Supporting Online Material for

Global Warming, Elevational Range Shifts, and Lowland Biotic Attrition in the Wet Tropics

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This PDF file includes:

Supporting Online Material

Figures

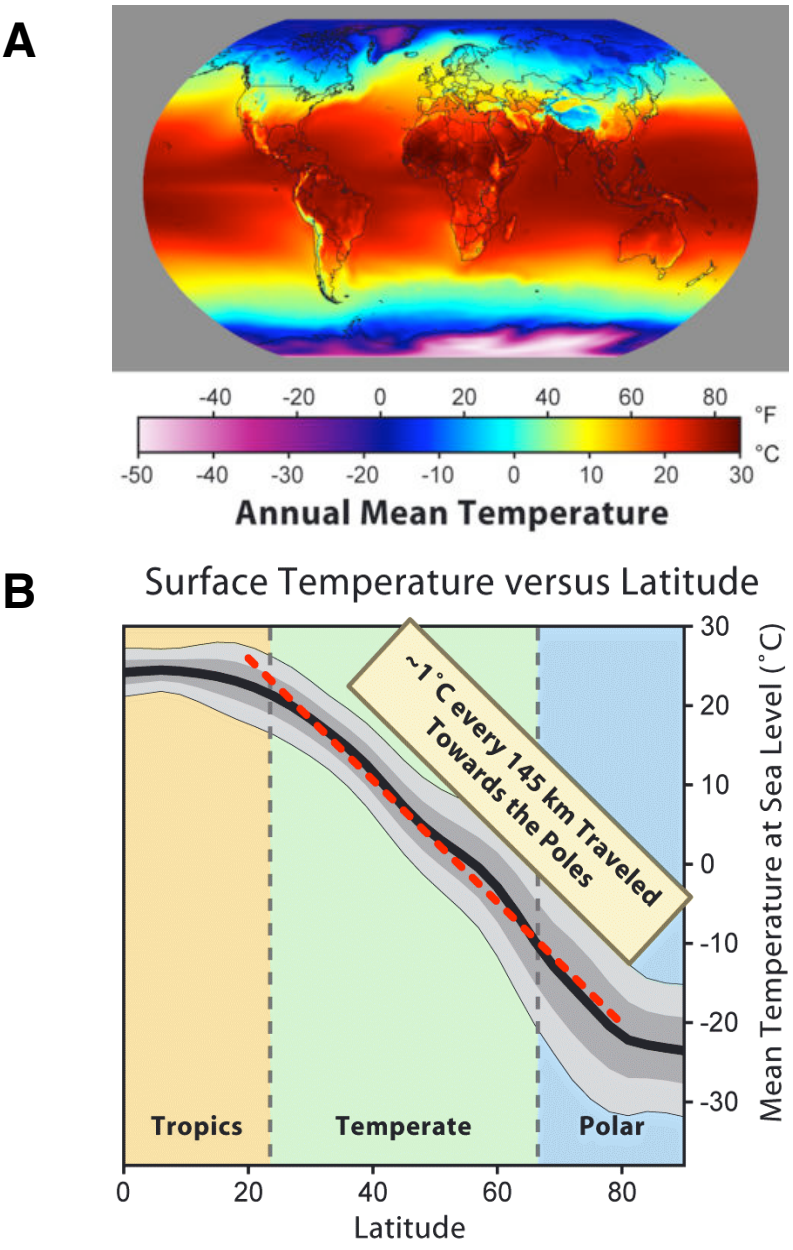

Fig. S1. (A) Global map of annually-averaged, near-surface air temperature from 1961-1990. **(B)** Variation in surface temperature as a function of latitude, after removing the effects of varying surface elevation, based on data from (A). Gray regions show first and second standard deviations. The almost linear increase in temperature with decreasing latitude across temperate and sub-polar latitudes levels off to a broad plateau between the Tropics of Cancer and Capricorn, where total annual net insolation varies little (*S1*, *S2*). Both figures copyright Robert A. Rohde, Global Warming Art, reproduced with permission: http://www.globalwarmingart.com/wiki/Image:Temperature_versus_Latitude_png.

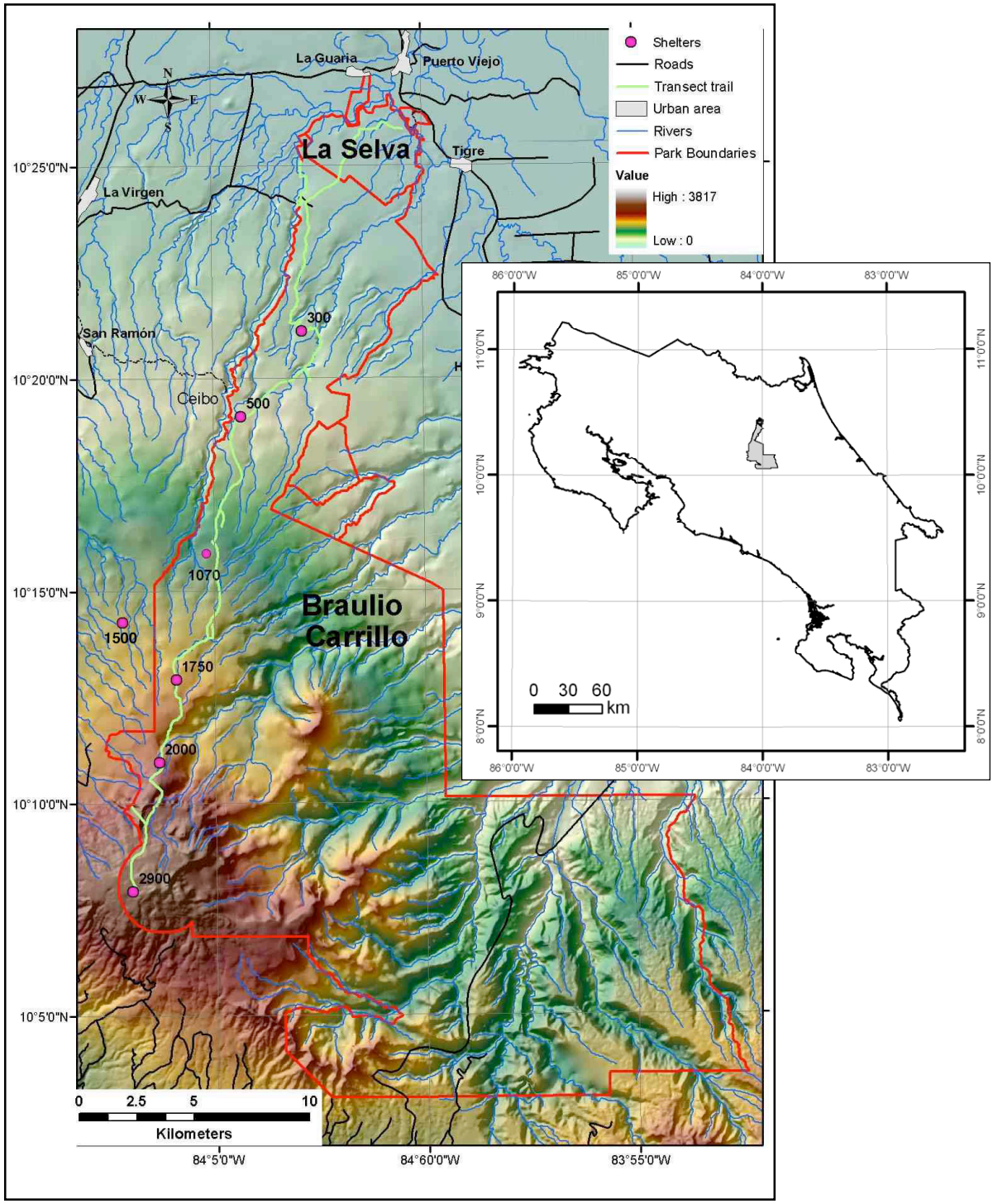

Fig. S2. The Barva Transect, traversing La Selva Biological Station and Braulio Carrillo National Park, Costa Rica. Pink dots are sampling sites for ants, with their elevations.

Materials and Methods

Field site. All field data for this investigation (the basis of Figs. 2 and 3) were collected along the La Selva-Braulio Carrillo elevational gradient (known as the Barva Transect) on the Atlantic slopes of Volcán Barva within the Cordillera Volcánica Central of Costa Rica. This old growth tropical forest corridor (Fig. S2), which ascends from 30 m elevation at La Selva Biological Station through the Parque Nacional Braulio Carrillo to the summit of Volcán Barva at 2906 m elevation, represents one of the few remaining uninterrupted elevational tracts of uncut rainforest in Central America (*S3*).

Adiabatic lapse rate. An estimate of the empirical adiabatic lapse rate for the Barva Transect was computed from temperature data recorded by Gilman (*S4*), every 30 min for a two year period (5 January 2004 – 12 January 12, 2006). Data were collected in seven old growth forest locations on the transect (100, 800, 1200, 1600, 2000, 2450, 2700 m elevation) using HoboPro Series RH/Temp microdaq data loggers (no data are available for an eighth location, at 400 m, because of the loss of the data logger at this site). At each location the data logger was located 1.3 m above ground level, close to a tree trunk to avoid direct sunlight. A wet adiabatic lapse rate of 5.1°C km^{-1} elevation was computed as the slope of an OLS regression of mean annual temperature on elevation. This estimate is close to the estimates of 5.5°C km^{-1} of Kluge et al. (*S5*) for the Barva Transect and Bush's estimate (*S6*) for a forested transect in the Kosñipata Valley, Peru.

Sampling methods for the epiphyte dataset. The epiphyte dataset was based on 4,710 individuals, representing 555 species of 53 families of epiphytes, inventoried at 6 sampling sites (30, 500, 1000, 1600, 2000, and 2600 m elevation) on the Barva Transect. Complete details on sampling sites and methods are presented by Cardelús *et al.* (*S7*).

Sampling methods for the Rubiaceae dataset. Field surveys were carried out between January 2004 and July 2004 at 28 sites on the Barva Transect, at 100 m increments of elevation between 100 and 2800 m elevation. Ten randomly located plots, each 50 x 2 m, were located within a 25 m-wide band along a topographic contour line at each sampling elevation. Data from the 10 plots at each site were pooled for the estimation of elevational range. A total of 14,268 individual Rubiaceae representing 81 species in 20 genera were recorded at the 28 sites, including 23 species for the largest genus *Psychotria*. For further details see Gilman (*S4*).

Sampling methods for the moth dataset. The moth dataset was based on 13,765 individuals, representing 739 species of Geometridae, inventoried at 6 sampling localities (40-45, 525-550, 1070-1115, 1690-1710, 2090-2140, and 2725-2730 m elevation) on the Barva Transect. Complete details on sampling sites and methods are documented by Brehm *et al.* (*S8*)

Sampling methods for the ant dataset. The ant dataset was based on 8,735 species occurrences (multiple individuals of the same species, within a given sample, were scored

as a single occurrence for that sample), representing 495 species of Formicidae, inventoried at six sampling sites (50, 300, 500, 1100, 1500, and 2000 m elevation) on the Barva Transect between 2001 and 2005. Ants were sampled at each site with a combination of methods: Berlese extraction of soil samples, Malaise traps, interception traps, and mini-Winkler extraction from leaf litter. Sites and methods are documented in detail on the "Collections and Expeditions" tab at http://purl.oclc.org/alas, and raw data are available through the "Specimen Database" tab at the same site.

Estimation of elevational ranges. Observed geographical ranges based on sampling data are inevitably minimum estimates, especially for rich tropical biotas, for which local species accumulation curves routinely fail to reach an asymptote (e.g. *S4*, *S5*, *S8*). Moreover, sampling in this study was not continuous along the transect, but at discrete elevations. Thus the observed elevational range of a species detected at only one site would be zero. To compensate approximately for both these issues, observed ranges were, without exception, both extrapolated and interpolated. For extrapolation, each observed range was augmented at both its lower and upper elevational limits by extending the range estimate downslope or upslope halfway to the nearest sampling site (or halfway to sea level or the summit elevation of Volcán Barva, for sites at the ends of the Barva Transect). For example, for the Rubiaceae dataset (for which sampling sites were at 100 m elevation intervals), an observed range extending from 300 m to 500m was adjusted to cover 250m to 550m elevation. With regard to interpolation, all ranges were assumed to be continuous, so that a species of Rubiaceae occurring at 300 m and 500 m, but not detected at 400 m, was nonetheless assumed to occur at this intermediate elevation. Both extrapolation and interpolation are conservative adjustments, with regard to the principal conclusions of this study.

Results

The two plant groups (epiphytes and Rubiaceae) are relatively similar in the pattern of potential lowland biotic attrition and range-shift gap accumulation (Fig. 3B), despite substantial differences in total richness and range size frequencies (Figs. 2A and 2B), because both groups share a similar pattern richness over the gradient, peaking at mid-elevations. The two insect groups (geometrid moths and ants) differ considerably in their patterns of potential lowland biotic attrition, range-shift gap accumulation, and extinction (Fig. 3B). As everywhere in the tropics, ants decline rapidly in richness with elevation (Fig. 2D), producing an early acceleration in lowland biotic attrition and range-shift gaps, whereas the moths in this study peak in richness at mid-elevations, yielding a slower rate of accumulated lowland biotic attrition and range-shift gaps. Because many species have narrow elevational ranges in these groups, all four show the striking pattern of rapid species turnover with elevation that is typical of tropical mountainsides.

References and Notes for Supporting Online Material

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Incidence Matrix for 555 species on the Barva Transect, Costa Rica

Elevation (m) —>	30	500	1000	1600	2000	2600
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Epi 2	1	0	0	0	0	0
Epi 3	1	0	0	0	0	0
Epi 4	1	0	0	0	0	0
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Epi 8	1	0	1	0	0	0
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Epi 339	0	0	0	0	1	0
Epi 340	0	0	0	1	1	0
Epi 341	0	1	0	0	0	0
Epi 342	1	0	0	0	0	0
Epi 343	0	0	1	0	0	0
Epi 344	0	0	1	0	0	0
Epi 345	0	0	0	1	0	0
Epi 346	0	0	0	1	0	0
Epi 347	0	0	1	0	0	0
Epi 348	0	0	0	1	1	1
Epi 349	1	0	0	1	0	0
Epi 350	0	0	1	0	0	0
Epi 351	0	0	1	1	1	0
Epi 352	0	0	1	1	1	0
Epi 353	0	0	1	0	0	0
Epi 354	0	1	1	0	0	0
Epi 355	0	0	1	1	0	0
Epi 356	1	0	0	0	0	0
Epi 357	0	0	1	1	1	0
Epi 358	1	1	0	0	0	0
Epi 359	1	0	0	0	0	0
Epi 360	0	1	0	0	0	0
Epi 361	0	0	0	1	0	0
Epi 362	0	0	1	0	0	0
Epi 363	0	0	0	1	0	0
Epi 364	0	1	0	0	0	0
Epi 365	1	0	0	0	0	0
Epi 366	1	0	0	0	0	0
Epi 367	0	0	0	1	0	0
Epi 368	0	1	0	0	0	0
Epi 369	0	0	1	0	0	0
Epi 370	1	0	0	0	0	0
Epi 371	1	0	0	0	1	0
Epi 372	0	1	0	0	0	0
Epi 373	0	0	1	0	0	0
Epi 374	0	0	0	1	0	0
Epi 375	0	0	0	1	1	0

Epi 376	0	0	0	0	1	0
Epi 377	0	0	0	1	0	0
Epi 378	0	0	0	0	1	0
Epi 379	0	0	1	0	0	0
Epi 380	0	0	0	0	1	0
Epi 381	0	0	1	0	0	0
Epi 382	0	0	0	0	1	0
Epi 383	0	1	0	0	0	0
Epi 384	0	0	0	0	1	0
Epi 385	0	0	1	0	0	0
Epi 386	0	1	1	1	1	0
Epi 387	0	0	0	0	1	0
Epi 388	0	1	0	0	0	0
Epi 389	1	0	0	0	0	0
Epi 390	0	0	0	0	1	0
Epi 391	0	0	0	1	0	0
Epi 392	0	0	0	1	1	0
Epi 393	0	0	0	1	0	0
Epi 394	0	0	1	1	0	0
Epi 395	0	1	0	0	0	0
Epi 396	1	1	1	0	1	0
Epi 397	1	0	0	0	0	0
Epi 398	0	1	1	0	0	0
Epi 399	0	0	1	0	0	0
Epi 400	0	0	1	0	0	0
Epi 401	0	0	0	1	1	0
Epi 402	0	0	0	0	1	0
Epi 403	0	0	0	0	1	0
Epi 404	0	0	0	1	1	0
Epi 405	0	0	1	1	1	0
Epi 406	0	0	1	0	0	0
Epi 407	0	0	0	0	1	0
Epi 408	0	0	0	1	1	0
Epi 409	0	1	1	0	0	0
Epi 410	0	0	0	0	1	0
Epi 411	0	0	1	0	0	0
Epi 412	0	0	0	1	0	0
Epi 413	0	1	0	0	0	0
Epi 414	0	1	1	1	0	0
Epi 415	0	0	0	0	1	0
Epi 416	0	1	0	1	0	0
Epi 417	0	1	0	0	0	0
Epi 418	0	0	1	1	0	0
Epi 419	0	0	1	0	0	0
Epi 420	0	0	1	0	0	0
Epi 421	1	0	0	0	0	0
Epi 422	0	0	1	0	0	0
Epi 423	0	0	1	0	0	0
Epi 424	0	0	0	0	1	0
Epi 425	0	0	1	0	0	0
Epi 426	0	0	1	0	0	0
Epi 427	0	1	1	0	0	0
Epi 428	0	1	0	0	0	0
Epi 429	1	1	0	0	0	0
Epi 430	0	0	1	0	0	0

Epi 431	0	1	0	0	0	0
Epi 432	0	0	1	1	1	0
Epi 433	0	0	1	0	0	0
Epi 434	0	0	0	0	0	1
Epi 435	0	0	0	0	1	0
Epi 436	0	0	0	0	1	0
Epi 437	0	0	0	1	0	0
Epi 438	0	0	0	1	1	0
Epi 439	0	1	0	0	0	0
Epi 440	0	1	1	0	0	0
Epi 441	0	0	1	0	0	0
Epi 442	0	0	0	0	1	1
Epi 443	0	1	0	0	1	0
Epi 444	0	0	1	1	0	0
Epi 445	0	0	0	0	0	1
Epi 446	0	0	0	1	1	0
Epi 447	0	0	1	0	0	0
Epi 448	0	1	1	0	0	0
Epi 449	0	0	0	0	1	0
Epi 450	0	1	0	0	0	0
Epi 451	0	1	0	0	0	0
Epi 452	0	1	1	0	0	0
Epi 453	0	0	0	1	0	0
Epi 454	0	1	0	0	0	0
Epi 455	0	0	1	0	0	0
Epi 456	0	0	0	1	0	0
Epi 457	0	1	0	0	0	0
Epi 458	0	1	0	0	0	0
Epi 459	0	0	0	1	0	0
Epi 460	0	0	0	1	0	0
Epi 461	0	0	1	0	0	0
Epi 462	0	0	0	0	1	0
Epi 463	0	0	0	1	0	0
Epi 464	0	0	1	1	0	0
Epi 465	0	0	1	0	0	0
Epi 466	0	1	0	0	0	0
Epi 467	0	1	1	0	0	0
Epi 468	0	1	1	1	1	1
Epi 469	0	1	0	0	0	0
Epi 470	0	1	0	0	0	0
Epi 471	0	0	0	0	1	1
Epi 472	0	1	0	0	0	0
Epi 473	0	0	1	1	1	0
Epi 474	1	1	1	0	0	0
Epi 475	0	0	0	0	0	1
Epi 476	0	0	1	1	0	0
Epi 477	0	0	1	0	0	0
Epi 478	0	0	0	1	0	0
Epi 479	0	0	0	1	0	0
Epi 480	0	0	0	0	1	0
Epi 481	0	0	0	1	0	0
Epi 482	0	0	1	0	0	0
Epi 483	0	0	1	0	0	0
Epi 484	0	0	0	1	0	0
Epi 485	0	0	0	1	0	0

Epi 486	0	0	0	1	0	0
Epi 487	0	0	0	0	1	0
Epi 488	0	0	0	0	1	0
Epi 489	0	0	0	0	1	0
Epi 490	0	0	0	1	1	0
Epi 491	1	0	0	0	0	0
Epi 492	0	0	1	0	0	0
Epi 493	0	1	1	0	0	0
Epi 494	0	1	0	0	0	0
Epi 495	0	0	0	1	0	0
Epi 496	0	0	0	1	0	0
Epi 497	0	0	0	1	0	0
Epi 498	0	0	0	0	1	0
Epi 499	0	0	1	1	1	0
Epi 500	0	0	1	1	0	0
Epi 501	0	0	1	0	0	0
Epi 502	1	1	1	0	0	0
Epi 503	0	1	0	0	0	0
Epi 504	1	0	0	0	0	0
Epi 505	0	0	1	1	1	0
Epi 506	1	0	0	0	0	0
Epi 507	0	0	1	0	0	0
Epi 508	0	0	1	0	0	0
Epi 509	0	0	1	0	0	0
Epi 510	0	1	0	0	0	0
Epi 511	0	1	0	0	0	0
Epi 512	1	1	0	0	0	0
Epi 513	1	0	0	0	0	0
Epi 514	0	1	1	0	0	0
Epi 515	1	1	1	1	0	0
Epi 516	0	0	1	0	0	0
Epi 517	0	1	0	0	0	0
Epi 518	0	1	1	0	0	0
Epi 519	0	0	0	1	0	0
Epi 520	0	1	1	1	0	0
Epi 521	0	0	1	0	0	0
Epi 522	0	0	0	0	1	0
Epi 523	1	0	0	0	0	0
Epi 524	0	0	0	0	1	0
Epi 525	0	0	0	0	1	0
Epi 526	0	0	0	0	0	1
Epi 527	0	0	1	1	0	0
Epi 528	0	1	1	1	0	0
Epi 529	0	0	1	1	0	0
Epi 530	0	0	0	0	1	1
Epi 531	0	1	1	0	0	0
Epi 532	0	1	1	0	0	0
Epi 533	0	0	1	1	1	1
Epi 534	1	0	1	0	0	0
Epi 535	0	0	0	1	0	0
Epi 536	1	1	0	0	0	0
Epi 537	0	0	0	0	1	0
Epi 538	0	0	1	0	0	0
Epi 539	0	0	0	0	1	0
Epi 540	0	0	0	0	1	1

Epi 541	0	1	1	0	1	0
Epi 542	0	1	1	1	0	0
Epi 543	0	0	1	1	0	0
Epi 544	0	1	1	1	0	0
Epi 545	1	1	0	0	0	0
Epi 546	0	0	0	0	1	0
Epi 547	0	0	0	1	1	0
Epi 548	0	1	0	0	0	0
Epi 549	0	0	1	1	0	0
Epi 550	0	0	0	1	0	0
Epi 551	0	0	0	0	1	0
Epi 552	0	0	1	1	0	0
Epi 553	0	0	0	0	1	0
Epi 554	1	1	1	0	0	0
Epi 555	0	0	1	1	0	0

Rubiaceae data from: Gilman, A. 2007. Tropical plant diversity and species altitudinal range across an elevational gradient in Costa Rica. Ph. D. UCLA, Los Angeles.

Incidence Matrix for 82 species on the Barva Transect, Costa Rica

Elevation (m) —>	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800
Rub 1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 4	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Rub 5	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Rub 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 8	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 9	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 10	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rub 13	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 14	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Rub 15	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Rub 16	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 17	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 18	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 19	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 20	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 21	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 22	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 23	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 24	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 25	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 26	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Rub 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rub 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Rub 29	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 30	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 31	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 32	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 33	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Rub 34	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 35	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 36	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 37	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 38	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 39	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 40	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rub 41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0
Rub 42	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 43	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Rub 45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Rub 46	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Rub 47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0
Rub 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
Rub 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Rub 50	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 51	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 52	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 53	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Rub 54	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 56	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Rub 57	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 58	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rub 60	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 61	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 62	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 63	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 64	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 65	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 66	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Rub 67	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 68	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 69	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 70	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 71	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rub 73	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 74	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rub 75	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 76	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 77	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 78	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Rub 79	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 80	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 81	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rub 82	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Geometridae data, from: Brehm, G., R. K. Colwell, and J. Kluge. 2007. The role of environment and mid-domain effect on moth species richness along a tropical elevational gradient. Global Ecology & Biogeography 16:205-219.

Incidence Matrix for 739 species on the Barva Transect, Costa Rica

Elevation (m) —>	40	45	525	550	1070	1115	1690	1710	2090	2140	2725	2730
Geom 1							1	1	1	1		
Geom 2					1							
Geom 3						1						
Geom 4							1	1		1		
Geom 5					1	1	1	1				
Geom 6			1			1						
Geom 7						1						
Geom 8			1									
Geom 9							1		1	1		
Geom 10	1				1							
Geom 11							1					
Geom 12							1					
Geom 13			1		1							
Geom 14		1	1	1								
Geom 15							1		1	1	1	
Geom 16	1											
Geom 17									1	1		
Geom 18	1			1								
Geom 19							1	1	1	1		
Geom 20			1	1								
Geom 21					1	1	1	1				
Geom 22					1	1	1	1				
Geom 23			1									
Geom 24									1	1	1	1
Geom 25						1						
Geom 26					1	1	1	1				
Geom 27				1			1	1				
Geom 28					1		1	1		1		
Geom 29						1						
Geom 30												1
Geom 31							1	1	1	1	1	1
Geom 32					1	1	1	1	1			
Geom 33							1	1				
Geom 34						1	1	1	1	1		1
Geom 35					1	1						
Geom 36						1						
Geom 37					1					1		
Geom 38			1		1	1	1	1				
Geom 39	1	1										
Geom 40										1		
Geom 41							1	1	1	1	1	1
Geom 42							1		1	1	1	1
Geom 43					1	1	1	1				

Geom 44		1										
Geom 45						1						
Geom 46							1					
Geom 47	1	1	1	1								
Geom 48					1	1						
Geom 49								1	1	1	1	1
Geom 50								1	1			
Geom 51					1	1						
Geom 52										1		
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Geom 54							1	1	1	1	1	1
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Geom 56				1								
Geom 57			1									
Geom 58	1											
Geom 59									1			
Geom 60			1									
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Geom 63				1	1							
Geom 64				1								
Geom 65							1	1				
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Geom 67										1		1
Geom 68	1											
Geom 69										1		1
Geom 70						1			1	1		
Geom 71	1			1								
Geom 72				1	1	1		1				
Geom 73								1	1			
Geom 74	1	1	1									
Geom 75								1	1		1	11
Geom 76								1	1	1		
Geom 77					1	1	1	1	1	1	1	1
Geom 78							1					
Geom 79					1	1						
Geom 80												1
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Geom 116	1	1	1	1								
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Geom 561	1											
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Geom 563							1		1	1	1	
Geom 564						1			1	1		
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Geom 573							1		1	1		
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Geom 575			1						1	1	1	
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Geom 578							1		1	1		
Geom 579					1							
Geom 580							1		1	1	1	1
Geom 581											1	
Geom 582								1				

Geom 583								1		1	1	1
Geom 584							1	1	1	1	1	1
Geom 585							1			1		
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Geom 588			1	1								
Geom 589											1	1
Geom 590								1	1	1	1	1
Geom 591					1			1				
Geom 592							1		1	1	1	1
Geom 593							1	1		1		
Geom 594							1					
Geom 595					1	1		1		1		
Geom 596							1			1		
Geom 597											1	
Geom 598			1		1	1	1	1	1	1		1
Geom 599									1	1	1	1
Geom 600					1	1		1	1		1	1
Geom 601											1	1
Geom 602					1			1				
Geom 603											1	
Geom 604		1										
Geom 605					1	1	1	1	1	1	1	1
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Geom 608										1		
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Geom 616						1						
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Geom 619					1	1	1	1	1	1	1	1
Geom 620					1	1	1	1		1		
Geom 621					1	1	1					
Geom 622					1	1		1				
Geom 623			1									
Geom 624			1		1	1	1	1	1	1		
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Geom 626									1	1	1	1
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Geom 628						1						
Geom 629					1	1	1	1	1	1		1
Geom 630				1								
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Geom 635	1		1									
Geom 636					1							
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Geom 677						1						
Geom 678					1							
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Geom 680				1		1						

Geom 681	1	1										
Geom 682						1						
Geom 683										1		
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Geom 685	1			1								
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Geom 691			1	1		1						
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Geom 693	1	1	1	1	1	1						
Geom 694							1	1				
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Geom 696		1										
Geom 697	1			1								
Geom 698	1	1										
Geom 699	1	1	1									
Geom 700	1											
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Geom 703		1										
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Geom 710	1	1	1	1	1	1						
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Geom 712	1	1										
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Geom 715			1	1		1						
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Geom 718											1	1
Geom 719		1				1						
Geom 720					1	1						
Geom 721		1		1								
Geom 722		1	1									
Geom 723						1	1	1	1	1	1	
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Geom 725									1			
Geom 726		1	1	1	1	1						
Geom 727		1		1								
Geom 728		1	1		1	1						
Geom 729					1	1				1		

Geom 730						1						
Geom 731			1									
Geom 732								1				
Geom 733	1											
Geom 734		1	1	1								
Geom 735	1											
Geom 736					1	1	1	1				
Geom 737			1									
Geom 738										1		
Geom 739	1											

Forcmidae data, from: Longino, J. T, Evergreen State College, unpublished						
Incidence Matrix for 495 species on the Barva Transect, Costa Rica						
Elevation (m) —>	50	300	500	1100	1500	2000
Ant 1	1	0	1	0	0	0
Ant 2	1	1	1	1	0	0
Ant 3	1	1	1	1	0	0
Ant 4	0	0	0	0	1	0
Ant 5	1	0	1	0	0	0
Ant 6	1	0	1	0	0	0
Ant 7	1	0	0	1	0	0
Ant 8	1	1	1	1	0	0
Ant 9	0	0	0	1	0	0
Ant 10	0	1	0	0	0	0
Ant 11	0	0	0	0	0	1
Ant 12	0	0	0	0	1	0
Ant 13	0	0	0	1	0	0
Ant 14	1	1	0	0	0	0
Ant 15	1	0	0	0	0	0
Ant 16	1	0	0	0	0	0
Ant 17	0	0	0	1	1	1
Ant 18	1	1	1	0	0	0
Ant 19	1	1	1	0	0	0
Ant 20	1	0	0	0	0	0
Ant 21	0	0	0	1	0	0
Ant 22	0	0	1	0	0	0
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Ant 32	0	0	1	0	0	0
Ant 33	1	1	1	0	0	0
Ant 34	1	0	0	0	0	0
Ant 35	0	1	0	0	0	0
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Ant 38	0	0	1	0	0	0
Ant 39	1	0	0	0	0	0
Ant 40	1	1	0	0	0	0
Ant 41	1	1	1	0	0	0
Ant 42	1	1	1	0	0	0
Ant 43	0	1	1	1	0	0
Ant 44	0	0	0	1	1	0
Ant 45	1	1	1	0	0	0
Ant 46	0	0	1	0	0	0
Ant 47	1	0	1	0	0	0
Ant 48	0	0	0	0	1	0

Ant 49	1	0	1	1	1	0
Ant 50	0	0	0	1	0	0
Ant 51	1	1	1	0	0	0
Ant 52	0	1	1	0	0	0
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Ant 105	0	0	0	1	0	0
Ant 106	1	1	0	0	0	0
Ant 107	0	1	1	0	0	0
Ant 108	1	1	1	0	0	0
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Ant 128	1	0	1	1	0	0
Ant 129	1	1	1	0	0	0
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Ant 160	0	1	0	0	0	0
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Ant 350	0	1	0	0	0	0
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Ant 353	0	0	0	0	1	0
Ant 354	1	1	0	1	0	0
Ant 355	1	0	0	0	0	0
Ant 356	0	0	0	1	0	0
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Ant 360	0	0	0	1	1	0
Ant 361	0	0	1	0	0	0
Ant 362	0	1	0	0	0	0
Ant 363	0	1	0	0	0	0
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Ant 365	1	1	0	0	0	0
Ant 366	0	1	1	0	0	0
Ant 367	1	1	1	0	0	0
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Ant 373	0	1	0	0	0	0
Ant 374	0	0	0	1	0	0
Ant 375	0	1	1	0	0	0
Ant 376	1	1	1	0	0	0
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Ant 378	1	1	0	0	0	0

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Ant 380	1	1	1	0	0	0
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Ant 382	1	0	0	0	0	0
Ant 383	1	1	1	0	0	0
Ant 384	0	0	0	1	1	0
Ant 385	1	1	1	1	1	1
Ant 386	0	1	0	0	0	0
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Ant 388	0	0	0	1	0	0
Ant 389	0	0	1	0	0	0
Ant 390	0	0	0	0	1	0
Ant 391	1	0	0	0	0	0
Ant 392	0	1	0	0	0	0
Ant 393	0	0	0	1	0	0
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Ant 396	1	1	1	0	0	0
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Ant 398	0	0	1	0	0	0
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Ant 404	0	0	0	1	0	0
Ant 405	0	0	1	0	0	0
Ant 406	0	0	0	0	1	0
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Ant 409	1	0	0	0	0	0
Ant 410	1	0	0	0	1	0
Ant 411	1	1	1	1	0	0
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Ant 414	1	1	1	0	0	0
Ant 415	0	1	1	0	0	0
Ant 416	0	0	0	1	1	0
Ant 417	1	1	0	0	0	0
Ant 418	1	1	1	0	0	0
Ant 419	0	0	0	1	0	0
Ant 420	0	0	0	1	0	0
Ant 421	0	0	0	1	0	0
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Ant 428	1	1	1	1	1	0
Ant 429	1	1	1	0	0	0
Ant 430	1	1	1	0	0	0
Ant 431	1	1	1	0	0	0
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Ant 433	0	0	0	1	0	0

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Ant 435	1	0	0	0	0	0
Ant 436	0	0	1	1	0	0
Ant 437	1	1	1	0	0	0
Ant 438	1	0	0	0	0	0
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Ant 448	1	0	0	0	0	0
Ant 449	1	1	1	1	1	0
Ant 450	1	0	1	1	1	1
Ant 451	0	1	1	1	1	0
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Ant 453	0	0	0	1	0	0
Ant 454	0	0	0	1	0	0
Ant 455	0	0	0	0	1	0
Ant 456	0	0	0	1	1	1
Ant 457	0	1	1	0	1	0
Ant 458	1	0	0	1	0	0
Ant 459	1	1	0	0	0	0
Ant 460	1	1	1	0	0	0
Ant 461	0	0	1	0	0	0
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Ant 468	1	1	0	0	0	0
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Ant 474	1	0	0	0	0	0
Ant 475	1	0	0	1	0	0
Ant 476	0	0	0	0	0	1
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Ant 479	1	0	0	0	0	0
Ant 480	0	1	0	0	0	0
Ant 481	0	0	1	0	0	0
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Ant 484	1	0	0	0	0	0
Ant 485	1	1	0	0	0	0
Ant 486	1	1	0	0	0	0
Ant 487	0	0	0	1	0	0
Ant 488	0	1	1	0	0	0

Ant 489	1	1	1	1	1	0
Ant 490	1	1	1	0	0	0
Ant 491	1	1	0	0	0	0
Ant 492	1	1	1	0	0	0
Ant 493	0	0	1	0	0	0
Ant 494	0	1	1	0	0	0
Ant 495	0	1	0	0	0	0