# 70 years of herpetology in India: insights into shifts in focal research areas and gender ratios among authors

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## Supplementary material

**Dataset S1.** The dataset includes metadata collected from 1177 articles published on Indian herpetology used to analyze trends in focal taxa, research questions and gender of author participation from 1947-2019.

**Table S1.** Keywords used to mine data on Indian Herpetology from Google scholar from 1947–2019 (original).

| Taxa | Journal | Herpetologist | Geographic location |
|---|---|---|---|
| Amphibians | *Amphibia-Reptilia* | Aniruddha Datta Roy | India |
| Reptiles | *Amphibian & Reptilian Conservation* | Akshay Khandekar | Western Ghats |
| Herpetofauna | *Cobra* | Abijith Das | North-east India |
| Frogs | *Copeia* | Aparna Lajmi | Andamans |
| Anura | *Current Science* | Anil Zachariah | Nicobar |
| Caecilians | *Frog Leg newsletter* | Ashok Captain | |
| Gymnophiona | *Hamadryad* | Barkha Subba | |
| Salamanders | *Herpetologica* | Bhagyashri Shanbhag | |
| Caudata | *Herpetological_bulletin* | S.D. Biju | |
| Crocodile | *Herpetological Journal* | S. Bhupathy | |
| Chelonians | *Herpetological Notes* | Basundhara Chettri | |
| Turtles | *Journal of the Bombay Natural History Society* | R. Chaitanya | |
| Tortoise | *Journal of Herpetology* | S. R. Chandramouli | |
| Squamata | *Journal of Threatened Taxa* | David Gower | |
| Sauria | *Phyllomedusa: journal of herpetology* | Debjani Roy | |
| Lizard | *Reptile Rap newsletter* | Deepak Veerapan | |
| Agamid | *Russian Journal of Herpetology* | K.P. Dinesh | |
| Scincidae | *Salamandra* | S.K. Dutta | |
| Gecko | *Sauria* | K.V. Gururaja | |
| Gekkonidae | *Zoo's Print Journal* | Hooroo, R. N. K | |

| | | | |
|---|---|---|---|
| Lacertid | *Zootaxa* | H.T._Lalremsanga | |
| Snake-eyed lizard | | S. Harikrishnan | |
| Varanid | | Indraneil Das | |
| Monitor lizard | | Ishan Agarwal | |
| Serpents | | Jayaditya Purkayastha | |
| Snakes | | J. Vijaya | |
| Serpents | | Kalpana Das | |
| snakes | | Kartik Shanker | |
| Worm snakes | | Karthikeyan Vasudevan | |
| Shieldtail snakes | | Maria Thaker | |
| Uropeltidae | | Nibeditha Sen | |
| Viper | | N.M. Ishwar | |
| Cobra | | R.S. Radder | |
| Elapid | | Rachunliu G Kamei | |
| Colubrid | | Romulus Whitaker | |
| Sea snakes | | Rosamma Mathew | |
| Hydrophidae | | Saibal Sengupta | |
| | | Savitha Krishna | |
| | | K.S. Seshadri | |
| | | S.K. Saidapur | |
| | | Sonali Garg | |
| | | S.P. Vijayakumar | |
| | | S.R. Ganesh | |

|  |  | Varad Giri |  |
|  |  | Vivek Sharma |  |
|  |  | Zeeshan Mirza |  |

**Table S2.** Definitions used to categorise articles into different subfields within herpetology (original)

| Subfield | Definition |
|---|---|
| Taxonomy & Systematics (TX) | Articles dealing with any aspect of taxonomy such as describing new species, nomenclatural changes and reporting data from museum specimen. |
| Diversity & Distribution (Div) | Any aspect describing the distribution of species such as new distributional records, species distribution modelling or reporting the diversity within an area in the form of inventories or checklists |
| Ecology (Ecol) | Articles dealing with the population ecology, diet, reproduction, predation, natural history (other than distribution records) of a species and aspects related to community structure and composition. |
| Behavioral ecology (BH) | Articles that describe the behaviour of species and examine inter and intra specific behavioural interactions such as signalling, mate choice, antipredatory defences etc. |
| Evolutionary biology (Evol) | Articled dealing with phylogenetic relationships, biogeography, phylogeography, population genetics, diversification, macroevolutionary patterns, adaptations, phenotypic evolution etc. Phylogenies published primarily for taxonomic purposes and not addressing evolutionary questions were categorised under TX and not under Evol. |
| Conservation & Management (Con) | Articles addressing any conservation issues such as wildlife trade, confiscation, in situ and ex situ management, conservation genetics, conservation status etc. |
| Development, Physiology & Cytology (DEV) | Articles that address questions related to developmental biology, physiology, karyotyping and other cytological studies. These groups were clubbed together since there were relatively few articles in our dataset and since they |

| | |
|---|---|
| | all are predominantly lab-based research questions less focused at the level of the organism. |
| Others (OT) | Studies that don't fit into any of the above categories such as report of record length of a species, articles reporting albinism or merely describing colour variations in species etc. |

**Table S3.** Results of the pairwise Fisher's exact test for proportions of articles published across year classes for different taxonomic groups (TG), specific taxa (ST) and subfields (SF). P-values ($P$) were obtained by pairwise comparisions of proportions for the preceeding year class. *'Pr'* indicates proportion of articles published. Statistically significant ($P < 0.05$) comparisions are indicated in bold (original).

| | Categories | | 1950-59 | 1960-69 | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|---|---|---|---|---|---|---|---|---|---|
| TG | Amphibians | *Pr* | 0.454 | 0.167 | 0.139 | 0.206 | 0.322 | 0.346 | 0.234 |
| | | *P* | - | 0.197 | 0.720 | 0.368 | 0.099 | 0.672 | **0.0006** |
| | Reptiles | *Pr* | 0.545 | 0.833 | 0.810 | 0.746 | 0.559 | 0.559 | 0.681 |
| | | *P* | - | 0.198 | 1 | 0.416 | **0.013** | 1 | **0.0005** |
| | Herpetofauna | *Pr* | *0* | *0* | 0.051 | 0.048 | 0.118 | 0.094 | 0.085 |
| | | *P* | - | 1 | 1 | 1 | 0.135 | 0.509 | 0.701 |
| ST | Caecilians | *Pr* | *0* | *0* | 0.025 | 0 | 0.013 | 0.052 | 0.012 |
| | | *P* | - | 1 | 1 | 0.503 | 1 | 0.065 | **0.0009** |
| | Salamanders | *Pr* | *0* | *0* | *0* | *0* | 0.020 | 0 | 0.004 |
| | | *P* | - | 1 | 1 | 1 | 0.557 | **0.041** | 0.553 |
| | Frogs | *Pr* | 0.455 | 0.167 | 0.101 | 0.191 | 0.165 | 0.273 | 0.197 |
| | | *P* | - | 0.198 | 0.423 | 0.15 | 0.693 | **0.013** | **0.014** |
| | Chelonians | *Pr* | 0 | 0 | 0 | 0.222 | 0.125 | 0.133 | 0.136 |
| | | *P* | - | 1 | 1 | **<0.0001** | 0.095 | 0.882 | 0.916 |
| | Crocodiles | *Pr* | 0 | 0 | 0.076 | 0.254 | 0.046 | 0.018 | 0.032 |
| | | *P* | - | 1 | 0.590 | **0.005** | **<0.0001** | 0.121 | 0.268 |
| | Lizards | *Pr* | 0 | 0.444 | 0.279 | 0.159 | 0.118 | 0.171 | 0.235 |
| | | *P* | - | **0.012** | 0.257 | 0.108 | 0.505 | 0.164 | **0.034** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Snakes | *Pr* | 0.364 | 0.333 | 0.342 | 0.079 | 0.125 | 0.164 | 0.255 |
| | | *P* | - | 1 | 1 | **0.0002** | 0.476 | 0.327 | **0.003** |
| | Mixed | *Pr* | **0.182** | **0.056** | 0.177 | 0.095 | 0.388 | 0.189 | 0.129 |
| | | *P* | - | 0.539 | 0.290 | 0.225 | **<0.0001** | **<0.0001** | **0.025** |
| SF | TX | *Pr* | 0.083 | 0.050 | 0.068 | 0.059 | 0.130 | 0.196 | 0.238 |
| | | *P* | - | 1 | 1 | 1 | 0.163 | 0.075 | 0.142 |
| | Ecol | *Pr* | 0.167 | 0.200 | 0.125 | 0.191 | 0.253 | 0.177 | 0.150 |
| | | *P* | - | 1 | 0.472 | 0.272 | 0.394 | **0.055** | 0.304 |
| | Div | *Pr* | 0.083 | 0.050 | 0.159 | 0.235 | 0.358 | 0.363 | 0.293 |
| | | *P* | - | 1 | 0.295 | 0.306 | 0.089 | 1 | **0.033** |
| | BH | *Pr* | 0 | 0 | 0.057 | 0.059 | 0.037 | 0.054 | 0.069 |
| | | *P* | - | 1 | 0.582 | 1 | 0.487 | 0.504 | 0.405 |
| | Con | *Pr* | 0 | 0 | 0.023 | 0.177 | 0.062 | 0.066 | 0.079 |
| | | *P* | - | 1 | 1 | **0.001** | **0.012** | 1 | 0.519 |
| | Evol | *Pr* | 0 | 0 | 0.068 | 0 | 0.025 | 0.038 | 0.082 |
| | | *P* | - | 1 | 0.590 | **0.036** | 0.322 | 0.594 | 0.358 |
| | Dev | *Pr* | 0.667 | 0.700 | 0.489 | 0.235 | 0.099 | 0.079 | 0.045 |
| | | *P* | - | 1 | 0.136 | **0.002** | **0.011** | 0.492 | **0.037** |
| | OT | *Pr* | 0 | 0 | 0.011 | 0.044 | 0.037 | 0.028 | 0.043 |
| | | *P* | - | 1 | 1 | 0.318 | 0.726 | 0.590 | 0.292 |

**Table S4.** Summary and comparison of different models from the GLM and GLMM analyses evaluating women authorship. Models in bold indicate the best-fit model with the lowest AIC values (original).

| Model | | LogLik | AIC | ΔAIC | *Akaike* |
|---|---|---|---|---|---|
| Dependant variable | Fixed effects | | | | *weights* |
| Women first authors (Binomial error distribution) | | | | | |
| **Women first author** | **Year class + Taxa + Group+Subfield** | **-536.361** | **1118.722** | **0** | **0.99** |
| Women first author | Year class + Group+Subfield | -551.668 | 1135.335 | 16.613 | 2.46e-04 |
| Women first author | Group+Subfield | -572.159 | 1164.318 | 45.596 | 1.25e-10 |
| Women first author | Subfield | -588.594 | 1193.188 | 74.466 | 6.75e-17 |
| Women first author | Group | -584.966 | 1175.931 | 57.209 | 3.77e-13 |
| Women first author | null | -602.712 | 1207.423 | 88.701 | 5.46e-20 |
| Women first authors after removing same first and corresponding authors (Binomial error distribution) | | | | | |
| **Women first author** | **Year class + Taxa + Group + Subfield + Corresponding author** | **-280.591** | **609.181** | **0** | **1.00e+00** |
| Women first author | Year class + Taxa + Group + Subfield + | -362.877 | 771.754 | 162.572 | 4.98e-36 |
| Women first author | null | -406.941 | 815.882 | 206.700 | 1.30e-45 |
| Women corresponding authors (Binomial error distribution) | | | | | |
| **Women corresponding author** | **Year class + Taxa + Group + Subfield** | **-567.7** | **1181.348** | **0** | **0.6541** |

| | | | | | |
|---|---|---|---|---|---|
| **Women corresponding author** | **Year class + Taxa + Subfield** | **-570.3** | **1182.623** | **1.275** | **0.3458** |
| Women corresponding author | Year class + Subfield | -599.2 | 1226.318 | 44.970 | 1.12e-10 |
| Women corresponding author | Subfield | -614.0 | 1244.060 | 62.712 | 1.57e-14 |
| Women corresponding author | Year class | -632.8 | 1279.607 | 98.259 | 3.01e-22 |
| Women corresponding author | null | -644.2 | 1290.327 | 108.979 | 1.41e-24 |
| Proportion of women authors (Binomial error distribution) | | | | | |
| cbind( Number women, Number men) | Year class + Group + Taxa + Subfield | -1042.408 | 2130.817 | 2.776 | 0.1997 |
| cbind( Number women, Number men) | **Year class + Taxa + Subfield** | -1043.020 | 2128.041 | 0 | 0.8002 |
| cbind( Number women, Number men) | Taxa + Subfield | -1063.298 | 2156.595 | 28.554 | 5.04e-07 |
| cbind( Number women, Number men) | Subfield | -1110.804 | 2237.608 | 109.567 | 1.29e-24 |
| cbind( Number women, Number men) | Taxa | -1082.396 | 2180.793 | 52.752 | 2.80e-12 |
| cbind( Number women, Number men) | null | -1136.543 | 2275.086 | 147.045 | 9.39e-33 |
| Proportion of women authors after excluding the corresponding author (Binomial error distribution) | | | | | |
| cbind( Number women, Number men) | **Corresponding author + Year class + Taxa + Subfield** | -492.734 | 1029.469 | 0 | 0.99 |

| | | | | | |
|---|---|---|---|---|---|
| cbind( Number women, Number men) | Year class + Taxa + Subfield | -507.154 | 1056.308 | 26.839 | 1.48e-06 |
| cbind( Number women, Number men) | null | -559.346 | 1120.692 | 91.223 | 1.55e-20 |

**Table S5.** Results of the pairwise comparison evaluating female authorship patterns (first author, corresponding author presence and number of female authors) across year class, group, taxa, and subfield (original). The estimate values provides the coefficient of change in the response variable when the predictor variable is increased by one unit.

| Pair of groups | Estimate | Std. Error | z value | P value |
|---|---|---|---|---|
| Women first author | | | | |
| Taxa | | | | |
| Lizards - Snakes | 1.3872 | 0.298 | 4.655 | 0.0001 |
| Subfield | | | | |
| Dev - TX | 1.425 | 0.308 | 4.634 | 0.0001 |
| Ecol - TX | 1.109 | 0.276 | 4.024 | 0.002 |
| Evol - TX | 1.104 | 0.345 | 3.203 | 0.030 |
| Year class | | | | |
| (1970-79) - (2000-09) | -1.810 | 0.561 | -3.229 | 0.021 |
| (1970-79) - (2010-19) | -1.929 | 0.553 | -3.488 | 0.009 |
| (1990-99) - (2000-09) | -1.201 | 0.359 | -3.344 | 0.015 |
| (1990-99) - (2010-19) | -1.321 | 0.348 | -3.793 | 0.003 |
| Corresponding Authorship (after removing removing same first and corresponding authors) | | | | |
| F - M | 3.3943 | 0.2824 | 12.021 | < 2e-16 |
| Women corresponding author | | | | |
| Taxa | | | | |
| Chelonians - Lizards | -0.875 | 0.251 | -3.483 | 0.012 |
| Crocodiles - Lizards | -1.739 | 0.517 | -3.37 | 0.017 |
| Lizards - Snakes | 1.541 | 0.269 | 5.733 | <0.0001 |
| Year class | | | | |
| 1970-79 - 1980-89 | -1.941 | 0.485 | -4.002 | 0.001 |
| 1970-79 - 2000-09 | -1.315 | 0.435 | -3.026 | 0.040 |
| 1970-79 - 2010-19 | -1.256 | 0.425 | -2.953 | 0.049 |
| 1980-89 - 1990-99 | 1.388 | 0.381 | 3.649 | 0.005 |
| Subfield | | | | |
| BH - TX | 1.859 | 0.358 | 5.198 | <0.0001 |
| Dev - TX | 2.009 | 0.337 | 5.953 | <0.0001 |
| Div - TX | 1.402 | 0.302 | 4.638 | 0.0001 |
| Ecol - TX | 1.798 | 0.309 | 5.815 | <0.0001 |
| Evol - TX | 1.744 | 0.379 | 4.604 | 0.0001 |

| Proportion of women authors (Binomial regression) | | | | |
|---|---|---|---|---|
| Taxa | | | | |
| Chelonians - Frogs | -0.8061 | 0.165 | -4.882 | <0.0001 |
| Crocodiles - Frogs | -1.3447 | 0.356 | -3.779 | 0.004 |
| Frogs - Lizards | 0.4233 | 0.122 | 3.475 | 0.012 |
| Frogs - Mixed | 0.7569 | 0.167 | 4.520 | 0.0002 |
| Frogs - Snakes | 1.2530 | 0.162 | 7.741 | <0.0001 |
| Lizards - Snakes | 0.8297 | 0.166 | 5.005 | <0.0001 |
| Year class | | | | |
| (1970-79) - (1980-89) | -1.2163 | 0.407 | -2.990 | 0.044 |
| (1970-79) - (2000-09) | -1.1815 | 0.356 | -3.322 | 0.016 |
| (1970-79) - (2010-19) | -1.4827 | 0.347 | -4.271 | 0.0004 |
| (1990-99) - (2010-19) | -0.8405 | 0.216 | -3.889 | 0.002 |
| Subfield | | | | |
| BH - TX | 0.9486 | 0.192 | 4.951 | <.0001 |
| Dev - Div | 0.6845 | 0.175 | 3.913 | 0.002 |
| Dev - TX | 1.1248 | 0.177 | 6.365 | <.0001 |
| Ecol - TX | 0.7147 | 0.160 | 4.480 | 0.0002 |
| Evol - TX | 0.6317 | 0.181 | 3.481 | 0.012 |
| Proportion of women authors after removing the corresponding author(Binomial regression) | | | | |
| Corresponding author | | | | |
| F - M | 1.1566 | 0.20790 | 5.563 | <.0001 |
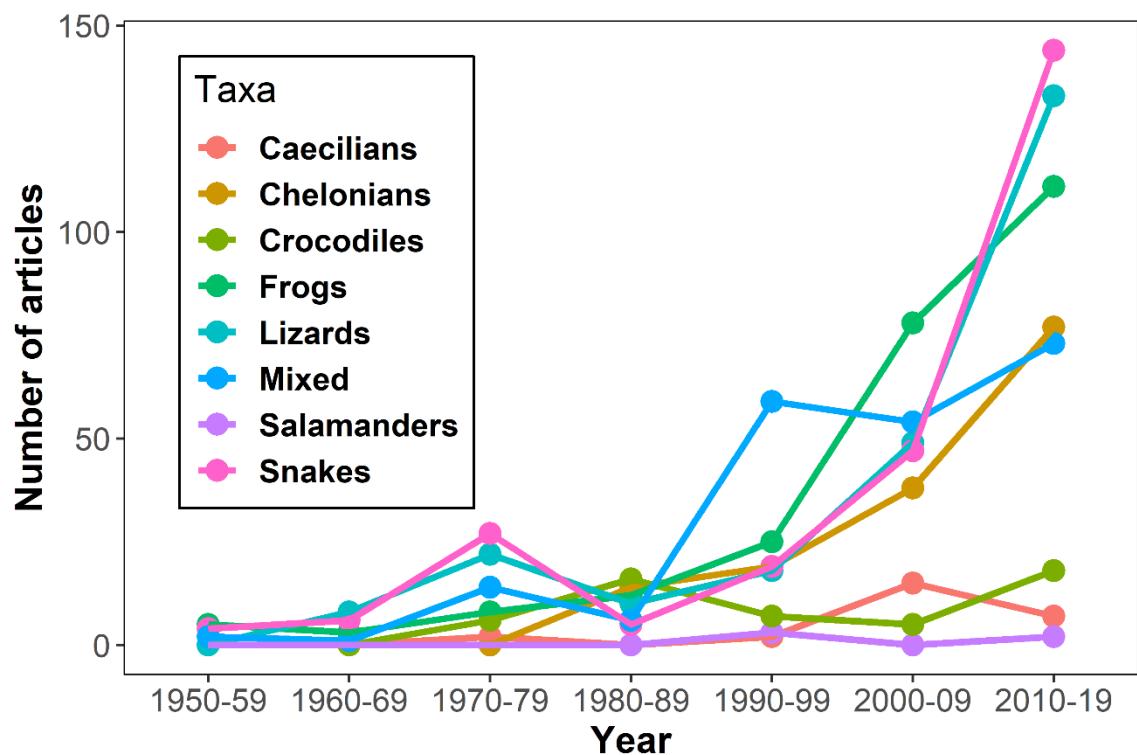
**Figure S1.** Trends in the total number of herpetological publications over the last 70 years on across different taxa within amphibians and reptiles (original).
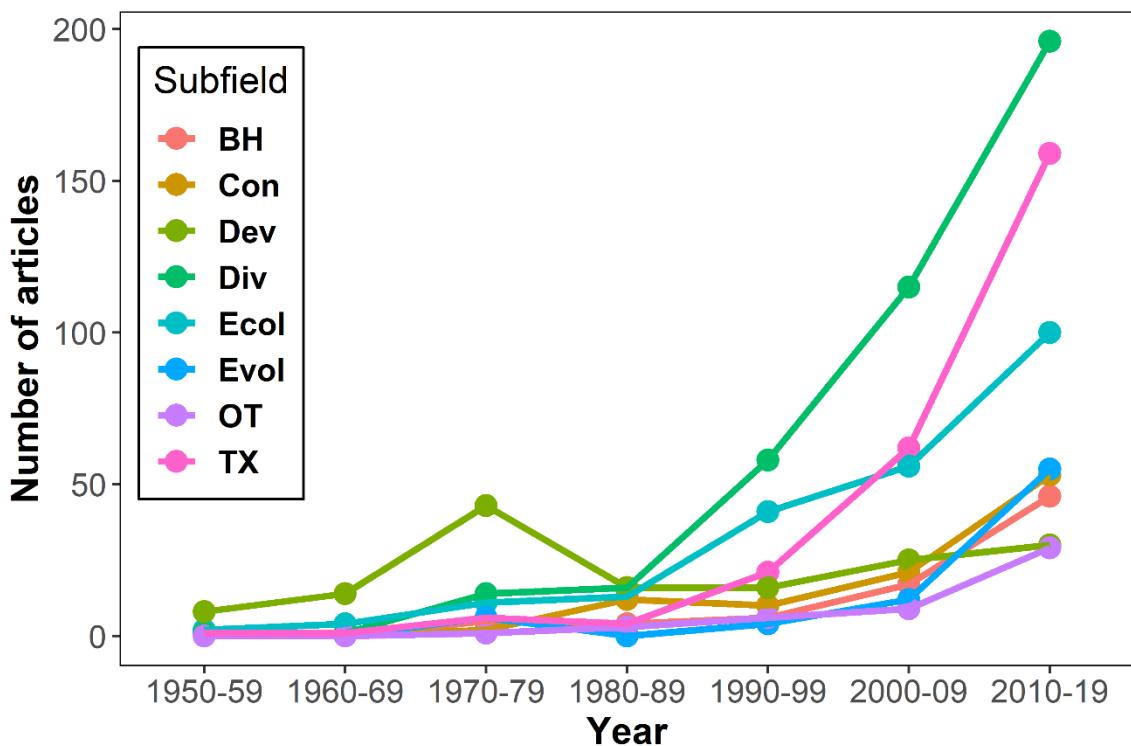
**Figure S2.** Trends in the total number of herpetological publications over the last 70 years on across different subfields. Subfields include Behaviour (BH), Conservation & Management (Con), Development, Physiology and Cytology (Dev), Diversity & Distribution (Div), Ecology (Ecol), Evolutionary biology (Evol), Taxonomy & Systematics (TX) and Others (OT) (original).
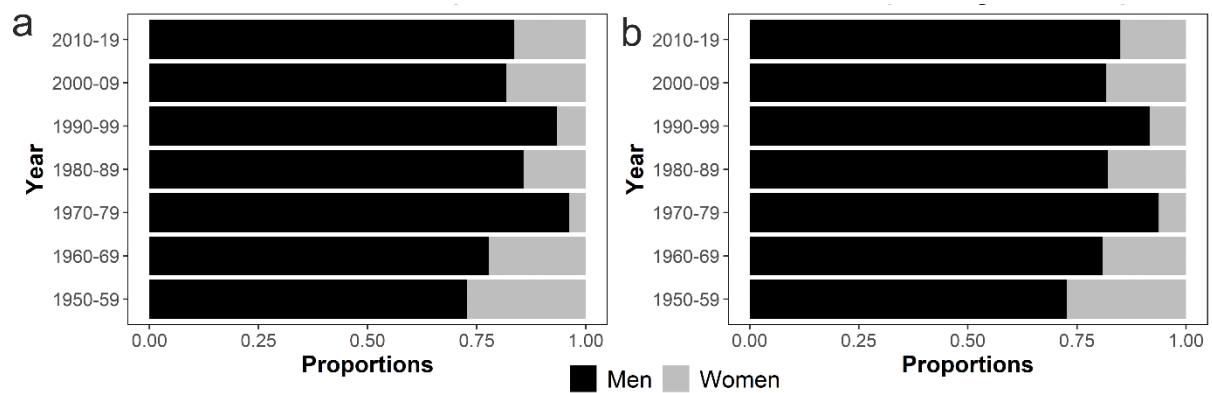
**Figure S3.** Year-wise changes in the proportion of articles with women and men as first (a) and corresponding authors (b) (original).