>Dilleniaceae</u>
<i>Syzygium samarangense</i>	Jamrul	L,S,F	<u>Myrtaceae</u>
<i>Anacardium occidentale</i>	Kaju	L,S,F,B	Anacardiaceae
<i>Loranthus Sp.</i>	Malango	Entire Plant	Loranthaceae

Table 2 - Non Forest Plant

Scientific Name	Common Name	Parts Consumed	Family
<i>Solanum melongena</i>	Baigan	Entire Plant	Solanaceae
<i>Solanum lycopersicum</i>	Tomato	Entire Plant	
<i>Solanum tuberosum</i>	Alu	Entire Plant	
<i>Benincasa hispida</i>	Kakharu	Entire Plant	<u>Cucurbitaceae</u>
<i>Cucumis sativus</i>	Kakudi	F	
<i>Citrullus lanatus</i>	Tarbujho	Entire Plant	
<i>Cephalandra indica</i>	Kunduri	Entire Plant	
<i>Cucurbita pepo</i>	Boitalu	Entire Plant	
<i>Luffa acutangula</i>	Janhi	Entire Plant	
<i>Lagenaria siceraria</i>	Lau	Entire Plant	
<i>Trichosanthes dioica</i>	Potolo	Entire Plant	
<i>Brassica oleracea</i>	Bondha Kobi	Entire Plant	Brassicaceae
<i>Raphanus sativu</i>	Mula	Entire Plant	
<i>Spinacia oleracea</i>	Palango Sago	Entire Plant	<u>Amaranthaceae</u>
<i>Abelmoschus esculentus</i>	Bhendi	Entire Plant	Malvaceae
<i>Daucus carota</i>	Gajar	Entire Plant	<u>Apiaceae</u>
<i>Psidium guajava</i>	Pijuli	Entire Plant	Myrtaceae
<i>Vigna mungo</i>	Biri	Entire Plant	Fabaceae
<i>Vigna unguiculata</i>	Naduka	Entire Plant	

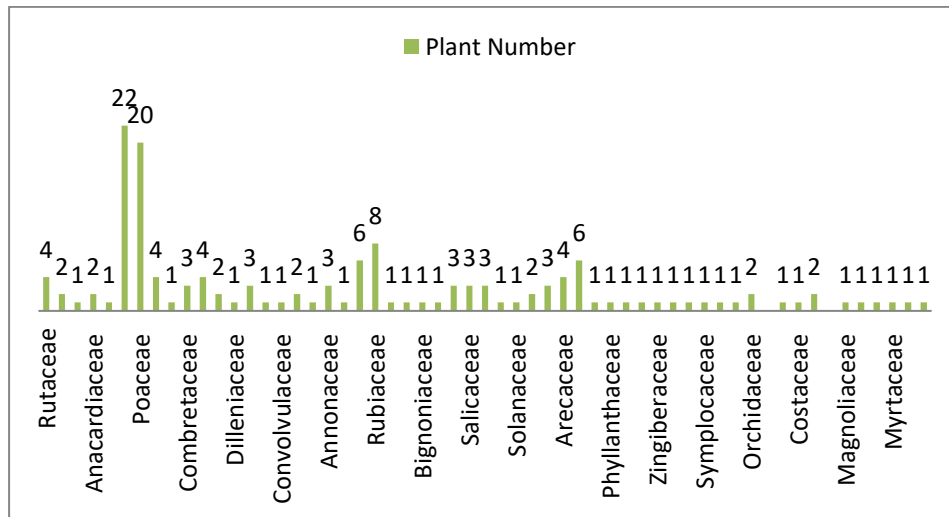


Fig.01- Family of plant indicate the total numbers of plant species

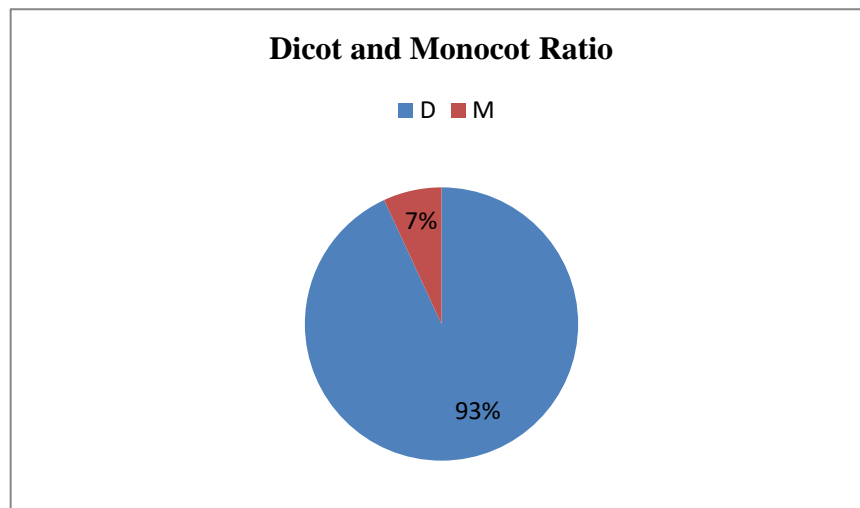


Fig.02- Dicotyledons and monocotyledons ratio

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