**Appendix 1**

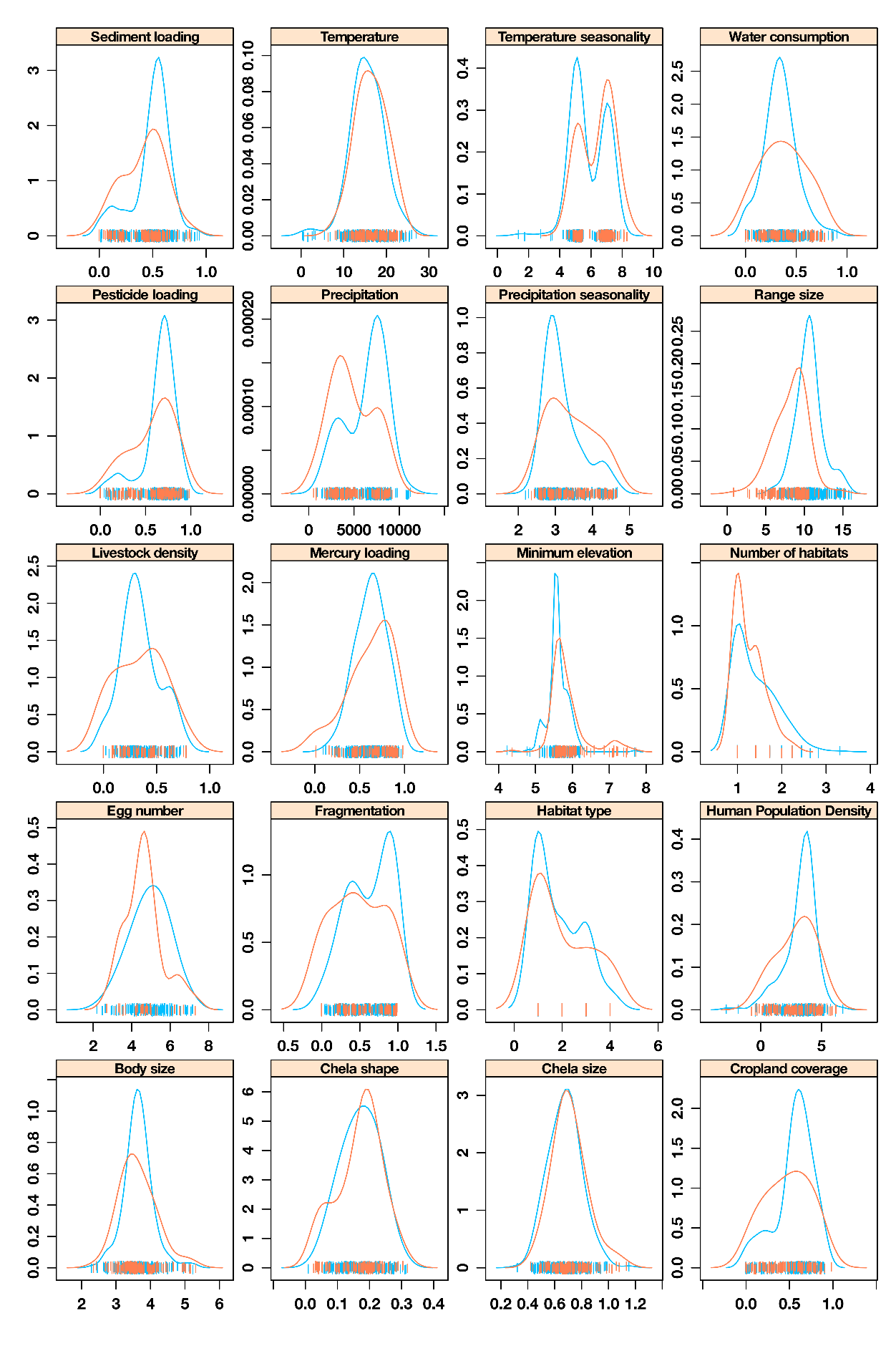
**Data**

I collected maximum body size (mm) from species descriptions, field guides and museum specimens (references available on request). I used maximum body size as mean body size is generally not available for crayfish species. I found three measures of crayfish body size: occipital carapace length (OCL), carapace length (CL), and body length (BL). I used CL as the preferred measure of body size as it was available for most species (397 species). For species for which maximum CL was missing, I preferentially transformed OCL values, as crayfish BL is a more variable measure of crayfish body size than OCL. I corrected OCL into CL for 53 species and BL into CL for 79 species. I developed correction factors between OCL and CL, and BL and CL from a database of morphological measurements of 1,743 specimens. These measurements were obtained from species descriptions, museum plates, museum specimens and field specimens (references available on request). I used species-specific correction factors when available, if not I used genus-specific correction factors (29 species).

I derived the average ratio of chela length to carapace length as a measure of chela size, and ratio of chela width to chela length as a measure of chela shape. I obtained morphological measurements at 0.1 mm precision from 1,743 museum specimens, field specimens and species description. I derived chela size and shape for female and intersex specimens, and for 20 heterochelous specimens I used measurements from the largest chela.

I followed Adamowicz & Purvis (2006) and assigned species to four habitat types: 1) streams and rivers, 2) lakes and wetlands, 3) burrows, and 4) caves. I used data from Adamowicz & Purvis (2006) for 490 species, and used IUCN assessments (IUCN 2010), field guides and species descriptions to classify the remaining species. Most secondary and tertiary burrowers from the scheme for North American species developed by Hobbs (1989) were placed in category “lakes and wetlands”, while “burrows” was reserved for primary burrowers. “Strong burrowers” in the Australian scheme of Riek (1972) were also placed in “burrows”, while weak or moderate burrowers were placed in categories “streams and rivers” or “lakes and wetlands” according to other habitat information.

As some species display habitat flexibility, I derived a measure of habitat specialisation from the number of IUCN-listed habitats occupied by each species (IUCN 2010). I recorded the geographical range size for each species (IUCN 2010). I extracted mean values in the species’ range of extrinsic factors with the *raster* package in R (Hijmans and van Etten, 2012).



**Figure S1.** Density plots of explanatory variables for non-threatened species (blue) and threatened species (red) (n = 450).

**Table S1.** Biological and extrinsic factors collected for freshwater crayfish included in the analysis (n=443).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Unit** | **Source** | **Resolution** | **Transformation** | **Completeness** |
| Body size | Maximum carapace length (mm) | Species descriptions and museum specimens | 0.1 mm | Log | 440 |
| Egg number | Maximum number of eggs | Species descriptions, field guides and museum specimens |  | Log | 170 |
| Chela size | Chela length (mm)/ Carapace length (mm) for females | Species descriptions and museum specimens | 0.1 mm | NA | 355 |
| Chela shape | Chela width (mm)/ Chela length (mm) for females | Species descriptions and museum specimens | 0.1 mm | Square | 354 |
| Habitat type | Streams and rivers, Lakes and wetlands, Burrow, Cave | Adamowicz & Purvis (2006), species descriptions and field guides |  | NA | 443 |
| Number of IUCN habitats |  | IUCN 2010 |  | Square root | 443 |
| Range size | km² | IUCN 2010 |  | Log | 443 |
| Mean annual temperature | Degrees (°C) | Hijmans *et al.* 2005 | 2.5 arc minutes | NA | 442 |
| Mean temperature seasonality | Standard deviation | Hijmans *et al.* 2005 | 2.5 arc minutes | Log | 442 |
| Mean annual precipitation | Millimeters | Hijmans *et al.* 2005 | 2.5 arc minutes | NA | 442 |
| Mean precipitation seasonality | Coefficient of variation | Hijmans *et al.* 2005 | 2.5 arc minutes | Log | 442 |
| Minimum elevation | Meters | Hijmans *et al.* 2005 | 2.5 arc minutes | Log | 442 |
| Elevation range | Meters | Hijmans *et al.* 2005 | 2.5 arc minutes | Log | 442 |
| Mean cropland coverage | CDF-standardized fraction of land devoted to growing crops | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 340 |
| Mean water consumption | CDF-standardized water consumption through irrigation, thermoelectric and manufacturing industries divided by contemporary discharge | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 437 |
| Mean wetland disconnectivity | CDF-standardized proportion of wetland occupied by cropland or impervious surface area | Vorosmarty *et al.* 2010 | 30 arc seconds | Log | 437 |
| Mean river fragmentation | CDF-standardized proportion of each drainage basin that is accessible from a given grid cell | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 433 |
| Mean mercury deposition | CDF-standardized difference between present-day and pre-industrial Hg deposition | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 437 |
| Mean pesticide loading | CDF-standardized country-based pesticide application to croplands | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 437 |
| Mean nitrogen loading | CDF-standardized nitrogen loads to rivers and their ctachments | Vorosmarty *et al.* 2010 | 30 arc seconds | NA | 340 |
| Mean sediment loading | CDF-standardized total suspended solids | Vorosmarty *et al.* 2010 | 30 arc seconds | Square | 437 |
| Mean human population density (2000) | People per km² | CIESIN 2005 | 30 arc seconds | Log | 358 |

**Table S2.** Threats affecting crayfish.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Threat | Count | Agriculture | Water management | Pollution |
| Climate change & severe weather | 192 |  |  |  |
| Agricultural & forestry effluents | 134 |  |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |
| Residential & commercial development | 107 |  |  |  |
| Biological resource use | 101 |  |  |  |
| Invasive species | 92 |  |  |  |
| Dams & water management/use | 88 |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |  |
| Domestic & urban waste water | 67 |  |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |
| Livestock farming & ranching | 57 | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |  |  |
| Transportation & service corridors | 55 |  |  |  |
| Fire & fire suppression | 43 |  |  |  |
| Industrial & military effluents | 41 |  |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |
| Annual & perennial non-timber crops | 40 | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |  |  |
| Human intrusions & disturbance | 36 |  |  |  |
| Energy production & mining | 25 |  |  |  |
| Other ecosystem modifications | 23 |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |  |
| Introduced genetic material & problematic native species | 23 |  |  |  |
| Wood & pulp plantations | 10 | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |  |  |
| Other threat | 4 |  |  |  |
| Garbage & solid waste | 3 |  |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |
| Air-borne pollutants | 3 |  |  | http://upload.wikimedia.org/wikipedia/commons/thumb/9/90/Check_mark_23x20_02.svg/1081px-Check_mark_23x20_02.svg.png |

**Table S3.** Taxonomic distribution of species in the IUCN Red List assessment by family.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Astacidae | Cambaridae | Parastacidae |
| All species | 6 | 307 | 138 |
| Threatened | 3 | 70 | 71 |
| Threat type |  |  |  |
| Agriculture | 1 | 40 | 48 |
| Water management | 3 | 58 | 31 |
| Pollution | 3 | 100 | 43 |

**Table S4.** Congruence in species listed under each threat type.

|  |  |  |  |
| --- | --- | --- | --- |
| Threat | Agriculture | Water management | Pollution |
| Agriculture |  | 28 | 46 |
| Water management |  |  | 47 |
| Pollution |  |  |  |

**Table S5.** Number of species and proportion of threatened species (in brackets) according to habitat type among data subsets. No Australian parastacids live in caves.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Global | American cambarids | Australian parastacids | Agriculture | Water management | Pollution |
| Streams | 226 (33%) | 134 (14%) | 60 (67%) | 37 (54%) | 54 (48%) | 70 (41%) |
| Temporary or standing waters | 88 (23%) | 59 (10%) | 6 (17%) | 16 (44%) | 12 (33%) | 21 (57%) |
| Burrows | 98 (27%) | 41 (17%) | 56 (34%) | 30 (57%) | 16 (75%) | 32 (56%) |
| Caves | 38 (60%) | 34 (65%) | NA | 45 (100%) | 10 (60%) | 22 (77%) |

**Table S6.** Phylogenetic signal of biological traits and extrinsic factors for the global crayfish dataset with undated phylogeny (n=443). Lambda (λ) was significantly different from zero for all variables. \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001.

|  |  |  |
| --- | --- | --- |
|  | λ | p-value |
| Life-history & morphology |  |  |
| Body size | 0.9 | <0.001\*\*\* |
| Egg number | 0.43 | 0.002\*\* |
| Chela size | 0.65 | <0.001\*\*\* |
| Chela shape | 0.73 | <0.001\*\*\* |
| Ecology |  |  |
| Habitat breadth | 0.51 | <0.001\*\*\* |
| Habitat type | 0.49 | <0.001\*\*\* |
| Range size | 0.68 | <0.001\*\*\* |
| Environment |  |  |
| Temperature | 0.98 | <0.001\*\*\* |
| Temperature seasonality | 1 | <0.001\*\*\* |
| Precipitation | 0.9 | <0.001\*\*\* |
| Precipitation seasonality | 1 | <0.001\*\*\* |
| Minimum elevation | 1 | <0.001\*\*\* |
| Drivers |  |  |
| Cropland coverage | 0.72 | <0.001\*\*\* |
| Livestock density | 0.74 | <0.001\*\*\* |
| Water consumption | 0.6 | <0.001\*\*\* |
| River fragmentation | 0.7 | <0.001\*\*\* |
| Mercury loading | 0.86 | <0.001\*\*\* |
| Pesticide loading | 0.77 | <0.001\*\*\* |
| Sediment loading | 0.82 | <0.001\*\*\* |
| Human population density | 0.63 | <0.001\*\*\* |

**Table S7.** Results of univariate pGLS on extinction risk (as defined by IUCN Red List categories) for the global crayfish dataset (n = 443). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.895 | 0.162 | -5.541 | 445 | 0 | 0.065 |
| Egg number | -0.245 | 0.081 | -3.039 | 169 | 0.003\*\* | 0.052 |
| Chela size | 1.433 | 0.708 | 2.025 | 357 | 0.044\* | 0.011 |
| Chela shape | -3.09 | 1.323 | -2.336 | 356 | 0.02\* | 0.015 |
| Habitat breadth | -0.865 | 0.159 | -5.439 | 448 | <0.001\*\*\* | 0.06 |
| Range size | -0.389 | 0.027 | -14.436 | 448 | <0.001\*\*\* | 0.316 |
| Temperature | 0.067 | 0.026 | 2.584 | 416 | 0.01\* | 0.016 |
| Temperature seasonality | -0.023 | 0.005 | -4.989 | 448 | <0.001\*\*\* | 0.051 |
| Precipitation | 0.583 | 0.22 | 2.653 | 448 | 0.008\*\* | 0.013 |
| Precipitation seasonality | 0.383 | 0.13 | 2.939 | 448 | 0.003\*\* | 0.017 |
| Minimum elevation | 0.815 | 0.096 | 8.443 | 448 | <0.001\*\*\* | 0.135 |
| Water consumption | 0.646 | 0.342 | 1.889 | 446 | 0.059 | 0.008 |
| Fragmentation | -0.138 | 0.302 | -0.456 | 441 | 0.648 | 0 |
| Mercury deposition | -0.617 | 0.367 | -1.683 | 446 | 0.093 | 0.006 |
| Pesticide loading | -0.206 | 0.389 | -0.529 | 446 | 0.597 | 0.001 |
| Sediment loading | -0.225 | 0.44 | -0.513 | 446 | 0.609 | 0.001 |
| Cropland coverage | 0.798 | 0.425 | 1.879 | 446 | 0.061 | 0.008 |
| Livestock density | -0.094 | 0.351 | -0.269 | 447 | 0.788 | 0 |
| HPD | 0.072 | 0.062 | 1.167 | 448 | 0.244 | 0.001 |
| HT intercept | 2.291 | 0.401 | 5.708 | 446 | <0.001\*\*\* | 0.108 |
| HT temporary or standing waters | -0.025 | 0.187 | -0.135 | 446 | 0.893 | NA |
| HT burrows | -0.322 | 0.21 | -1.537 | 446 | 0.125 | NA |
| HT caves | 1.687 | 0.248 | 6.804 | 446 | <0.001\*\*\* | NA |

**Table S8.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the global crayfish dataset (n = 443) with the undated phylogeny, with range size as a covariate. \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.446 | 0.141 | -3.17 | 444 | 0.002\*\* | 0.325 |
| Egg number | -0.025 | 0.072 | -0.351 | 168 | 0.726 | 0.352 |
| Chela size | 1.098 | 0.599 | 1.833 | 356 | 0.068 | 0.303 |
| Chela shape | -2.964 | 1.106 | -2.681 | 355 | 0.008 | 0.323 |
| Habitat breadth | -0.168 | 0.146 | -1.148 | 447 | 0.252 | 0.316 |
| Temperature | 0.041 | 0.022 | 1.894 | 415 | 0.059 | 0.33 |
| Temperature seasonality | -0.005 | 0.004 | -1.255 | 447 | 0.21 | 0.317 |
| Precipitation | -0.323 | 0.194 | -1.666 | 447 | 0.096 | 0.319 |
| Precipitation seasonality | 0.33 | 0.11 | 3 | 447 | 0.003\*\* | 0.328 |
| Minimum elevation | 0.192 | 0.102 | 1.879 | 447 | 0.061 | 0.32 |
| Water consumption | 0.735 | 0.283 | 2.593 | 445 | 0.01\* | 0.321 |
| Fragmentation | 0.146 | 0.252 | 0.58 | 440 | 0.562 | 0.31 |
| Mercury deposition | -0.155 | 0.308 | -0.503 | 445 | 0.615 | 0.311 |
| Pesticide loading | -0.027 | 0.324 | -0.085 | 445 | 0.932 | 0.311 |
| Sediment loading | -0.206 | 0.367 | -0.562 | 445 | 0.574 | 0.311 |
| Cropland coverage | 0.537 | 0.355 | 1.514 | 445 | 0.131 | 0.314 |
| Livestock density | -0.004 | 0.293 | -0.015 | 446 | 0.988 | 0.311 |
| HPD | 0.119 | 0.051 | 2.333 | 447 | 0.02\* | 0.323 |
| HT intercept | 5.985 | 0.449 | 13.326 | 445 | 0 | 0.379 |
| HT temporary or standing waters | 0.079 | 0.156 | 0.508 | 445 | 0.612 | NA |
| HT burrows | -0.307 | 0.178 | -1.731 | 445 | 0.084 | NA |
| HT caves | 1.307 | 0.209 | 6.244 | 445 | <0.001\*\*\* | NA |

**Table S9.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the American cambarids dataset (n = 268), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -8.02, df = 1,266, p<0.001, R² = 0.192). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.926 | 0.197 | -4.699 | 264 | <0.001\*\*\* | 0.253 |
| Egg number | -0.034 | 0.065 | -0.534 | 98 | 0.595 | 0.163 |
| Chela size | 1.578 | 0.733 | 2.154 | 215 | 0.032\* | 0.209 |
| Chela shape | -5.223 | 1.292 | -4.043 | 219 | <0.001\*\*\* | 0.246 |
| Habitat breadth | -0.107 | 0.193 | -0.557 | 265 | 0.578 | 0.175 |
| Temperature | 0.098 | 0.042 | 2.333 | 241 | 0.02\* | 0.242 |
| Temperature seasonality | -0.01 | 0.009 | -1.14 | 265 | 0.255 | 0.178 |
| Precipitation | -0.65 | 0.513 | -1.268 | 265 | 0.206 | 0.178 |
| Precipitation seasonality | 1.19 | 0.225 | 5.287 | 265 | <0.001\*\*\* | 0.262 |
| Minimum elevation | -0.095 | 0.305 | -0.312 | 265 | 0.755 | 0.173 |
| Water consumption | 0.889 | 0.451 | 1.972 | 265 | 0.05 | 0.187 |
| Fragmentation | 0.127 | 0.331 | 0.383 | 264 | 0.702 | 0.176 |
| Mercury deposition | 0.05 | 0.521 | 0.096 | 265 | 0.924 | 0.173 |
| Pesticide loading | -0.625 | 0.629 | -0.994 | 265 | 0.321 | 0.176 |
| Sediment loading | -0.912 | 0.567 | -1.609 | 265 | 0.109 | 0.181 |
| Cropland coverage | -0.693 | 0.544 | -1.274 | 265 | 0.204 | 0.178 |
| Livestock density | 0.135 | 0.477 | 0.283 | 265 | 0.777 | 0.173 |
| HPD | 0.261 | 0.107 | 2.43 | 265 | 0.016\* | 0.192 |
| HT intercept | 4.698 | 0.448 | 10.499 | 263 | <0.001\*\*\* | 0.429 |
| HT temporary or standing waters | 0.175 | 0.172 | 1.018 | 263 | 0.309 | NA |
| HT burrows | 0.102 | 0.205 | 0.496 | 263 | 0.62 | NA |
| HT caves | 2.008 | 0.201 | 9.964 | 263 | <0.001\*\*\* | NA |

**Table S10.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the Australian parastacids dataset (n = 122) with the undated phylogeny, with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t=-9.77, df=1,120, p<0.001, R²=0.44) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.147 | 0.225 | -0.651 | 119 | 0.516 | 0.437 |
| Egg number | 0.1 | 0.139 | 0.715 | 53 | 0.478 | 0.392 |
| Chela size | 0.805 | 1.261 | 0.639 | 88 | 0.524 | 0.498 |
| Chela shape | -0.758 | 2.574 | -0.294 | 90 | 0.769 | 0.491 |
| Habitat breadth | -0.08 | 0.258 | -0.312 | 119 | 0.756 | 0.434 |
| Temperature | 0.06 | 0.03 | 2.01 | 116 | 0.047\* | 0.472 |
| Temperature seasonality | 0.031 | 0.014 | 2.248 | 119 | 0.026\* | 0.456 |
| Precipitation | -0.529 | 0.309 | -1.713 | 119 | 0.089 | 0.447 |
| Precipitation seasonality | 0.287 | 0.234 | 1.226 | 119 | 0.222 | 0.44 |
| Minimum elevation | 0.023 | 0.232 | 0.098 | 119 | 0.922 | 0.434 |
| Water consumption | 0.671 | 0.409 | 1.642 | 118 | 0.103 | 0.455 |
| Fragmentation | -0.156 | 0.43 | -0.364 | 115 | 0.717 | 0.441 |
| Mercury deposition | 0.153 | 0.527 | 0.289 | 118 | 0.773 | 0.443 |
| Pesticide loading | 0.21 | 0.422 | 0.498 | 118 | 0.62 | 0.444 |
| Sediment loading | 0.136 | 0.547 | 0.249 | 118 | 0.804 | 0.443 |
| Cropland coverage | 0.836 | 0.614 | 1.362 | 118 | 0.176 | 0.451 |
| Livestock density | -0.317 | 0.414 | -0.766 | 119 | 0.445 | 0.437 |
| HPD | 0.035 | 0.065 | 0.539 | 119 | 0.591 | 0.435 |
| HT intercept | 6.534 | 0.611 | 10.703 | 118 | <0.001\*\*\* | 0.444 |
| HT temporary or standing waters | -0.347 | 0.468 | -0.74 | 118 | 0.46 | NA |
| HT burrows | -0.795 | 0.358 | -2.218 | 118 | 0.028\* | NA |

**Table S11.** Results of univariate pGLS on extinction risk (as defined by IUCN Red List categories) for the agriculture dataset (n = 82). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.162 | 0.403 | -0.402 | 79 | 0.689 | 0.276 |
| Egg number | -0.301 | 0.263 | -1.141 | 19 | 0.268 | 0.429 |
| Chela size | 2.301 | 1.283 | 1.794 | 59 | 0.078 | 0.267 |
| Chela shape | 2.025 | 2.594 | 0.781 | 60 | 0.438 | 0.241 |
| Habitat breadth | 0.193 | 0.453 | 0.427 | 79 | 0.67 | 0.273 |
| Temperature | -0.022 | 0.049 | -0.456 | 78 | 0.65 | 0.269 |
| Temperature seasonality | 0.426 | 0.21 | 2.024 | 78 | 0.046\* | 0.274 |
| Precipitation | 0.0002 | 0.00007 | 2.787 | 78 | 0.007\*\* | 0.248 |
| Precipitation seasonality | -0.192 | 0.272 | -0.708 | 78 | 0.481 | 0.271 |
| Minimum elevation | 0.419 | 0.46 | 0.91 | 78 | 0.366 | 0.269 |
| Water consumption | 0.456 | 0.73 | 0.625 | 76 | 0.534 | 0.269 |
| Fragmentation | 1.454 | 0.523 | 2.777 | 75 | 0.007\*\* | 0.244 |
| Mercury deposition | -0.23 | 0.796 | -0.289 | 76 | 0.774 | 0.265 |
| Pesticide loading | -0.284 | 0.81 | -0.351 | 76 | 0.727 | 0.268 |
| Sediment loading | -0.014 | 1.032 | -0.013 | 76 | 0.99 | 0.264 |
| HPD | 0.23 | 0.127 | 1.811 | 69 | 0.074 | 0.357 |
| Cropland coverage | -0.499 | 0.942 | -0.529 | 61 | 0.598 | 0.318 |
| Livestock density | -0.331 | 0.632 | -0.523 | 72 | 0.603 | 0.337 |
| HT intercept | 6.168 | 0.845 | 7.296 | 77 | <0.0001\*\*\* | 0.314 |
| HT temporary or standing waters | -0.306 | 0.459 | -0.668 | 77 | 0.506 | NA |
| HT burrows | 0.24 | 0.445 | 0.539 | 77 | 0.592 | NA |
| HT caves | 1.569 | 0.587 | 2.674 | 77 | 0.009\*\* | NA |

**Table S12.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the water management dataset (n = 92) for the undated phylogeny, with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -5.8, df = 1,90, p<0.001, R² = 0.272) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.422 | 0.283 | -1.492 | 88 | 0.139 | 0.277 |
| Egg number | 0.001 | 0.243 | 0.004 | 27 | 0.997 | 0.348 |
| Chela size | 0.903 | 1.493 | 0.605 | 69 | 0.547 | 0.237 |
| Chela shape | 2.935 | 2.551 | 1.151 | 68 | 0.254 | 0.252 |
| Habitat breadth | -0.192 | 0.392 | -0.491 | 89 | 0.625 | 0.259 |
| Temperature | -0.012 | 0.045 | -0.28 | 89 | 0.78 | 0.257 |
| Temperature seasonality | -0.085 | 0.185 | -0.461 | 89 | 0.646 | 0.258 |
| Precipitation | -0.0001 | 0.00008 | -1.386 | 89 | 0.169 | 0.273 |
| Precipitation seasonality | 0.535 | 0.251 | 2.13 | 89 | 0.036\* | 0.293 |
| Minimum elevation | 0.035 | 0.373 | 0.093 | 89 | 0.926 | 0.256 |
| Water consumption | 0.52 | 0.686 | 0.757 | 85 | 0.451 | 0.236 |
| Fragmentation | 0.433 | 0.596 | 0.727 | 84 | 0.469 | 0.236 |
| Mercury deposition | 0.341 | 0.766 | 0.445 | 85 | 0.658 | 0.233 |
| Pesticide loading | 0.387 | 0.728 | 0.531 | 85 | 0.597 | 0.234 |
| Sediment loading | -0.082 | 0.792 | -0.103 | 85 | 0.918 | 0.232 |
| HPD | 0.08 | 0.125 | 0.635 | 74 | 0.527 | 0.259 |
| Cropland coverage | 0.602 | 0.721 | 0.836 | 60 | 0.407 | 0.37 |
| Livestock density | 0.438 | 0.651 | 0.674 | 74 | 0.503 | 0.422 |
| HT intercept | 5.997 | 0.718 | 8.348 | 87 | <0.001\*\*\* | 0.263 |
| HT temporary or standing waters | -0.301 | 0.416 | -0.723 | 87 | 0.472 | NA |
| HT burrows | 0.464 | 0.426 | 1.091 | 87 | 0.278 | NA |
| HT caves | 0.332 | 0.473 | 0.701 | 87 | 0.485 | NA |

**Table S13.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the pollution dataset (n = 138), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -8.26, df = 1, 136, p < 0.001, R² = 0.33) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.326 | 0.252 | -1.296 | 134 | 0.197 | 0.324 |
| Egg number | -0.008 | 0.183 | -0.045 | 35 | 0.964 | 0.257 |
| Chela size | 2.375 | 0.958 | 2.479 | 110 | 0.015\* | 0.34 |
| Chela shape | -2.591 | 1.678 | -1.544 | 108 | 0.125 | 0.389 |
| Habitat breadth | -0.01 | 0.313 | -0.032 | 135 | 0.974 | 0.325 |
| Temperature | -0.002 | 0.027 | -0.057 | 134 | 0.954 | 0.325 |
| Temperature seasonality | 0.001 | 0.107 | 0.006 | 134 | 0.995 | 0.325 |
| Precipitation | 0.0003 | 0.0005 | 0.606 | 134 | 0.546 | 0.327 |
| Precipitation seasonality | 0.519 | 0.17 | 3.058 | 134 | 0.003\*\* | 0.369 |
| Minimum elevation | 0.192 | 0.324 | 0.593 | 134 | 0.554 | 0.327 |
| Water consumption | 1.287 | 0.563 | 2.286 | 131 | 0.024\* | 0.337 |
| Fragmentation | 0.495 | 0.375 | 1.319 | 131 | 0.189 | 0.32 |
| Mercury deposition | 1.393 | 0.57 | 2.445 | 131 | 0.016\* | 0.341 |
| Pesticide loading | 1.33 | 0.545 | 2.441 | 131 | 0.016\* | 0.341 |
| Sediment loading | 0.407 | 0.586 | 0.695 | 131 | 0.489 | 0.313 |
| HPD | 0.015 | 0.09 | 0.17 | 114 | 0.865 | 0.318 |
| Cropland coverage | 0.689 | 0.531 | 1.298 | 111 | 0.197 | 0.344 |
| Livestock density | 0.539 | 0.526 | 1.026 | 126 | 0.307 | 0.384 |
| HT intercept | 6.315 | 0.454 | 13.91 | 133 | <0.001\*\*\* | 0.435 |
| HT temporary or standing waters | -0.115 | 0.316 | -0.364 | 133 | 0.716 | NA |
| HT burrows | -0.407 | 0.261 | -1.558 | 133 | 0.121 | NA |
| HT caves | 1.223 | 0.284 | 4.313 | 133 | <0.001\*\*\* | NA |

**Table S14.** Phylogenetic signal of biological traits and extrinsic factors for the global crayfish dataset with dated phylogeny (n=267). Lambda (λ) was significantly different from zero for all variables. \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001.

|  |  |  |
| --- | --- | --- |
|  | λ | p-value |
| Life-history & morphology |  |  |
| Body size | 0.443 | <0.001\*\*\* |
| Egg number | 0.593 | <0.001\*\*\* |
| Chela size | 0.691 | <0.001\*\*\* |
| Chela shape | 0.657 | <0.001\*\*\* |
| Ecology |  |  |
| Habitat breadth | 0.592 | <0.001\*\*\* |
| Habitat type | 0.37 | <0.001\*\*\* |
| Range size | 0.469 | <0.001\*\*\* |
| Environment |  |  |
| Temperature | 0.964 | <0.001\*\*\* |
| Temperature seasonality | 0.933 | <0.001\*\*\* |
| Precipitation | 0.616 | <0.001\*\*\* |
| Precipitation seasonality | 0.971 | <0.001\*\*\* |
| Minimum elevation | 0.429 | <0.001\*\*\* |
| Drivers |  |  |
| Cropland coverage | 0.775 | <0.001\*\*\* |
| Livestock density | 0.798 | <0.001\*\*\* |
| Water consumption | 0.835 | <0.001\*\*\* |
| River fragmentation | 0.781 | <0.001\*\*\* |
| Mercury loading | 0.376 | <0.001\*\*\* |
| Pesticide loading | 0.703 | <0.001\*\*\* |
| Sediment loading | 0.69 | <0.001\*\*\* |
| Human population density | 0.662 | <0.001\*\*\* |

**Table S15.** Results of univariate pGLS on extinction risk (as defined by IUCN Red List categories) for the global crayfish dataset and dated phylogeny (n=267). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.416 | 0.177 | -2.353 | 263 | 0.019\* | 0.021 |
| Egg number | -0.152 | 0.097 | -1.565 | 131 | 0.12 | 0.018 |
| Chela size | 1 | 0.92 | 1.086 | 203 | 0.279 | 0.006 |
| Chela shape | -1.335 | 1.274 | -1.047 | 205 | 0.296 | 0.005 |
| Habitat breadth | -0.308 | 0.191 | -1.611 | 265 | 0.108 | 0.006 |
| Range size | -0.297 | 0.036 | -8.325 | 265 | <0.001\*\*\* | 0.204 |
| Temperature | 0.049 | 0.034 | 1.439 | 241 | 0.152 | 0.009 |
| Temperature seasonality | -0.015 | 0.007 | -2.213 | 265 | 0.028\* | 0.014 |
| Precipitation | 0.247 | 0.321 | 0.769 | 265 | 0.442 | -0.002 |
| Precipitation seasonality | 0.533 | 0.197 | 2.702 | 265 | 0.007\*\* | 0.023 |
| Minimum elevation | 0.838 | 0.161 | 5.218 | 265 | <0.001\*\*\* | 0.09 |
| Water consumption | 0.522 | 0.439 | 1.19 | 264 | 0.235 | 0.005 |
| Fragmentation | 0.127 | 0.358 | 0.355 | 262 | 0.723 | 0 |
| Mercury deposition | -0.799 | 0.498 | -1.604 | 264 | 0.11 | 0.01 |
| Pesticide loading | -0.131 | 0.468 | -0.281 | 264 | 0.779 | 0 |
| Sediment loading | -1.23 | 0.502 | -2.452 | 264 | 0.015\* | 0.022 |
| Cropland coverage | 0.72 | 0.557 | 1.292 | 264 | 0.197 | 0.006 |
| Livestock density | 0.068 | 0.435 | 0.156 | 265 | 0.876 | -0.004 |
| HPD | -0.067 | 0.074 | -0.909 | 265 | 0.364 | -0.001 |
| HT intercept | 2.297 | 0.336 | 6.835 | 263 | <0.001\*\*\* | 0.031 |
| HT temporary or standing waters | -0.406 | 0.268 | -1.516 | 263 | 0.131 | NA |
| HT burrows | -0.118 | 0.25 | -0.47 | 263 | 0.639 | NA |
| HT caves | 1.003 | 0.368 | 2.721 | 263 | 0.007\*\* | NA |

**Table S16.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the global crayfish dataset and dated phylogeny (n=267), with range size as a covariate. \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.071 | 0.165 | -0.427 | 262 | 0.669 | 0.206 |
| Egg number | -0.017 | 0.091 | -0.189 | 130 | 0.851 | 0.211 |
| Chela size | 0.756 | 0.816 | 0.927 | 202 | 0.355 | 0.222 |
| Chela shape | -1.617 | 1.109 | -1.459 | 204 | 0.146 | 0.241 |
| Habitat breadth | 0.242 | 0.183 | 1.321 | 264 | 0.188 | 0.207 |
| Temperature | 0.054 | 0.03 | 1.82 | 240 | 0.07 | 0.243 |
| Temperature seasonality | 0.005 | 0.007 | 0.77 | 264 | 0.442 | 0.203 |
| Precipitation | -0.807 | 0.308 | -2.621 | 264 | 0.009 | 0.222 |
| Precipitation seasonality | 0.559 | 0.175 | 3.197 | 264 | 0.002\*\* | 0.231 |
| Minimum elevation | 0.163 | 0.185 | 0.878 | 264 | 0.381 | 0.204 |
| Water consumption | 0.556 | 0.391 | 1.422 | 263 | 0.156 | 0.213 |
| Fragmentation | 0.137 | 0.32 | 0.428 | 261 | 0.669 | 0.204 |
| Mercury deposition | -0.5 | 0.447 | -1.118 | 263 | 0.265 | 0.211 |
| Pesticide loading | 0.039 | 0.418 | 0.092 | 263 | 0.927 | 0.207 |
| Sediment loading | -1.11 | 0.447 | -2.48 | 263 | 0.014\* | 0.225 |
| Cropland coverage | 0.743 | 0.495 | 1.499 | 263 | 0.135 | 0.214 |
| Livestock density | -0.159 | 0.388 | -0.408 | 264 | 0.683 | 0.202 |
| HPD | -0.014 | 0.067 | -0.215 | 264 | 0.83 | 0.201 |
| HT intercept | 5.117 | 0.463 | 11.062 | 262 | <0.001\*\*\* | 0.221 |
| HT temporary or standing waters | 0.007 | 0.246 | 0.027 | 262 | 0.979 | NA |
| HT burrows | -0.092 | 0.225 | -0.41 | 262 | 0.682 | NA |
| HT caves | 0.912 | 0.331 | 2.756 | 262 | 0.006\*\* | NA |

**Table S17.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the American cambarids dataset with the dated phylogeny (n = 158), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -4.43, df = 1,156, p<0.001, R² = 0.112). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.319 | 0.215 | -1.48 | 154 | 0.141 | 0.124 |
| Egg number | -0.066 | 0.067 | -0.983 | 76 | 0.329 | 0.107 |
| Chela size | 1.283 | 0.917 | 1.399 | 118 | 0.164 | 0.093 |
| Chela shape | -1.866 | 1.193 | -1.564 | 121 | 0.12 | 0.1 |
| Habitat breadth | 0.12 | 0.226 | 0.533 | 155 | 0.595 | 0.102 |
| Temperature | -0.016 | 0.043 | -0.362 | 137 | 0.718 | 0.106 |
| Temperature seasonality | 0.018 | 0.009 | 1.859 | 155 | 0.065 | 0.105 |
| Precipitation | -0.097 | 0.576 | -0.169 | 155 | 0.866 | 0.101 |
| Precipitation seasonality | 0.266 | 0.288 | 0.924 | 155 | 0.357 | 0.106 |
| Minimum elevation | 0.097 | 0.286 | 0.339 | 155 | 0.735 | 0.101 |
| Water consumption | -0.146 | 0.625 | -0.234 | 155 | 0.815 | 0.101 |
| Fragmentation | 0.446 | 0.38 | 1.174 | 155 | 0.242 | 0.109 |
| Mercury deposition | -0.937 | 0.52 | -1.804 | 155 | 0.073 | 0.119 |
| Pesticide loading | -0.568 | 0.663 | -0.856 | 155 | 0.393 | 0.105 |
| Sediment loading | -1.625 | 0.666 | -2.439 | 155 | 0.016\* | 0.118 |
| Cropland coverage | 0.717 | 0.615 | 1.167 | 155 | 0.245 | 0.108 |
| Livestock density | -0.318 | 0.527 | -0.604 | 155 | 0.547 | 0.103 |
| HPD | -0.117 | 0.132 | -0.887 | 155 | 0.376 | 0.105 |
| HT intercept | 3.322 | 0.535 | 6.205 | 153 | <0.001\*\* | 0.223 |
| HT temporary or standing waters | -0.036 | 0.226 | -0.159 | 153 | 0.874 | NA |
| HT burrows | 0.339 | 0.203 | 1.674 | 153 | 0.096 | NA |
| HT caves | 1.201 | 0.241 | 4.979 | 153 | <0.001\*\* | NA |

**Table S18.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the Australian parastacids dataset with the dated phylogeny (n=90), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t=-7.55, df=1,88, p<0.001, R²=0.393) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | 0.011 | 0.249 | 0.046 | 87 | 0.964 | 0.379 |
| Egg number | 0.119 | 0.164 | 0.725 | 43 | 0.473 | 0.365 |
| Chela size | 0.002 | 1.538 | 0.002 | 65 | 0.999 | 0.446 |
| Chela shape | -2.391 | 2.682 | -0.891 | 66 | 0.376 | 0.455 |
| Habitat breadth | 0.062 | 0.305 | 0.205 | 87 | 0.838 | 0.38 |
| Temperature | 0.098 | 0.043 | 2.303 | 84 | 0.024\* | 0.429 |
| Temperature seasonality | 0.039 | 0.019 | 2.11 | 87 | 0.038\* | 0.41 |
| Precipitation | -0.733 | 0.389 | -1.886 | 87 | 0.063 | 0.406 |
| Precipitation seasonality | 0.51 | 0.325 | 1.568 | 87 | 0.121 | 0.392 |
| Minimum elevation | 0.152 | 0.318 | 0.477 | 87 | 0.635 | 0.38 |
| Water consumption | 0.607 | 0.529 | 1.148 | 86 | 0.254 | 0.401 |
| Fragmentation | 0.49 | 0.545 | 0.898 | 84 | 0.372 | 0.394 |
| Mercury deposition | 0.259 | 0.716 | 0.361 | 86 | 0.719 | 0.394 |
| Pesticide loading | 0.621 | 0.572 | 1.084 | 86 | 0.281 | 0.401 |
| Sediment loading | -0.017 | 0.688 | -0.025 | 86 | 0.98 | 0.393 |
| Cropland coverage | 1.521 | 0.877 | 1.734 | 86 | 0.087 | 0.415 |
| Livestock density | -0.215 | 0.575 | -0.374 | 87 | 0.709 | 0.379 |
| HPD | -0.037 | 0.083 | -0.443 | 87 | 0.659 | 0.381 |
| HT intercept | 6.635 | 0.611 | 10.857 | 86 | <0.001\*\*\* | 0.385 |
| HT temporary or standing waters | -0.267 | 0.63 | -0.423 | 86 | 0.673 | NA |
| HT burrows | -0.783 | 0.404 | -1.939 | 86 | 0.056 | NA |

**Table S19.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the agriculture dataset with the dated phylogeny (n = 49). \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | 0.358 | 0.434 | 0.824 | 46 | 0.414 | 0.353 |
| Egg number | -0.204 | 0.3 | -0.677 | 13 | 0.51 | 0.372 |
| Chela size | 1.25 | 2.102 | 0.595 | 33 | 0.556 | 0.323 |
| Chela shape | 0.142 | 3.828 | 0.037 | 34 | 0.971 | 0.344 |
| Habitat breadth | 0.31 | 0.512 | 0.606 | 46 | 0.548 | 0.354 |
| Temperature | 0 | 0.058 | 0.005 | 46 | 0.996 | 0.345 |
| Temperature seasonality | 0.224 | 0.231 | 0.972 | 46 | 0.336 | 0.356 |
| Precipitation | 0 | 0 | 2.231 | 46 | 0.031\* | 0.395 |
| Precipitation seasonality | -0.223 | 0.374 | -0.597 | 46 | 0.553 | 0.35 |
| Minimum elevation | -0.194 | 0.538 | -0.361 | 46 | 0.72 | 0.349 |
| Water consumption | 0.305 | 0.844 | 0.361 | 44 | 0.72 | 0.369 |
| Fragmentation | 1.232 | 0.681 | 1.809 | 44 | 0.077 | 0.396 |
| Mercury deposition | -1.163 | 0.924 | -1.258 | 44 | 0.215 | 0.382 |
| Pesticide loading | 0.086 | 0.941 | 0.091 | 44 | 0.928 | 0.365 |
| Sediment loading | -0.118 | 1.111 | -0.106 | 44 | 0.916 | 0.365 |
| HPD | 0.207 | 0.14 | 1.474 | 45 | 0.148 | 0.401 |
| Cropland coverage | 2.268 | 1.205 | 1.883 | 31 | 0.069 | 0.35 |
| Livestock density | -0.539 | 0.879 | -0.614 | 40 | 0.543 | 0.437 |
| HT intercept | 6.835 | 0.901 | 7.583 | 44 | <0.001\*\*\* | 0.39 |
| HT temporary or standing waters | -0.955 | 0.626 | -1.524 | 44 | 0.135 | NA |
| HT burrows | -0.217 | 0.463 | -0.468 | 44 | 0.642 | NA |
| HT caves | 1.617 | 0.937 | 1.727 | 44 | 0.091 | NA |

**Table S20.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the water management dataset with the dated phylogeny (n = 60), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -3.36, d f= 1,58, p = 0.001, R² = 0.16) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.356 | 0.31 | -1.146 | 57 | 0.256 | 0.157 |
| Egg number | -0.138 | 0.286 | -0.481 | 23 | 0.635 | 0.279 |
| Chela size | 0.818 | 2.086 | 0.392 | 42 | 0.697 | 0.098 |
| Chela shape | 1.2 | 3.036 | 0.395 | 40 | 0.695 | 0.124 |
| Habitat breadth | -0.214 | 0.439 | -0.487 | 57 | 0.628 | 0.138 |
| Temperature | 0.002 | 0.052 | 0.047 | 57 | 0.962 | 0.134 |
| Temperature seasonality | -0.115 | 0.209 | -0.55 | 57 | 0.584 | 0.139 |
| Precipitation | -0.00004 | 0.0001 | -0.327 | 57 | 0.745 | 0.135 |
| Precipitation seasonality | 0.406 | 0.324 | 1.254 | 57 | 0.215 | 0.156 |
| Minimum elevation | 0.245 | 0.435 | 0.564 | 57 | 0.575 | 0.14 |
| Water consumption | 0.655 | 0.805 | 0.814 | 55 | 0.419 | 0.154 |
| Fragmentation | 0.708 | 0.677 | 1.045 | 54 | 0.3 | 0.163 |
| Mercury deposition | 1.098 | 0.841 | 1.306 | 55 | 0.197 | 0.169 |
| Pesticide loading | 0.952 | 0.772 | 1.234 | 55 | 0.222 | 0.168 |
| Sediment loading | 0.696 | 1 | 0.696 | 55 | 0.489 | 0.152 |
| HPD | 0.153 | 0.137 | 1.117 | 54 | 0.269 | 0.193 |
| Cropland coverage | 1.874 | 1.291 | 1.452 | 35 | 0.155 | 0.289 |
| Livestock density | 0.938 | 0.818 | 1.17 | 45 | 0.258 | 0.36 |
| HT intercept | 5.313 | 0.985 | 5.396 | 55 | <0.001\* | 0.121 |
| HT temporary or standing waters | -0.472 | 0.489 | -0.966 | 55 | 0.338 | NA |
| HT burrows | 0.181 | 0.603 | 0.3 | 55 | 0.766 | NA |
| HT caves | 0.014 | 0.647 | 0.021 | 55 | 0.983 | NA |

**Table S21.** Results of bivariate pGLS on extinction risk (as defined by IUCN Red List categories) for the pollution dataset with the dated phylogeny (n = 83), with range size as a covariate. Range size is the most significant predictor of risk in univariate pGLS (t = -5.64, df = 1,81, p < 0.001, R² = 0.282) \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom. HT: habitat type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Body size | -0.015 | 0.319 | -0.048 | 79 | 0.962 | 0.282 |
| Egg number | 0.117 | 0.215 | 0.545 | 27 | 0.59 | 0.376 |
| Chela size | 1.894 | 1.614 | 1.174 | 60 | 0.245 | 0.277 |
| Chela shape | -1.287 | 2.586 | -0.498 | 59 | 0.621 | 0.366 |
| Habitat breadth | 0.51 | 0.411 | 1.241 | 80 | 0.218 | 0.278 |
| Temperature | -0.019 | 0.04 | -0.479 | 80 | 0.633 | 0.266 |
| Temperature seasonality | -0.07 | 0.163 | -0.43 | 80 | 0.668 | 0.266 |
| Precipitation | 0.00003 | 0.00008 | 0.371 | 80 | 0.712 | 0.265 |
| Precipitation seasonality | 0.507 | 0.244 | 2.076 | 80 | 0.041\* | 0.33 |
| Minimum elevation | 0.251 | 0.454 | 0.553 | 80 | 0.582 | 0.267 |
| Water consumption | 1.156 | 0.816 | 1.417 | 78 | 0.161 | 0.32 |
| Fragmentation | 0.892 | 0.635 | 1.405 | 78 | 0.164 | 0.298 |
| Mercury deposition | 0.967 | 0.779 | 1.242 | 78 | 0.218 | 0.316 |
| Pesticide loading | 1.285 | 0.685 | 1.876 | 78 | 0.064 | 0.333 |
| Sediment loading | 0.381 | 0.994 | 0.383 | 78 | 0.703 | 0.282 |
| HPD | 0.019 | 0.101 | 0.187 | 78 | 0.852 | 0.291 |
| Cropland coverage | 1.439 | 0.66 | 2.182 | 63 | 0.033 | 0.398 |
| Livestock density | 1.208 | 0.707 | 1.708 | 73 | 0.092 | 0.392 |
| HT intercept | 6.118 | 0.653 | 9.37 | 78 | <0.001\* | 0.306 |
| HT temporary or standing waters | 0.212 | 0.595 | 0.356 | 78 | 0.723 | NA |
| HT burrows | -0.053 | 0.325 | -0.163 | 78 | 0.871 | NA |
| HT caves | 0.797 | 0.458 | 1.737 | 78 | 0.086 | NA |

**Table S22.** Results of minimum adequate models of extinction risk (as defined by IUCN Red List categories) for the dated phylogeny for: (a) global crayfish dataset (n = 242), (b) American cambarids (n = 157), (c) Australian parastacids (n = 87), and species threatened by: (d) agriculture (n = 49), (e) water management (n = 60), and (f) pollution (n = 83). Model sample sizes may differ from dataset sizes due to missing data. P: \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. Pcorr are Bonferroni adjusted p-values. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | P | Pcorr | Model R2 | λ |
| (a) Global |  |  |  |  |  |  |  |
| Intercept | 18.331 | 3.322 | 5.518 | <0.001 |  | 0.322 | 0.361 |
| Range size | -0.425 | 0.045 | -9.524 | <0.001 | <0.001\*\*\* |  |  |
| Habitat type - Cave | 1.04 | 0.316 | 3.296 | 0.001 | 0.006\*\* |  |  |
| Temperature | 0.087 | 0.029 | 3.009 | 0.003 | 0.015\* |  |  |
| Precipitation | -1.718 | 0.425 | -4.047 | <0.001 | <0.001\*\*\* |  |  |
| Mercury deposition | -1.979 | 0.587 | -3.372 | 0.001 | 0.004\*\* |  |  |
| (b) American cambarids | | | | |  |  |  |
| (Intercept) | 15.334 | 5.131 | 2.988 | 0.003 |  | 0.292 | 0 |
| Range size | -0.224 | 0.055 | -4.067 | <0.001 | <0.001\*\*\* |  |
| Body size | -0.396 | 0.2 | -1.977 | 0.05 | 0.299 |  |
| Habitat type - Burrows | 0.484 | 0.199 | 2.428 | 0.016 | 0.098 |  |
| Habitat type - Cave | 1.185 | 0.234 | 5.069 | <0.001 | <0.001\*\*\* |  |
| Precipitation | -1.302 | 0.625 | -2.084 | 0.039 | 0.233 |  |
| Mercury deposition | -1.548 | 0.562 | -2.756 | 0.007 | 0.039\* |  |
| (c) Australian parastacids |  |  |  |  |  |  |  |
| Intercept | 3.249 | 1.01 | 3.216 | 0.002 |  | 0.487 | 0.402 |
| Range size | -0.555 | 0.065 | -8.58 | <0.001 | <0.001\*\*\* |  |  |
| Temperature seasonality | 0.058 | 0.019 | 3.073 | 0.003 | 0.009\*\* |  |  |
| Temperature | 0.139 | 0.043 | 3.253 | 0.002 | 0.005\*\* |  |  |
| (d) Agriculture |  |  |  |  |  |  |  |
| Intercept | 6.608 | 0.722 | 9.158 | 0 |  | 0.458 | 0 |
| Range size | -0.596 | 0.098 | -6.077 | 0 | <0.001\*\*\* |  |  |
| Habitat type - Cave | -0.815 | 0.369 | -2.205 | 0.033 | 0.098 |  |  |
| Precipitation | 0.0003 | 0.0001 | 3.488 | 0.001 | 0.003\*\* |  |  |
| (e) Water management |  |  |  |  |  |  |  |
| Intercept | 5.254 | 0.92 | 5.709 | <0.001 |  | 0.163 | 0.55 |
| Range size | -0.285 | 0.085 | -3.366 | 0.001 | 0.001\* |  |  |
| (f) Pollution |  |  |  |  |  |  |  |
| Intercept | 4.263 | 0.99 | 4.306 | <0.001 |  | 0.379 | 0 |
| Range size | -0.355 | 0.058 | -6.092 | <0.001 | <0.001\*\*\* |  |  |
| Habitat type - Cave | 0.88 | 0.429 | 2.052 | 0.043 | 0.13 |  |  |
| Precipitation seasonality | 0.548 | 0.24 | 2.279 | 0.025 | 0.076 |  |  |

**Table S23.** Multiplicative bivariate pGLS including range size and significant factors for MAMs based on the non-dated phylogeny. P: \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. Pcorr are Bonferroni adjusted p-values. No.: number of. HPD: human population density. SE: standard error. df: degrees of freedom.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | P | Pcorr | Model R2 | λ |
| (a) Global |  |  |  |  |  |  |  |
| **Body size** |  |  |  |  |  |  |  |
| Intercept | 9.992 | 1.937 | 5.157 | <0.001 | NA | 0.328 | 0.637 |
| Range size | -0.597 | 0.188 | -3.185 | 0.002 | 0.005 |  |  |
| Body size | -1.073 | 0.517 | -2.076 | 0.038 | 0.115 |  |  |
| Range size x body size | 0.064 | 0.05 | 1.258 | 0.209 | 0.627 |  |  |
| **Habitat type - Cave** |  |  |  |  |  |  |  |
| Intercept | 5.937 | 0.467 | 12.701 | <0.001 | NA | 0.379 | 0.523 |
| Range size | -0.364 | 0.026 | -13.77 | <0.001 | <0.001 |  |  |
| Habitat type - Cave | 0.799 | 1.34 | 0.596 | 0.551 | 1 |  |  |
| Range size x Cave | 0.056 | 0.139 | 0.403 | 0.687 | 1 |  |  |
| **Precipitation** |  |  |  |  |  |  |  |
| Intercept | -6.504 | 4.03 | -1.614 | 0.107 | NA | 0.346 | 0.522 |
| Range size | 1.284 | 0.418 | 3.073 | 0.002 | 0.007 |  |  |
| Precipitation | 1.857 | 0.571 | 3.251 | 0.001 | 0.004\*\* |  |  |
| Range size x Precipitation | -0.244 | 0.06 | -4.049 | <0.001 | <0.001\*\*\* |  |  |
| **Minimum elevation** |  |  |  |  |  |  |  |
| Intercept | 2.39 | 1.726 | 1.385 | 0.167 | NA | 0.327 | 0.532 |
| Range size | -0.102 | 0.151 | -0.676 | 0.499 | 1 |  |  |
| Minimum elevation | 0.648 | 0.286 | 2.267 | 0.024 | 0.072 |  |  |
| Range size x Minimum elevation | -0.048 | 0.028 | -1.709 | 0.088 | 0.265 |  |  |
| **Human population density** |  |  |  |  |  |  |  |
| Intercept | 6.203 | 0.623 | 9.953 | <0.001 | NA | 0.327 | 0.549 |
| Range size | -0.432 | 0.054 | -8.051 | <0.001 | <0.001 |  |  |
| Human population density | -0.003 | 0.154 | -0.022 | 0.983 | 1 |  |  |
| Range size x HPD | 0.015 | 0.017 | 0.848 | 0.397 | 1 |  |  |
| (b) American cambarids | | | | |  |  |  |
| **Body size** |  |  |  |  |  |  | 0.968 |
| Intercept | 27.078 | 4.55 | 5.951 | <0.001 | NA | 0.296 |
| Range size | -2.016 | 0.422 | -4.779 | <0.001 | <0.001 |  |
| Body size | -6.014 | 1.253 | -4.798 | <0.001 | <0.001\*\*\* |  |
| Range size x body size | 0.475 | 0.115 | 4.112 | <0.001 | <0.001\*\*\* |  |
| **Habitat type - Cave** |  |  |  |  |  | 0.852 |
| Intercept | 4.641 | 0.464 | 10.002 | <0.001 | NA | 0.434 |
| Range size | -0.262 | 0.041 | -6.42 | <0.001 | <0.001 |  |
| Habitat type - Cave | 2.177 | 1.277 | 1.705 | 0.089 | 0.268 |  |
| Range size x Cave | -0.025 | 0.132 | -0.19 | 0.85 | 1 |  |
| **River fragmentation** |  |  |  |  |  | 0.997 |
| Intercept | 5.899 | 1.647 | 3.581 | <0.001 | NA | 0.177 |
| Range size | -0.364 | 0.156 | -2.33 | 0.021 | 0.062 |  |
| Fragmentation | -0.552 | 2.108 | -0.262 | 0.794 | 1 |  |
| Range size x fragmentation | 0.066 | 0.201 | 0.326 | 0.745 | 1 |  |
| (c) Australian parastacids |  |  |  |  |  |  |  |
| **Habitat type** |  |  |  |  |  |  |  |
| Intercept | 6.264 | 0.852 | 7.35 | 0 | NA | 0.476 | 0.472 |
| Range size | -0.42 | 0.075 | -5.601 | <0.001 | <0.001 |  |  |
| Habitat type – Standing water | -2.556 | 1.56 | -1.638 | 0.104 | 0.521 |  |  |
| Habitat type – Burrows | -0.121 | 0.912 | -0.132 | 0.895 | 1 |  |  |
| Range size x Standing waters | 0.238 | 0.159 | 1.499 | 0.137 | 0.683 |  |  |
| Range size x Burrows | -0.068 | 0.094 | -0.718 | 0.474 | 1 |  |  |
| **Temperature** |  |  |  |  |  |  |  |
| Intercept | 11.148 | 1.841 | 6.056 | <0.001 | NA | 0.526 | 0.683 |
| Range size | -1.127 | 0.198 | -5.688 | <0.001 | <0.001 |  |  |
| Temperature | -0.313 | 0.111 | -2.816 | 0.006 | 0.017\* |  |  |
| Range size x Temperature | 0.042 | 0.012 | 3.473 | 0.001 | 0.002\*\* |  |  |
| **Temperature seasonality** |  |  |  |  |  |  |  |
| Intercept | 11.03 | 1.977 | 5.579 | <0.001 | NA | 0.51 | 0.657 |
| Range size | -1.082 | 0.202 | -5.367 | <0.001 | <0.001 |  |  |
| Temperature seasonality | -0.132 | 0.052 | -2.52 | 0.013 | 0.039\* |  |  |
| Range size x Temperature seas | 0.017 | 0.005 | 3.202 | 0.002 | 0.005\*\* |  |  |
| **Pesticide loading** |  |  |  |  |  |  |  |
| Intercept | 7.163 | 0.94 | 7.617 | <0.001 | NA | 0.464 | 0.604 |
| Range size | -0.584 | 0.091 | -6.433 | <0.001 | <0.001 |  |  |
| Pesticide | -2.307 | 1.313 | -1.756 | 0.082 | 0.245 |  |  |
| Range size x pesticide | 0.299 | 0.149 | 2.011 | 0.047 | 0.14 |  |  |
| (d) Agriculture |  |  |  |  |  |  |  |
| **Habitat type - Cave** |  |  |  |  |  |  |  |
| Intercept | 6.504 | 0.792 | 8.21 | <0.001 | NA | 0.361 | 0.435 |
| Range size | -0.394 | 0.07 | -5.64 | <0.001 | <0.001 |  |  |
| Habitat type - Cave | -4.766 | 4.338 | -1.099 | <0.001 | 0.826 |  |  |
| Range size x Cave | 0.696 | 0.472 | 1.473 | 0.145 | 0.435 |  |  |
| (f) Pollution |  |  |  |  |  |  |  |
| **Habitat type - Cave** |  |  |  |  |  |  |  |
| Intercept | 5.987 | 0.403 | 14.851 | <0.001 | NA | 0.441 | 0 |
| Range size | -0.363 | 0.041 | -8.884 | <0.001 | <0.001 |  |  |
| Habitat type - Cave | 2.385 | 3.937 | 0.606 | 0.546 | 1 |  |  |
| Range size x Habitat type - Cave | -0.108 | 0.413 | -0.262 | 0.793 | 1 |  |  |
| **Precipitation seasonality** |  |  |  |  |  |  |  |
| Intercept | 8.482 | 2.461 | 3.447 | 0.001 | NA | 0.366 | 0.319 |
| Range size | -0.805 | 0.257 | -3.132 | 0.002 | 0.006 |  |  |
| Precipitation seasonality | -0.41 | 0.699 | -0.586 | 0.559 | 1 |  |  |
| Range size x Precipitation seas | 0.112 | 0.074 | 1.504 | 0.135 | 0.405 |  |  |

**Table S24.** Results of univariate pGLS on minimum elevation, with the global dataset and undated phylogeny. \*: p<0.05; \*\*: p<0.01; \*\*\*: p<0.001. HPD: human population density. SE: standard error. df: degrees of freedom.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coefficient | SE | t | df | p-value | R² |
| Water consumption | -0.351 | 0.137 | -2.555 | 446 | 0.011\* | 0.014 |
| River fragmentation | 0.484 | 0.121 | 3.992 | 441 | <0.001\*\*\* | 0.035 |
| Mercury deposition | -0.724 | 0.149 | -4.865 | 446 | <0.001\*\*\* | 0.05 |
| Pesticide loading | -0.178 | 0.161 | -1.11 | 446 | 0.268 | 0.003 |
| Sediment loading | -0.153 | 0.179 | -0.854 | 446 | 0.394 | 0.002 |
| Cropland coverage | 1.028 | 0.164 | 6.262 | 446 | <0.001\*\*\* | 0.081 |
| Livestock density | 0.394 | 0.141 | 2.793 | 447 | 0.005\*\* | 0.017 |
| HPD | -0.028 | 0.026 | -1.105 | 448 | 0.27 | 0 |