SUPPLEMENTARY MATERIAL

**Diversity of moths and butterflies of the southwestern region of Costa Rica**

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Supplementary Table 1

List of taxonomists that contributed to the identifications of species in each family in which at least some species were identified to the species level or categorized as a morpho species within a particular genus. The affiliation of each taxonomist is also included.

|  |  |  |
| --- | --- | --- |
| **Family** | **Taxonomist** | **Affiliation** |
| Aididae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Don Davis  | Smithsonian Institution Washington |
| Daniel H. Janzen | University of Pennsylvania |
| Apatelodidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Rodolphe Rougerie | Muséum national d’Histoire naturelle, Sorbonne Université |
| Arrhenophanidae | Daniel H. Janzen | University of Pennsylvania |
| Blastobasidae | David Adamski | Smithsonian Institution Washington |
| Daniel H. Janzen | University of Pennsylvania |
| Bombycidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Rodolphe Rougerie | Muséum national d’Histoire naturelle, Sorbonne Université |
| Castniidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Jacqueline Miller | University of Florida, Gainesville, Florida |
| Choreutidae | Daniel H. Janzen | University of Pennsylvania |
| Crambidae | Daniel H. Janzen | University of Pennsylvania |
| Eugene G. Munroe  | Entomology Division in Ottawa, Ontario, Canada |
| Alma Solis  | Smithsonian Institution Washington |
| Dalceridae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Don Davis  | Smithsonian Institution Washington |
| Daniel H. Janzen | University of Pennsylvania |
| Scott Miller  | Smithsonian Institution Washington |
| Elachistidae | Daniel H. Janzen | University of Pennsylvania |
| Erebidae | Victor O. Becker | Reserva Serra Bonita, Brazil |
| Bernardo Espinoza Sanabria | INBio |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Paul Goldstein  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| Suzanne Rab-Green | American Museum of Natural History, New York |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Euteliidae | Paul Goldstein  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Geometridae | Gunnar Brehm | Institut für Spezielle Zoologie und Evolutionsbiologie Museum, Germany |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Tanner Matson | Smithsonian Institution Washington |
| Roy Mora | INBio |
| Linda M. Pitkin | Natural History Museum, London |
| John E. Rawlins  | Carnegie Museum of Natural History |
| J. Bolling Sullivan  | North Carolina Biodiversity Project |
| Hedylidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Malcolm J. Scoble  | Natural History Museum, London |
| Hesperiidae | George T. Austin  | Butterflies of America |
| Andrew Brower | American Museum of Natural History, New York |
| John Burns  | Smithsonian Institution Washington |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Nick V. Grishin | Butterflies of America |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Olaf Hermann Hendrik Mielke | Universidad Federal do Parana, Brasil |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Dick Vane-Wright  | Natural History Museum, London |
| Andrew D. Warren | University of Florida, Gainesville, Florida |
| Lasiocampidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| José Montero Ramírez | INBio |
| Limacodidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Jorge Corrales Mayorga | INBio |
| Don Davis  | Smithsonian Institution Washington |
| Mark Epstein | California Department of Food and Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| Lycaenidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Phil De Vries | University of New Orleans |
| Andrew Brower | American Museum of Natural History, New York |
| Daniel H. Janzen | University of Pennsylvania |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Robert Robbins  | Smithsonian Institution Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Dick Vane-Wright  | Natural History Museum, London |
| Megalopygidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Don Davis  | Smithsonian Institution Washington |
| Mark Epstein | California Department of Food and Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| Mimallonidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Noctuidae | Victor O. Becker | Reserva Serra Bonita, Brazil |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| John G. Franclemont  | Cornell University |
| Paul Goldstein  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| J. Donal Lafontaine  | Canadian National Collection of Insects and Arachnids |
| Robert W. Poole | Smithsonian Institution Washington |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Nolidae | Paul Goldstein  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Notodontidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Paul Goldstein  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| James S. Miller  | American Museum of Natural History, New York |
| Mike Pogue  | Smithsonian Institution Washington |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Alexander Schintlmeister | Museum Witt Munich & Nature Research Center Vilnius |
| Ryan St Laurent | University of Colorado Boulder |
| Paul Thiaucourt  | Muséum national d'Histoire naturelle  |
| Nymphalidae | Annette Aiello | Smithsonian Tropical Research Institute |
| Patrick Blandin | Muséum National d'Histoire Naturelle |
| Andrew Brower | American Museum of Natural History, New York |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Phil De Vries | University of New Orleans |
| Daniel H. Janzen | University of Pennsylvania |
| Mirna Martins Casagrande | Universidad Federal do Paraná |
| André Victor Lucci Freitas | Universidade Estadual de Campinas, Brazil |
| Jason P. W. Hall | Smithsonian Institution Washington |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Roberto Gonzalo de la Maza | Sociedad Mexicana de Lepidopterología  |
| Javier de la Maza Elvira  | Sociedad Mexicana de Lepidopterología  |
| Lee D. Miller  | Allyn Museum of Entomology, Sarasota Florida |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Dick Vane-Wright  | Natural History Museum, London |
| Keith Willmott | Florida Museum of Natural History |
| Oecophoridae | Ronald W. Hodges  | U.S. Department of Agriculture |
| Daniel H. Janzen | University of Pennsylvania |
| Papilionidae | Andrew Brower | American Museum of Natural History, New York |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Phil De Vries | University of New Orleans |
| Daniel H. Janzen | University of Pennsylvania |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Roberto Gonzalo de la Maza | Sociedad Mexicana de Lepidopterología  |
| Javier de la Maza Elvira | Mexico |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Dick Vane-Wright  | Natural History Museum, London |
| Keith Willmott | Florida Museum of Natural History |
| Phiditiidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Rodolphe Rougerie | Muséum national d’Histoire naturelle, Sorbonne Université |
| Pieridae | Andrew Brower | American Museum of Natural History, New York |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Phil De Vries | University of New Orleans |
| Daniel H. Janzen | University of Pennsylvania |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Roberto Gonzalo de la Maza | Sociedad Mexicana de Lepidopterología  |
| Javier de la Maza Elvira | Mexico |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Dick Vane-Wright  | Natural History Museum, London |
| Keith Willmott | Florida Museum of Natural History |
| Pyralidae | Daniel H. Janzen | University of Pennsylvania |
| Eugene G. Munroe  | Entomology Division in Ottawa, Ontario, Canada |
| Michael Schaffer  | Entomological Society of Scandanavia |
| Alma Solis  | Smithsonian Institution Washington |
| Riodinidae | George T. Austin  | Butterflies of America |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Andrew Brower | American Museum of Natural History, New York |
| Phil De Vries | University of New Orleans |
| Don Harvey  | Smithsonian Institution Washington |
| Daniel H. Janzen | University of Pennsylvania |
| Gerardo Lamas | Universidad Nacional Mayor de San Marcos, Lima, Perú |
| Andrei Sourakov | Museum of Natural History, Gainesville, Florida |
| Paul A. Opler  | Smithsoniam Institution, Washington |
| Gordon B. Small | Smithsonian Institution Washington |
| Dick Vane-Wright  | Natural History Museum, London |
| Saturniidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Claude Lemaire  | Muséum national d'Histoire naturelle  |
| Rodolphe Rougerie | Muséum national d’Histoire naturelle, Sorbonne Université |
| Sematuridae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Sphingidae | Jean Marie Cadiou  | Muséum national d'Histoire naturelle  |
| Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| Daniel H. Janzen | University of Pennsylvania |
| Ian Kitching | Natural History Museum, London |
| Rodolphe Rougerie | Muséum national d’Histoire naturelle |
| Thyrididae | Daniel H. Janzen | University of Pennsylvania |
| Tortricidae | John W. Brown  | Smithsonian Institution Washington |
| Daniel H. Janzen | University of Pennsylvania |
| Eugenie Phillips Rodríguez | INBio |
| Jerry A. Powell | University of California, Berkeley |
| Józef Razowski | Polish Academy of Sciences |
| Uraniidae | Isidro Chacón | BioAlfa, Santo Domingo de Heredia, Costa Rica |
| John E. Rawlins  | Carnegie Museum of Natural History |
| Yponomeutidae | Daniel H. Janzen | University of Pennsylvania |

Supplementary Table 2

Number specimens identified exclusively to each taxonomic category, and the percentage of specimens identified in each category. Data correspond to the 78747 specimens of moths and butterflies included in this study.

|  |  |  |
| --- | --- | --- |
| Category | No. specimens | Percentage |
| Order | 2097 | 2.7 |
| Family | 13638 | 17.3 |
| Genus | 5211 | 6.6 |
| Species/morphospecies | 57801 | 73.4 |

Supplementary Table 3

Number species (or morphospecies) and the number of specimens identified for each of the 37 families of moths and butterflies, collected in the southwestern region of Costa Rica. Families for which specimens were not identified to species or morphospecies are not included.

|  |  |  |
| --- | --- | --- |
| Family | No. species | No. specimens |
| Aididae | 1 | 81 |
| Apatelodidae | 17 | 823 |
| Arrhenophanidae | 1 | 3 |
| Blastobasidae | 9 | 13 |
| Bombycidae | 12 | 966 |
| Castniidae | 3 | 22 |
| Choreutidae | 28 | 247 |
| Crambidae | 287 | 6709 |
| Dalceridae | 8 | 121 |
| Elachistidae | 29 | 373 |
| Erebidae | 842 | 14913 |
| Euteliidae | 10 | 166 |
| Geometridae | 306 | 7633 |
| Hedylidae | 13 | 588 |
| Hesperiidae | 76 | 290 |
| Lasiocampidae | 42 | 1182 |
| Limacodidae | 60 | 2058 |
| Lycaenidae | 34 | 105 |
| Megalopygidae | 24 | 965 |
| Mimallonidae | 31 | 412 |
| Noctuidae | 313 | 3109 |
| Nolidae | 39 | 689 |
| Notodontidae | 261 | 6877 |
| Nymphalidae | 177 | 2037 |
| Oecophoridae | 5 | 5 |
| Papilionidae | 14 | 115 |
| Phiditiidae | 2 | 19 |
| Pieridae | 21 | 114 |
| Pyralidae | 96 | 1648 |
| Riodinidae | 57 | 158 |
| Saturniidae | 61 | 2246 |
| Sematuridae | 1 | 1 |
| Sphingidae | 96 | 1461 |
| Thyrididae | 31 | 165 |
| Tortricidae | 20 | 252 |
| Uraniidae | 2 | 33 |
| Yponomeutidae | 1 | 3 |
| TOTAL | 3030 | 56602 |

Supplementary Table 4

Pairwise comparisons of dissimilarity between families on Sorensen index values calculated for each family among localities. Estimate refers to the difference of Sorensen mean values between the corresponding pair of families. Values in bold indicate significant differences.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Contrast | Estimate | SE | df | t.ratio | p.value |
| Apatelodidae – Bombycidae | 0.060 | 0.047 | 168 | 1.26 | 0.311 |
| Apatelodidae – Crambidae | -0.129 | 0.047 | 168 | -2.72 | **0.020** |
| Apatelodidae – Erebidae | -0.221 | 0.047 | 168 | -4.68 | **<0.001** |
| Apatelodidae – Geometridae | -0.110 | 0.047 | 168 | -2.33 | **0.049** |
| Apatelodidae – Lasiocampidae | -0.212 | 0.047 | 168 | -4.49 | **<0.001** |
| Apatelodidae – Megalopygidae | -0.162 | 0.047 | 168 | -3.42 | **0.003** |
| Apatelodidae – Noctuidae | -0.257 | 0.047 | 168 | -5.43 | **<0.001** |
| Apatelodidae – Notodontidae | -0.144 | 0.047 | 168 | -3.06 | 0.010 |
| Apatelodidae – Nymphalidae | -0.211 | 0.047 | 168 | -4.46 | **<0.001** |
| Apatelodidae – Saturniidae | -0.082 | 0.047 | 168 | -1.73 | 0.147 |
| Apatelodidae – Sphingidae | -0.128 | 0.047 | 168 | -2.70 | **0.020** |
| Bombycidae – Crambidae | -0.188 | 0.047 | 168 | -3.99 | **0.001** |
| Bombycidae – Erebidae | -0.281 | 0.047 | 168 | -5.94 | **<0.001** |
| Bombycidae – Geometridae | -0.170 | 0.047 | 168 | -3.60 | **0.002** |
| Bombycidae – Lasiocampidae | -0.272 | 0.047 | 168 | -5.76 | **<0.001** |
| Bombycidae – Megalopygidae | -0.221 | 0.047 | 168 | -4.69 | **<0.001** |
| Bombycidae – Noctuidae | -0.316 | 0.047 | 168 | -6.69 | **<0.001** |
| Bombycidae – Notodontidae | -0.204 | 0.047 | 168 | -4.32 | **<0.001** |
| Bombycidae – Nymphalidae | -0.270 | 0.047 | 168 | -5.72 | **<0.001** |
| Bombycidae – Saturniidae | -0.142 | 0.047 | 168 | -3.00 | **0.011** |
| Bombycidae – Sphingidae | -0.187 | 0.047 | 168 | -3.96 | **0.001** |
| Crambidae – Erebidae | -0.092 | 0.047 | 168 | -1.95 | 0.105 |
| Crambidae – Geometridae | 0.018 | 0.047 | 168 | 0.39 | 0.780 |
| Crambidae – Lasiocampidae | -0.084 | 0.047 | 168 | -1.77 | 0.147 |
| Crambidae – Megalopygidae | -0.033 | 0.047 | 168 | -0.70 | 0.571 |
| Crambidae – Noctuidae | -0.128 | 0.047 | 168 | -2.71 | **0.020** |
| Crambidae – Notodontidae | -0.016 | 0.047 | 168 | -0.33 | 0.786 |
| Crambidae – Nymphalidae | -0.082 | 0.047 | 168 | -1.73 | 0.147 |
| Crambidae – Saturniidae | 0.047 | 0.047 | 168 | 0.99 | 0.434 |
| Crambidae – Sphingidae | 0.001 | 0.047 | 168 | 0.02 | 0.982 |
| Erebidae – Geometridae | 0.111 | 0.047 | 168 | 2.34 | **0.049** |
| Erebidae – Lasiocampidae | 0.009 | 0.047 | 168 | 0.18 | 0.883 |
| Erebidae – Megalopygidae | 0.059 | 0.047 | 168 | 1.25 | 0.311 |
| Erebidae – Noctuidae | -0.036 | 0.047 | 168 | -0.75 | 0.562 |
| Erebidae – Notodontidae | 0.076 | 0.047 | 168 | 1.62 | 0.177 |
| Erebidae – Nymphalidae | 0.010 | 0.047 | 168 | 0.22 | 0.867 |
| Erebidae – Saturniidae | 0.139 | 0.047 | 168 | 2.94 | 0.013 |
| Erebidae – Sphingidae | 0.093 | 0.047 | 168 | 1.98 | 0.103 |
| Geometridae – Lasiocampidae | -0.102 | 0.047 | 168 | -2.16 | 0.073 |
| Geometridae – Megalopygidae | -0.052 | 0.047 | 168 | -1.09 | 0.398 |
| Geometridae – Noctuidae | -0.146 | 0.047 | 168 | -3.10 | **0.009** |
| Geometridae – Notodontidae | -0.034 | 0.047 | 168 | -0.72 | 0.565 |
| Geometridae – Nymphalidae | -0.100 | 0.047 | 168 | -2.12 | 0.077 |
| Geometridae – Saturniidae | 0.028 | 0.047 | 168 | 0.60 | 0.638 |
| Geometridae – Sphingidae | -0.017 | 0.047 | 168 | -0.37 | 0.780 |
| Lasiocampidae – Megalopygidae | 0.051 | 0.047 | 168 | 1.07 | 0.401 |
| Lasiocampidae – Noctuidae | -0.044 | 0.047 | 168 | -0.94 | 0.445 |
| Lasiocampidae – Notodontidae | 0.068 | 0.047 | 168 | 1.44 | 0.246 |
| Lasiocampidae – Nymphalidae | 0.002 | 0.047 | 168 | 0.04 | 0.982 |
| Lasiocampidae – Saturniidae | 0.130 | 0.047 | 168 | 2.76 | **0.020** |
| Lasiocampidae – Sphingidae | 0.085 | 0.047 | 168 | 1.79 | 0.145 |
| Megalopygidae – Noctuidae | -0.095 | 0.047 | 168 | -2.01 | 0.099 |
| Megalopygidae – Notodontidae | 0.017 | 0.047 | 168 | 0.37 | 0.780 |
| Megalopygidae – Nymphalidae | -0.049 | 0.047 | 168 | -1.03 | 0.416 |
| Megalopygidae – Saturniidae | 0.080 | 0.047 | 168 | 1.69 | 0.158 |
| Megalopygidae – Sphingidae | 0.034 | 0.047 | 168 | 0.72 | 0.565 |
| Noctuidae – Notodontidae | 0.112 | 0.047 | 168 | 2.37 | **0.048** |
| Noctuidae – Nymphalidae | 0.046 | 0.047 | 168 | 0.97 | 0.434 |
| Noctuidae – Saturniidae | 0.175 | 0.047 | 168 | 3.70 | **0.002** |
| Noctuidae – Sphingidae | 0.129 | 0.047 | 168 | 2.73 | **0.020** |
| Notodontidae – Nymphalidae | -0.066 | 0.047 | 168 | -1.40 | 0.257 |
| Notodontidae – Saturniidae | 0.063 | 0.047 | 168 | 1.32 | 0.288 |
| Notodontidae – Sphingidae | 0.017 | 0.047 | 168 | 0.36 | 0.780 |
| Nymphalidae – Saturniidae | 0.129 | 0.047 | 168 | 2.72 | **0.020** |
| Nymphalidae – Sphingidae | 0.083 | 0.047 | 168 | 1.76 | 0.147 |
| Saturniidae – Sphingidae | -0.046 | 0.047 | 168 | -0.97 | 0.434 |