

SUPPLEMENTARY MATERIAL

Understanding global patterns of insectivorous bat dietary research

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Supplementary material 1: Trends and distribution of dietary research regionally

Research patterns were analysed for nine regions, in 84 countries and three islands (New Caledonia, Northern Mariana Islands, and Puerto Rico). The majority of publications were from North America ($n = 116$; 26.79% of all publications, 2 countries), followed by Europe ($n = 97$; 22.40%; 25 countries).

Geographical region	Number of publications	Percentage of publications (%)	Number of countries with studied
Africa	52	12.01	18
East Asia	24	5.54	4
Europe	97	22.40	25
Latin America	58	13.39	15
North America	116	26.79	2
North Asia	5	1.15	3
Oceania	30	6.93	3
South and Southeast Asia	36	8.31	9
West and Central Asia	15	3.46	5

Supplementary material 2: Study areas in dietary research

Certain publications reported the diet information but did not apparently state on habitat type, comprising the publications that used the specimen from museum ($n = 10$; 2.29%) and did not state habitat type ($n = 8$; 1.83%).

Most publications in natural areas were in North America ($n = 71$; 27.95% of all publications in natural areas), followed by Latin America ($n = 47$; 18.50%), and Europe ($n = 39$; 15.35%). Agroecosystems and industrial made up the majority of publications in Europe ($n = 25$; 30.86%), followed by North America ($n = 24$; 29.63%), and Africa ($n = 11$; 13.58%). For studies round buildings, the majority of publications were in Europe ($n = 34$; 38.64% of all publications round buildings), followed by North America ($n = 23$; 26.14%), and Africa ($n = 16$; 18.18%) (Fig. 4. B.). The proportion of publications among three habitats across all of regions was significantly different ($F = 54.8$; $df = 16$; $p < 0.001$).

Geographical region	Natural areas		Agroecosystems		Buildings	
	Number of publications	Percentage of publications (%)	Number of publications	Percentage of publications (%)	Number of publications	Percentage of publications (%)
Africa	21	8.27	11	13.58	16	18.18
East Asia	18	7.09	1	1.23	4	4.55
Europe	39	15.35	25	30.86	34	38.64
Latin America	47	18.50	4	4.94	4	4.55
North America	71	27.95	24	29.63	23	26.14

Geographical region	Natural areas		Agroecosystems		Buildings	
	Number of publications	Percentage of publications (%)	Number of publications	Percentage of publications (%)	Number of publications	Percentage of publications (%)
North Asia	2	0.79	-	-	1	1.14
Oceania	23	9.06	4	4.94	1	1.14
South and Southeast Asia	24	9.45	10	12.35	4	4.55
West and Central Asia	9	3.54	2	2.47	1	1.14

Supplementary material 3: Research by taxa

Publications were recorded for 19 bat families 374 species, though three (0.71%) publications did not clearly identify bat species. Vespertilionidae made-up the majority of publications (n = 275; 44.00%), followed by Rhinolophidae (n = 72; 11.52%), Molossidae (n = 68; 10.88%), Hipposideridae (n = 48; 7.68%), and Phyllostomidae (n = 38; 6.08%). For four bat families (Cistugidae, Craseonycteridae, Furipteridae, and Natalidae) we found a single publication (0.16%) for each bat family.

Five regions (Africa, Europe, Latin America, North America, and Oceania) included research for all bat families present in those regions. Four regions (all except Latin America) have the majority of their publications on Vespertilionidae (n = 105; 37.10% in North America, n = 81; 28.62% in Europe, n = 25; 8.83% in Africa, and n = 17; 6.01% in Oceania), and the majority of publications in Latin America were on Phyllostomidae (n = 37; 94.87%). East Asia, North Asia, and West and Central Asia have the majority of their publications on Vespertilionidae (n = 14; 4.95%, n = 5; 1.77%, and n = 11; 3.89% respectively), for South and Southeast Asia had the highest publications on Hipposideridae (n = 18; 37.50%). The proportion of publications among all bat families across geographical regions was significantly different ($\chi^2 = 870$; $df = 144$; $p < 0.001$).

Bat family	Number of publications	Percentage of publications (%)
Cistugidae	1	0.16
Craseonycteridae	1	0.16
Emballonuridae	24	3.84
Furipteridae	1	0.16
Hipposideridae	48	7.68
Megadermatidae	17	2.72
Miniopteridae	29	4.64
Molossidae	68	10.88
Mormoopidae	12	1.92
Mystacinidae	3	0.48
Myzopodidae	3	0.48
Natalidae	1	0.16
Noctilionidae	6	0.96
Nycteridae	19	3.04
Phyllostomidae	38	6.08
Rhinolophidae	72	11.52
Rhinopomatidae	5	0.80
Thyropteridae	2	0.32
Vespertilionidae	275	44.00

Bat family	Number of publications (Percentage of publication, %)									
	Africa	East Asia	Europe	Latin America	North America	North Asia	Oceania	South and Southeast Asia	West and Central Asia	
Cistugidae	1(100)	-	-	-	-	-	-	-	-	-
Craseonycteridae	-	-	-	-	-	-	5(20.83)	1(100)	-	-
Emballonuridae	6(25.00)	2(8.33)	-	3(12.50)	-	-	-	6(25.00)	-	2(8.33)
Furipteridae	-	-	-	1(100)	-	-	8(16.67)	-	-	-
Hipposideridae	16(33.33)	3(6.25)	-	-	-	-	5(29.41)	18(37.50)	-	3(6.25)
Megadermatidae	2(11.76)	-	-	-	-	-	6(20.69)	10(58.82)	-	-
Miniopteridae	12(41.38)	3(10.34)	4(13.79)	-	-	-	6(8.82)	2(6.90)	-	2(6.90)
Molossidae	20(29.41)	-	4(5.88)	9(13.24)	17(25.00)	-	-	8(11.76)	-	4(5.88)
Mormoopidae	-	-	-	11(91.67)	1(8.33)	-	3(100)	-	-	-
Mystacinidae	-	-	-	-	-	-	-	-	-	-
Myzopodidae	3(100)	-	-	-	-	-	-	-	-	-
Natalidae	-	-	-	1(100)	-	-	-	-	-	-
Noctilionidae	-	-	-	6(100)	-	-	-	-	-	-
Nycteridae	18(94.74)	-	-	-	-	-	-	-	-	1(5.26)
Phyllostomidae	-	-	-	37(94.87)	2(5.13)	-	-	-	-	-
Rhinolophidae	15(20.00)	10(13.33)	25(33.33)	-	-	-	4(5.33)	14(18.67)	-	7(9.33)
Rhinopomatidae	1(20.00)	-	-	-	-	-	-	1(20.00)	-	3(60.00)
Thyropteridae	-	-	-	2(100)	-	-	-	-	-	-
Vespertilionidae	25(8.83)	14(4.95)	81(28.62)	12(4.24)	105(37.10)	5(1.77)	17(6.01)	13(4.59)	-	11(3.89)

Supplementary material 4: Insectivorous bat species with studies

Out of 19 families, six families (Cistugidae, Craseonycteridae, Furipteridae, Mystacinidae, Myzopodidae, Noctilionidae) have very low species diversity (1-2 species in family), which all families except Furipteridae and Mystacinidae had report the diet information on all of species (100% of all species in the IUCN Red List), consisting of Cistugidae (2 species), Craseonycteridae (1 species), Myzopodidae (2 species), and Noctilionidae (2 species) (Table 4; Fig. 3. A.). For the other 13 families; seven families are highly diverse on global scale, but have a low number of species studied (< 40% of all species) comprising Vespertilionidae (155 species; 33.70%), Phyllostomidae (58 species; 28.29%), Molossidae (33 species; 27.50%), Hipposideridae (28 species; 29.17%), Rhinolophidae (36 species; 39.13%), Emballonuridae (21 species; 38.89%), and Miniopteridae (11 species; 36.67%) (Table 4; Fig. 3. A.). Vespertilionidae (50 species; from a total of 143 bat species within the study) had the highest number of species studied in a single publication, followed by Phyllostomidae (20 species; 13.99%), Molossidae (17 species; 11.89%), and Hipposideridae (14 species; 9.79%). Of the 374 species, only six species (1.61%) have more than 20 publications, comprising *Eptesicus fuscus* (n = 43 publications), *Myotis lucifugus* (n = 30), *Lasiurus borealis* (n = 27), *Pipistrellus pipistrellus* (n = 26), *Rhinolophus ferrumequinum* (n = 24), and *Lasiurus cinereus* (n = 21).

Bat family	Number of species studied	Percentage of species studied (%)
Cistugidae	2	1.40
Craseonycteridae	1	0.70
Emballonuridae	11	7.69
Furipteridae	1	0.70
Hipposideridae	14	9.79
Miniopteridae	6	4.20
Molossidae	17	11.89
Mormoopidae	3	2.10
Myzopodidae	1	0.70
Natalidae	1	0.70
Nycteridae	1	0.70
Phyllostomidae	20	13.99
Rhinolophidae	13	9.09
Rhinopomatidae	2	1.40
Vespertilionidae	50	34.96

Vespertilionidae was only family distributed in all the regions, and three regions had over a hundred species, with South and Southeast Asia having the highest richness (140 species; 30.43% of all species in Vespertilionidae), followed by Africa (104 species; 22.61%), and East Asia (101 species; 21.96%). Vespertilionids were the majority species studied in seven regions (Africa, East Asia, Europe, North America, North Asia, Oceania, and West and Central Asia), the greatest number of species studied was at Africa (31 species studied; 29.81% of all species in Vespertilionidae sort by region), followed by North America (29 species; 85.29%), Europe (28 species; 71.79%), Oceania (27 species, 47.37%), and West and Central Asia (24 species; 35.82%). The highest proportion of species studied in Latin America were Phyllostomids (56 species studied; 27.32% of all species were in Phyllostomidae), for South and in Southeast Asia the majority of species studied were Rhinolophids (19 species; 35.85%).

Bat family	Number of species studied (Percentage of species studied, %)									
	Africa	East Asia	Europe	Latin America	North America	North Asia	Oceania	South and Southeast Asia	West and Central Asia	
Cistugidae	2(100)	-	-	-	-	-	-	-	-	-
Craseonycteridae	-	-	-	-	-	-	-	1(100)	-	-
Emballonuridae	2(18.18)	1(50.00)	-	8(36.36)	-	-	5(33.33)	6(42.86)	1(50.00)	-
Furipteridae	-	-	-	1(50.00)	-	-	-	-	-	-
Hipposideridae	10(37.04)	2(20.00)	-	-	-	-	6(35.29)	13(22.41)	1(10.00)	-
Megadermatidae	1(50.00)	-	-	-	-	-	1(100)	2(66.67)	-	-
Miniopteridae	6(30.00)	2(66.67)	1(100)	-	-	-	4(66.67)	1(12.50)	1(50.00)	-
Molossidae	17(38.64)	-	1(100)	5(11.11)	4(57.14)	-	7(38.89)	1(6.25)	1(20.00)	-
Mormoopidae	-	-	-	8(72.73)	1(100)	-	-	-	-	-
Mystacinidae	-	-	-	-	-	-	1(50.00)	-	-	-
Myzopodidae	2(100)	-	-	-	-	-	-	-	-	-
Natalidae	-	-	-	1(9.09)	-	-	-	-	-	-
Noctilionidae	-	-	-	2(100)	-	-	-	-	-	-
Nycteridae	6(42.86)	-	-	-	-	-	-	-	-	1(100)
Phyllostomidae	-	-	-	56(27.32)	3(50.00)	-	-	-	-	-
Rhinolophidae	14(41.18)	8(34.78)	4(80.00)	-	-	-	1(20.00)	19(35.85)	5(55.56)	-
Rhinopomatidae	1(25.00)	-	-	-	-	-	-	1(50.00)	2(40.00)	-
Thyropteridae	-	-	-	1(20.00)	-	-	-	-	-	-
Vespertilionidae	31(29.81)	14(13.86)	28(71.79)	19(20.43)	29(85.29)	15(35.71)	27(47.37)	17(12.14)	24(35.82)	-

Supplementary material 5.1 and 5.2. : Threatened Species

Most species studied were in the LC category by the IUCN (n = 357; 64.79% of all publications), followed by NT (n = 76; 13.79%), VU (n = 59; 10.71%), EN (n = 38; 6.90%), DD (n = 19; 3.45%), and CR (n = 2; 0.36%). The proportion of publications among all threat categories was significantly different ($\chi^2 = 957$; df = 5; $p < 0.001$) (Table 5).

Overall LC species had the highest number of publications in all regions, the majority of publications of LC species were in North America (n = 93 publications; 25.27% of all publications in LC), followed by Europe (n = 82; 22.28%), Latin America (n = 53; 14.40%), and Africa (n = 50; 13.59%). NT species were largely in publications in Europe (n = 31; 38.27% of all publications in NT) and North America (n = 22; 27.16%) only East Asia had no publications which included NT bat species. VU species had diet publications in all the regions, and more than ten publications in North America (n = 17; 28.81% of all publications in VU), Oceania (n = 12; 20.34%), and Europe (n = 11; 18.64%). Most of publications of EN species were in North America (n = 33; 86.84% of all publications of EN species). DD species had few publications within seven regions except North America and North Asia, and the major publication was at Africa (n = 6; 31.58% of all publications for DD species). CR species had two publications which were both in Oceania (Fig. 4. C.). The proportion of publications for all threat categories across regions was significantly different ($\chi^2 = 165$; df = 40; $p < 0.001$).

The majority of species studied were LC (306 species; 45.33% of all species in IUCN RedList sorted by threat category), followed by NT (22 species; 30.14%), VU (18 species; 23.68%), DD (17 species; 7.56%), EN (10 species; 17.86%), and CR (1 species; 6.67%), these species (*Miniopterus fuliginosus*, *Rhinolophus cornutus*, and *Rhinolophus thailandensis*) were included in DD/unreviewed due to insufficient information (Table 5). The majority of bat species (143 species; 38.23% of all species studied) had a single publication on diet research, which the species in LC category (108 species; 75.52%) was highest number of species studied in a single publication, followed by DD (11 species; 7.69%), NT (10 species; 6.99%), EN (8 species; 5.59%), and VU (6 species; 4.19%). Six species have more than 20 publications, five species were classed as LC (*Eptesicus fuscus*, *Lasiurus borealis*, *Lasiurus cinereus*, *Pipistrellus pipistrellus*, and *Rhinolophus ferrumequinum*), while *Myotis lucifugus* is EN.

LC category has greatest number of species studied in each region, and the majority of the species studied was in Latin America (89 species; 33.84% of all species in IUCN sort by threatened category in each region), followed by Africa (79 species studied; 48.17%), South and Southeast Asia (48 species studied; 26.97%), Oceania (41 species; 51.90%). For the other threatened categories, a maximum of under ten species were studied in each the region.

Threatened Species 5.1

Threatened category	Number of publications (Percentage of publication, %)									
	Africa	East Asia	Europe	Latin America	North America	North Asia	Oceania	South and Southeast Asia	West and Central Asia	
DD	6(31.58)	2(10.53)	1(5.26)	5(26.32)	-	-	1(5.26)	2(10.53)	2(10.53)	2(10.53)
LC	50(13.59)	20(5.43)	82(22.28)	53(14.40)	93(25.27)	4(1.09)	20(5.43)	32(8.70)	14(3.80)	14(3.80)
NT	7(8.64)	-	31(38.27)	7(8.64)	22(27.16)	2(2.47)	1(1.23)	5(6.17)	6(7.41)	6(7.41)
VU	6(10.17)	3(5.08)	11(18.64)	1(1.69)	17(28.81)	2(3.39)	12(20.34)	4(6.78)	3(5.08)	3(5.08)
EN	-	1(2.63)	-	1(2.63)	33(86.84)	-	1(2.63)	2(5.26)	-	-
CR	-	-	-	-	-	-	2(100)	-	-	-

Threatened Species 5.2.

Threatened category	Number of species studied (Percentage of species studied, %)									
	Africa	East Asia	Europe	Latin America	North America	North Asia	Oceania	South and Southeast Asia	West and Central Asia	
DD	5(8.33)	2(11.76)	1(33.33)	5(7.35)	-	-	1(10.00)	2(3.17)	1(7.69)	1(7.69)
LC	79(48.17)	21(20.39)	24(82.76)	89(33.84)	29(76.32)	12(32.43)	41(51.90)	48(26.97)	29(38.67)	29(38.67)
NT	4(33.33)	-	5(100)	5(20.83)	3(75.00)	2(28.57)	1(16.67)	6(28.57)	3(50.00)	3(50.00)
VU	4(33.33)	1(50.00)	4(44.44)	1(4.35)	2(66.67)	1(33.33)	7(53.85)	3(13.04)	3(60.00)	3(60.00)
EN	-	3(37.50)	-	1(6.25)	3(100)	-	1(14.29)	2(22.22)	-	-
CR	-	-	-	-	-	-	1(25.00)	-	-	-