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Thrips (Insecta: Thysanoptera) fauna of Kaziranga National Park, Assam

Thrips are one of the economically important insects, belonging to the order Thysanoptera, having fringes on the wings with the body size ranging from 0.5 to 16 mm (ref. 1). The small body size of thrips is compensated by their appreciable breeding potential and quick development with at least 10–12 generations per year, especially under the tropical climate². They display a great diversity in terms of feeding habit and habitat. With their piercing and sucking mouth parts, thrips feed on pollen grains, plant cell sap, fungal spore and mycelia, and even soft-bodied insects. Such feeding habits enable them to choose microhabitats like flowers, leaf sheaths, underneath barks, plant galls, leaf litters, etc. By virtue of their association with plants, some species could attain the status of primary pests, gall makers and vectors of plant diseases, besides pollinators^{3–5}. The world record indicates occurrence of about 5864 species of thrips⁶, of which nearly 700 species are known from the Indian subcontinent⁷ and 205 from NE India⁸. However, only 16 species have been collected so far from Assam, including a new species *Neodixothrips*

assamensis Sen & Muraleedharan⁹. The present report highlights thrips collections exclusively from the biodiversity-rich Kaziranga National Park (KNP), Assam.

KNP is one of the oldest national parks of Assam and it is a UNESCO World Heritage site, known for the Great Indian one-horned Rhinoceros. It covers an area of approximately 430 sq. km along the mighty Brahmaputra river in the north and the Karbi Anglong hills in the South, and is situated between 26°30'–26°45'N lat. and 93°08'–93°36'E long. (ref. 10). It is one of the largest tracts of protected land in the sub-Himalayan belt. The park is located in the Indo-Malaya ecozone; the dominant biomes of the region include Brahmaputra valley semi-evergreen forests of the tropical and subtropical moist broadleaf forest biome and a frequently flooded variant of the Terai–Duar savanna and grasslands of the tropical and subtropical grasslands, savannas, and shrub land biome. The park experiences summer, monsoon and winter seasons. The dry and windy summer extends approximately from February to May with the

mean maximum and minimum temperatures of 37°C and 7°C respectively. The hot and humid monsoon persists from June to October. During the southwest monsoon, the park receives an average rainfall of 2220 mm/annum. The winter, extending from November to February, is mild and dry, with the mean maximum and minimum of 25°C and 5°C respectively^{10,11}. The climatic conditions and varied vegetation make the park conducive for thrips to survive. They are abundant during March, April, September and October, which in turn, has enabled thrips collection during the above months. Specimens were sampled at random from grasses, plant gall, leaf litter and foliages of different plants following the standard techniques³. The collected specimens were balsam-mounted by conventional methods⁸ and subsequently identified with standard keys available for the Indian fauna^{12–15}. The permanent slides of the specimens are deposited in the PUSA collections, Indian Agricultural Research Institute, New Delhi. Prior permission was obtained from the Principal Chief Conservator of Forest/Wildlife, Assam to collect the specimens

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Table 1. List of thrips collected from Kaziranga National Park, Assam

Thrips species	Date of collection	Habit and habitat	Geographical distribution
Suborder: Terebrantia; family: Thripidae			
1. <i>Anaphothrips sudanensis</i> Trybom, 1911	11-04-11	Pest	Cosmopolitan (worldwide in tropical and subtropical countries)
2. <i>Ayyaria chaetophora</i> Karny 1927	18-11-12	Flowers	Japan, India, Indonesia
3. <i>Chaetanaphothrips orchidii</i> (Moulton, 1907)	07-05-11	Free foliage	Cosmopolitan
4. <i>Craspedothrips minor</i> (Bagnall, 1921)	11-03-11	Free foliage	Cosmopolitan
5. <i>Dendrothrips stannardi</i> (Ananthkrishnan, 1957)	12-11-11	Free foliage	India (Manipur, Nagaland, Tamil Nadu (TN)); China
6. <i>Dichromothrips nakahari</i> Mound, 1976	13-11-12	Orchid flowers	Cosmopolitan
7. <i>Dichromothrips smithi</i> (Zimmerman, 1900)	12-03-12	Orchid flowers	India (TN); Malaya, Taiwan, Solomon Island
8. <i>Frankliniella intonsa</i> (Trybom, 1895)	10-03-11	Flowers	Cosmopolitan
9. <i>Fulmekiola serrata</i> (Kubos, 1893)	11-03-12	Free foliage	India (Manipur, Arunachal Pradesh); Indonesia (Java)
10. <i>Hydatothrips aureus</i> Bhatti, 1973	22-3-11	Grass	China, India
11. <i>Lefroyothrips lefroyi</i> (Bagnall, 1913)	7-11-11	Flowers	India (Assam, Himachal Pradesh (HP), Uttar Pradesh (UP), West Bengal (WB), Nagaland); Japan, Indonesia, Taiwan, China
12. <i>Megalurothrips distalis</i> (Karny 1913)	18-03-12	Leguminous flowers	India, Indonesia, Sri Lanka, Philippines, Korea, Fiji
13. <i>M. mucunae</i> (Priesner, 1938)	10-05-11	Flowers	Cosmopolitan
14. <i>M. peculiaris</i> (Bagnall, 1918)	08-05-11	Flowers	India (Bihar, UP, Delhi, Karnataka, TN); Nepal, Bangladesh, Philippines, China
15. <i>M. typicus</i> Bagnall, 1915	18-03-11	Flowers	India, Bhutan, Indonesia, Malaysia, Guam, Mariana Island, Taiwan, Saipan, Philippines, Guanda
16. <i>M. usitatus</i> (Bagnall, 1913)	15-11-12	Flowers	India, Bangladesh, Thailand, Vietnam, Japan, Philippines, Sri Lanka, Malaysia, Indonesia, New Guinea, China, Japan, Kiribati, Samoa, Australia
17. <i>Microcephalothrips abdominalis</i> (Crawford, 1910)	22-03-11	Flowers of Asteraceae	Cosmopolitan
18. <i>Mycterothrips setiventris</i> (Bagnall, 1918)	17-11-11	Free foliage	India, China
19. <i>Neohydatothrips raniae</i> Bhatti, 1967	18-11-12	Flowers	Delhi, UP (endemic species)
20. <i>Rhamphothrips parviceps</i> Hood, 1919	15-03-12	Grass	India (Delhi, Madhya Pradesh (MP), Manipur, Maharashtra, TN, WB); China, Taiwan
21. <i>Sciothrips cardamomi</i> (Ramakrishna, 1935)	20-03-11	Pest	India, China, Costa Rica
22. <i>Scirtothrips dorsalis</i> Hood, 1919	07-11-11	Pest	South Africa, Oriental region
23. <i>Stenchaetothrips biformis</i> (Bagnall, 1913)	22-03-11	Paddy seedlings	India (Manipur, Nagaland); Asian countries, Europe, South America
24. <i>Taeniothrips major</i> Bagnall, 1916	20-03-12	Flowers	Korea, India, China, Nepal
25. <i>Thrips andrewsi</i> (Bagnall, 1921)	12-05-11	Flowers	India (Chandigarh, HP, Punjab, UP, WB); Japan, China
26. <i>T. coloratus</i> Schmutz, 1913	15-05-11	Weed	India (Meghalaya, WB, Punjab, HP); Sri Lanka, Pakistan, Thailand, Laos, Indonesia, Korea, China, Japan
27. <i>T. flavidulus</i> (Bagnall, 1923)	22-11-12	Weed	Hill ranges of India, Sri Lanka, Korea, Japan
28. <i>T. flavus</i> Schrank, 1776	20-03-11	Flowers	India, Japan, Korea, Iran, Europe, North America
29. <i>T. hawaiiensis</i> (Morgan, 1913)	11-11-11	Flowers (polyphagous)	Cosmopolitan
30. <i>T. kodaikanalensis</i> Ananthkrishnan and Jagadish, 1966	14-11-11	Free foliage	Endemic species (hill ranges of South and NE India)
31. <i>Thrips (Isothrips) orientalis</i> (Bagnall, 1915)	16-11-12	Free foliage	Oriental region
32. <i>T. palmi</i> Karny, 1925	15-05-11	Pest	Cosmopolitan
33. <i>T. tabaci</i> Lindeman, 1889	25-11-12	Pest	Cosmopolitan
34. <i>Astrothrips tumiceps</i> (Karny, 1923)	18-11-12	Grass	All over India, Indonesia

(Contd)

Table 1. (Contd)

Thrips species	Date of collection	Habit and habitat	Geographical distribution
35. <i>Helionothrips kadaliphilus</i> (Ramakrishna and Margabandhu, 1931)	12-05-11	Pest	New Guinea, South India, NE India
36. <i>H. parvus</i> Bhatti, 1968	20-03-12	Free foliage	UP, Manipur, endemic species
37. <i>Monilothrips kempii</i> Moulton, 1929	24-11-12	Grass	India (Manipur, WB, UP, TN); South Africa, North America
38. <i>Panchaethrips indicus</i> Bagnall, 1912	22-11-12	Pest	India, China, Bangladesh, Thailand
39. <i>Phibalothis peringueyi</i> (Faure, 1925)	22-03-11	Grass	India – widely distributed; SE Asia, South Africa
40. <i>Retithrips syriacus</i> (Mayet, 1890)	15-11-11	Pest	All over India, Afghanistan, Bangladesh; Pakistan, Sri Lanka
41. <i>Rhipiphorothis cruentatus</i> Hood, 1919	17-05-11	Free foliage	All over India; Afghanistan; Bangladesh, Pakistan, Sri Lanka
42. <i>Selenothrips rubrocinctus</i> (Giard, 1901)	12-05-11	Free foliage	India (Andaman and Nicobar, Kerala, WB, Manipur, Assam); Philippines, Taiwan; Burma, Thailand, Bangladesh; Sri Lanka, Honduras, Mexico
43. <i>Zaniothis ricini</i> Bhatti, 1967	15-03-11	Free foliage	India, China
Suborder: Tubulifera, family: Phlaeothripidae			
44. <i>Androthrips flavitibia</i> Moulton, 1932	14-11-11	Predator	Dehradun, Manipur, Assam
45. <i>A. ramachandrai</i> Karny, 1926	22-11-12	Predator	India (Arunachal Pradesh, Kerala and TN); China
46. <i>Araeothrips longisetis</i> Ananthakrishnan, 1976	09-11-11	Free foliage	Western Ghats, MP, NE India (endemic species)
47. <i>Araeothrips vama</i> Muraleedharan, 1982	09-11-11	Free foliage	Endemic species to NE India
48. <i>Arrhenothrips longisetis</i> Sen, 1977	12-08-12	Free foliage	WB, Manipur, Nagaland (endemic species)
49. <i>Bamboosiella nayari</i> (Ananthakrishnan, 1958)	12-11-12	Grass	India, China
50. <i>Crotonothrips cacharensis</i> Muraleedharan & Sen, 1978	09-11-11	Gall	India (Assam and Tripura) (endemic species)
51. <i>Dexiothis madrasensis</i> (Ananthakrishnan, 1964)	21-03-11	Leaf litter (mycophagus)	India (TN, Kerala, Manipur); Indonesia, Malaysia
52. <i>Dolichothis indicus</i> (Hood, 1919)	14-03-12	Weed	Assam, Karnataka, Manipur, TN, endemic species
53. <i>D. montanus</i> Ananthakrishnan, 1964	12-03-12	Weed	Hill ranges of India (endemic species)
54. <i>Ecacanthothrips tibialis</i> (Ashmead, 1905)	20-11-12	Leaf litter (mycophagus)	India, China, Japan, Vietnam, Indonesia, Malaysia, New Zealand, Australia
55. <i>Eurynchothis ordinarius</i> (Hood, 1919)	11-05-11	Free foliage	India – Palghat (recorded for the first time from NE India). Endemic species
56. <i>Gigantothrips elegans</i> Zimmerman, 1900	08-08-12	Free foliage	All over India. World – Philippines, Japan, Indonesia (Java), Thailand
57. <i>G. tibialis</i> (Bagnall, 1921)	14-05-11	Free foliage	India (Kerala, Manipur and TN); China, Sri Lanka
58. <i>Gynaikothrips bengalensis</i> Ananthakrishnan, 1973	22-03-11	Gall	India – Assam, Manipur, WB (endemic species)
59. <i>G. cecidii</i> Ananthakrishnan, 1968	18-11-12	Gall	TN, MP (endemic species)
60. <i>G. uzeli</i> Zimmerman, 1900	22-11-12	Gall	India (TN, Odisha, WB); Algiers, Java, Madeira, Canary Islands, Cuba, Puerto Rico and Florida
61. <i>Haplothis ceylonicus</i> Schmutz, 1913	07-11-11	Weed	India (TN, WB, Manipur, Nagaland); Sri Lanka, Java, Sumatra
62. <i>H. ganglbaueri</i> Schmutz, 1913	17-11-12	Weed	India – widely distributed. World – Sri Lanka, Pakistan, Java, Solomon Island, Philippines, Iran, Japan, Pakistan, Indonesia, Egypt
63. <i>H. gowdeyi</i> (Franklin, 1908)	15-11-11	Flower (polyphagus)	China, Japan, Latin America, India
64. <i>H. longisetosus</i> Ananthakrishnan, 1955	12-11-11	Grass	Manipur, Kerala and TN (endemic species)

(Contd)

SCIENTIFIC CORRESPONDENCE

Table 1. (Contd)

Thrips species	Date of collection	Habit and habitat	Geographical distribution
65. <i>Haplothrips (Haplothrips) montanus</i> (Ananthakrishnan & Jagadish, 1970)	18-11-12	Flower	Nagaland, WB (endemic species)
66. <i>H. tenuipennis</i> Bagnall, 1918	14-08-12	Weed	India – widely distributed. World – Bangladesh, Java, China, Indonesia
67. <i>Hoplandrothrips flavipes</i> Bagnall, 1923	23-11-12	Decaying palm leaves and banana sheaths (mycophagus)	Western Ghats, NE India; Kenya, Philippines, Hawaii, China, Solomon Island, Europe
68. <i>Hoplothrips fungosus</i> Moulton, 1928	22-11-12	Dry and decaying twigs (mycophagus)	India (TN, Karnataka, WB); Japan, China
69. <i>Leeuwenia ananthakrishnani</i> Varatharajan and Sen, 2000	18-03-11	Free foliage (oak leaf)	Manipur, Nagaland (endemic species)
70. <i>L. karniyana</i> Priesner, 1925	15-03-12	Free foliage	India (Assam, Kerala); China
71. <i>Liophloeothrips amoenus</i> Ananthakrishnan, 1966	13-11-11	Gall	Maharashtra, Manipur (endemic species)
72. <i>L. pavetae</i> Ananthakrishnan and Jagadish, 1969	10-05-11	Gall	Eastern Ghat, Manipur and Nagaland (endemic species)
73. <i>Liothrips aequilus</i> Ananthakrishnan and Jagadish, 1969	13-05-11	Gall	Andhra Pradesh (AP), Nagaland (endemic species)
74. <i>L. associatus</i> Ananthakrishnan and Jagadish, 1969	11-08-12	Gall	TN (endemic species)
75. <i>L. himalayanus</i> Ananthakrishnan & Jagadish, 1970	11-08-12	Gall	Darjeeling, Manipur, Nagaland (endemic species)
76. <i>L. infrequens</i> Muraleedharan and Sen, 1979	14-05-11	Gall	Tripura (endemic species)
77. <i>L. mohanrami</i> Bhatti <i>et al.</i> , 2006	11-08-12	Gall	Manipur, Nagaland (endemic to NE India)
78. <i>L. morulus</i> Ananthakrishnan and Jagadish, 1970	11-05-11	Gall	WB (endemic species)
79. <i>L. ramakrishnae</i> Ananthakrishnan and Jagadish, 1969	13-08-12	Gall	TN (endemic species)
80. <i>Membrothrips indicus</i> (Hood, 1919)	12-05-11	Flowers	Manipur, TN, WB (endemic species)
81. <i>Mesothrips ambasensis</i> Muraleedharan and Sen, 1981	15-11-12	Gall	Tripura (endemic species)
82. <i>M. extensivus</i> Ananthakrishnan & Jagadish, 1969	22-11-12	Gall	Kerala, Meghalaya, TN (endemic species)
83. <i>M. lividicornis</i> (Karny, 1923)	23-11-12	Gall	Oriental region
84. <i>Mimothrips orientalis</i> Ananthakrishnan, 1949	16-11-12	Free foliage	TN, New record for NE India
85. <i>Neodixothrips assamensis</i> Sen and Muraleedharan, 1976	14-05-11	Gall	Assam (endemic species)
86. <i>Tylothrips indicus</i> Sen & Muraleedharan, 1977	18-11-12	Free foliage	NE India (endemic species)
87. <i>Xylaplothrips pusillus</i> Ananthakrishnan & Jagadish, 1969	17-03-11	Dry leaves and twigs (mycophagus)	AP, Kerala, Manipur, WB (endemic species)
88. <i>Dinothrips sumatrensis</i> Bagnall, 1908	18-11-12	Dry twigs (mycophagus)	India (TN, Karnataka, Kerala, Tripura, Meghalaya, Arunachal Pradesh), World – Sumatra, Sri Lanka, Bhutan, Malaysia, Java, Borneo
89. <i>Elaphrothrips curvipes</i> Priesner, 1929	14-11-11	Dry twigs (mycophagus)	India – WB, Meghalaya, Manipur; Thailand, Malaya, Sumatra Laos, Java, Bhutan
90. <i>E. denticollis</i> (Bagnall, 1914)	23-11-12	Dry leaves (mycophagus)	India (Kerala, TN, Karnataka and Tripura); Sri Lanka, Burma, Malaysia, Java and Borneo
91. <i>E. greeni</i> (Bagnall, 1914)	24-11-12	Dry leaves (mycophagus)	India (TN, Kerala, Karnataka); Indonesia, Sri Lanka, China
92. <i>E. procer</i> (Schmutz, 1913)	13-11-11	Dry twigs and palm leaf sheath (mycophagus)	India (TN, Kerala, Karnataka, Maharashtra, Manipur, Assam); Sri Lanka, Laos
93. <i>E. spiniceps</i> Bagnall, 1932	23-11-12	Dry twigs (mycophagus)	India (Kathgodam, Manipur); Myanmar, Taiwan, Java, Japan, China
94. <i>Meiothrips nepalensis</i> Kudo and Ananthakrishnan, 1974	22-11-12	Dry leaves and sheaths (mycophagus)	India (Manipur and Nagaland), Nepal (endemic species)
95. <i>Nesothrips brevicolis</i> (Bagnall, 1914)	12-03-12	Dry twigs (mycophagus)	India (Kerala, MP); Taiwan, Japan
96. <i>N. lativentris</i> (Karny, 1913)	10-05-11	Dry twigs and leaves (mycophagus)	India – WB, Tripura, Arunachal Pradesh, Assam. World – Mauritius, Virgin Islands, Philippines, Hawaii, Japan, Queensland, Jamaica, Guam

from KNP during the period April 2011 to March 2013.

The survey undertaken at KNP revealed the occurrence of 96 species of thrips in 55 genera under two major families, viz. Thripidae and Phlaeothripidae of the two respective suborders, namely Terebrantia and Tubulifera. Of the 53 species of phlaeothripids of the latter suborder, the subfamily Phlaeothripinae had a representation of 44 species in 21 genera and the fungal spore feeding Idolothripinae with 9 species in 4 genera. On the other hand, among the 43 species of terebrantians, 33 were represented by members of the subfamily Thripinae in 21 genera and the rest 10 species under 9 genera by Panchaethripinae. It is significant to note that of the 96 thrips collected in the present study, 32 are endemic. Further, the collection record has also indicated the occurrence of 22 species of free-living foliage feeders, 19 anthophilous forms, 17 gall makers, 14 mycophagous thrips, 8 pests, 7 each of weed and grass inhabitants, besides 2 predatory thrips (Table 1). Thus the field survey has not only reflected the diverse feeding habits and habitats of thysanopterans, but also signifies the faunal similarity to some extent with that of the Western Ghats of South India (60%), the Great Himalayan ranges of North India (35%) and also with Southeast Asia (20%) at varying levels, besides having fauna of its own along with a few cosmopolitan species. Because KNP is located in the Indo-Malaya ecozone, there is a possibility of sharing the fauna with SE Asia owing to proximity. Therefore, thrips of KNP can be considered as a mixed composition of diverse species from different geographic regions. Table 1 provides the systematic inventory of 96 species of thrips collected from KNP during the survey period 2011–2012.

Although the maiden attempt at KNP indicated the presence of 96 species of thrips with diverse feeding habits and habitats, a concentrated survey in future would certainly reveal existence of many more species. Occurrence of 80 species of phytophagous thrips inhabiting the flowers, foliage, gall, grass and the weed in comparison to 14 mycophagous and two predatory forms reflects appreciably the rich floristic composition of KNP. The faunal similarity of KNP with that of Western Ghats, Himalayan ranges and SE Asia highlights that it can be considered as a safe zone for thrips conservation as the study site comes under the protective area of the local administration.

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Microforaminiferal linings from the upper part of the Upper Disang Formation at Gelmoul quarry, Churachandpur, Imphal valley and their bearing on palaeoenvironment

Diverse microforaminiferal linings with a few pollen, spores and dinoflagellate cysts in the upper part of the Upper Disang Formation, Disang Group are

reported in the present study. Five main types of microforaminiferal linings are encountered in the preparations by standard palaeo-palynological analysis. These

are biserial type II, planispiral type III, planispiral type IV, trochospiral type I and trochospiral type II. A warm, shallow marine environment of deposition for the