**Supporting Information Tables S2–S4**

**Table S2** List of taxa included in the phylogeny and Genbank accession numbers for each gene

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species** | **Reproduction** | **trnL-trnF** | **ITS** | **PgiC** |
| *Chaemerion angustifolium*† | sex | AY264505 | L28011 | GU176493 |
| *Chylismia arenaria*† | sex | AY264531 | AY271543 | GU176497 |
| *Clarkia concinna*† | sex | AY264519 | AY271532 | X89390 |
| *Gayophytum eriospermum*† | sex | GU176569 | GU176537 | GU176499 |
| *Oenothera acutissima*† | sex | AY264563 | AY271575 | GU176501 |
| *Oenothera gaura*† | PTH | AJ620586 | AJ620517 | GU176498 |
| *Oenothera kunthiana*† | PTH | GU176579 | GU176547 | GU176514 |
| *Oenothera lindheimeri*† | sex | AJ620594 | AJ620526 | [AJ550748](http://www.ncbi.nlm.nih.gov/nuccore/45581348?ordinalpos=1&itool=EntrezSystem2.PEntrez.Sequence.Sequence_ResultsPanel.Sequence_RVDocSum) |
| *Oenothera affinis* | sex | AY264551 | AY271563 | GU176502 |
| *Oenothera argillicola* | sex | GU176572 | GU176540 | GU176503 |
| *Oenothera bahia-blancae* | PTH | GU176573 | GU176541 | GU176504 |
| *Oenothera berlandieri* | sex | AY264574 | AY271586 | GU176495 |
| *Oenothera biennis* | PTH | AY264553 | DQ006021 | GU176505 |
| *Oenothera clelandii* | PTH | GU176574 | GU176542 | |  | | --- | | GU176506 | |
| *Oenothera drummondii* | sex | AJ620605 | AJ620537 | GU176507 |
| *Oenothera elata hookeri* | sex | AY264552 | DQ075625 | GU176508 |
| *Oenothera elongata* | PTH | GU176589 | GU176557 | GU176524 |
| *Oenothera glazioviana* | PTH | GU176575 | GU176543 | GU176509 |
| *Oenothera grandiflora* | sex | GU176577 | GU176545 | GU176511 |
| *Oenothera grandis* | sex | GU176576 | GU176544 | GU176510 |
| *Oenothera heterophylla* | sex | AY264548 | AJ620538 | GU176512 |
| *Oenothera humifusa* | PTH | GU176578 | GU176546 | GU176513 |
| *Oenothera laciniata* | PTH | AJ620607 | AJ620539 | GU176515 |
| *Oenothera longissima* | sex | GU176580 | GU176548 | GU176516 |
| *Oenothera longituba* | sex | GU176581 | GU176549 | GU176517 |
| *Oenothera mendocinensis* | sex | GU176582 | GU176550 | GU176518 |
| *Oenothera nana* | PTH | GU176583 | GU176551 | GU176519 |
| *Oenothera nutans* | PTH | GU176584 | GU176552 | GU176520 |
| *Oenothera oakesiana* | PTH | GU176585 | GU176553 | GU176521 |
| *Oenothera paradonia* | PTH | GU176586 | GU176554 | GU176522 |
| *Oenothera picensis picensis* | PTH | GU176588 | GU176556 | GU176523 |
| *Oenothera ravenii chilensis* | PTH | GU176590 | GU176558 | GU176525 |
| *Oenothera recurva* | PTH | GU176591 | GU176559 | GU176526 |
| *Oenothera rhombipetala* | sex | GU176592 | GU176560 | GU176527 |
| *Oenothera sandiana* | PTH | GU176593 | GU176561 | GU176528 |
| *Oenothera serrulata* | PTH | GU176567 | GU176534 | GU176496 |
| *Oenothera stricta stricta* | PTH | GU176594 | GU176562 | GU176529 |
| *Oenothera tarijensis* | PTH | GU176595 | GU176563 | GU176530 |
| *Oenothera toumeyi* | sex | GU176568 | GU176535 | [AJ550747](http://www.ncbi.nlm.nih.gov/nuccore/45581346?ordinalpos=1&itool=EntrezSystem2.PEntrez.Sequence.Sequence_ResultsPanel.Sequence_RVDocSum) |
| *Oenothera versicolor* | sex | GU176596 | GU176564 | GU176531 |
| *Oenothera villaricae* | PTH | GU176597 | GU176565 | GU176532 |
| *Oenothera villosa* | PTH | GU176598 | GU176566 | GU176533 |
| *L. uruguayensis* |  | \* | \* | GU176492 |
| *F. boliviana* |  | \* | \* | GU176494 |
| *O. acaulis* |  | GU176571 | GU176539 | GU176500 |
| *G. diffusum diffusum* |  | \* | GU176536 | \* |
| *G. diffusum parviflorum* |  | GU176570 | GU176538 | \* |
| *O. perennis* |  | GU176587 | GU176555 | \* |

Species with superscript † represent taxa treated as outgroups in phylogenetic analyses. (\* denote sequences for which an accession number is still pending).

**Table S3** Statistics associated with alternative models of evolution for sexual and PTH reproduction

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | AIC | SEX | PTH | *df* | *t* | *P* | *d* |
| Median latitude (deg. N/S) |  |  |  |  |  |  |  |
| OLS | 231.11 | 31.35 | 33.16 | 30 | -0.60 | 0.55 |  |
| PGLS | 231.61 | 32.43 | 35.70 | 30 | -11.78 | <0.001 |  |
| OU | 217.57 | 32.23 | 35.50 | 30 | -7.93 | <0.001 | 0.28 |
| Lowest latitute (deg N/S) |  |  |  |  |  |  |  |
| OLS | 239.15 | 24.24 | 25.06 | 30 | -0.24 | 0.81 |  |
| PGLS | 264.65 | 25.82 | 28.13 | 30 | -4.96 | <0.001 |  |
| OU | 235.57 | 23.21 | 25.19 | 30 | -1.22 | 0.23 | 0 |
| Highest latitude (deg (N/S) |  |  |  |  |  |  |  |
| OLS | 236.60 | 38.45 | 41.26 | 30 | -0.85 | 0.40 |  |
| PGLS | 291.00 | 39.03 | 43.26 | 30 | -6.03 | <0.001 |  |
| OU | 236.08 | 37.59 | 41.19 | 30 | -1.54 | 0.13 | 0 |
| Range size (km2) |  |  |  |  |  |  |  |
| OLS | 1032.96 | 1060789 | 2229696 | 30 | -1.41 | 0.17 |  |
| PGLS | 1085.47 | 1434667 | 2046950 | 30 | -3.54 | 0.001 |  |
| OU | 1033.20 | 1228962 | 2122423 | 30 | -1.48 | 0.15 | 0 |
| Petal length (cm) | 3.00 |  |  |  |  |  |  |
| OLS | 96.37 | 2.77 | 1.78 | 31 | 2.86 | 0.01 |  |
| PGLS | 120.56 | 2.62 | 0.98 | 31 | 35.63 | <0.001 |  |
| OU | 95.97 | 3.01 | 1.60 | 31 | 6.50 | <0.001 | 0 |
| Floral tube length (cm) | 4.00 |  |  |  |  |  |  |
| OLS | 147.41 | 4.51 | 3.14 | 31 | 1.83 | 0.08 |  |
| PGLS | 153.85 | 3.57 | 2.65 | 31 | 12.05 | <0.001 |  |
| OU | 140.54 | 4.22 | 3.29 | 31 | 6.61 | <0.001 | 0.13 |
| Style length (cm) | 5.00 |  |  |  |  |  |  |
| OLS | 161.26 | 6.34 | 4.13 | 31 | 2.39 | 0.02 |  |
| PGLS | 208.39 | 5.02 | 3.31 | 31 | 9.84 | <0.001 |  |
| OU | 160.23 | 6.20 | 4.28 | 31 | 3.19 | 0.00300 | 0 |
| Anther length (mm) | 6.00 |  |  |  |  |  |  |
| OLS | 174.12 | 9.05 | 6.05 | 31 | 2.67 | 0.01 |  |
| PGLS | 234.97 | 8.02 | 3.73 | 31 | 16.48 | <0.001 |  |
| OU | 173.64 | 9.40 | 5.86 | 31 | 4.05 | <0.001 | 0 |
| Filament length (mm) | 7.00 |  |  |  |  |  |  |
| OLS | 227.16 | 15.7 | 10.56 | 31 | 2.05 | 0.05 |  |
| PGLS | 266.98 | 11.53 | 8.39 | 31 | 7.42 | <0.001 |  |
| OU | 223.03 | 15.16 | 11.20 | 31 | 2.59 | 0.01 | 0 |
| Capsule length (cm) | 8.00 |  |  |  |  |  |  |
| OLS | 80.41 | 2.97 | 2.72 | 31 | 0.93 | 0.36 |  |
| PGLS | 102.29 | 2.71 | 2.48 | 31 | 6.63 | <0.001 |  |
| OU | 75.17 | 3.01 | 2.77 | 31 | 2.01 | 0.05 | 0 |
| Seed length (mm) | 9.00 |  |  |  |  |  |  |
| OLS | 7.38 | 1.49 | 1.40 | 31 | 1.04 | 0.31 |  |
| PGLS | 8.54 | 1.57 | 1.70 | 31 | -15.07 | <0.001 |  |
| OU | 5.69 | 1.47 | 1.59 | 31 | -11.70 | <0.001 | 0.63 |
| Leaf length (cm) | 10.00 |  |  |  |  |  |  |
| OLS | 173.47 | 8.73 | 9.54 | 30 | -0.66 | 0.51 |  |
| PGLS | 211.09 | 6.95 | 6.09 | 30 | 4.29 | <0.001 |  |
| OU | 172.48 | 9.15 | 9.07 | 30 | 0.10 | 0.92 | 0 |
| Leaf width (cm) | 11.00 |  |  |  |  |  |  |
| OLS | 98.34 | 1.52 | 1.76 | 30 | -0.63 | 0.53 |  |
| PGLS | 182.60 | 1.09 | 1.48 | 30 | -3.04 | 0.005 |  |
| OU | 92.47 | 1.41 | 1.71 | 30 | -1.08 | 0.29 | 0 |
| Plant height (cm) | 12.00 |  |  |  |  |  |  |
| OLS | 347.09 | 78.75 | 67.89 | 31 | 0.70 | 0.49 |  |
| PGLS | 440.88 | 75 | 18.68 | 31 | 9.56 | <0.001 |  |
| OU | 347.28 | 79.92 | 64.48 | 31 | 1.08 | 0.29 | 0 |

For each variable we compared Akiake Information Criterion (AIC) values from regression analyses that assume one of three models of evolution: (1) Traits that evolve independent of phylogeny (OLS); (2) Traits that evolve according to a random-walk Brownian motion process, similar to genetic drift (PGLS); and (3) Trait evolution which follows an Ornstein–Uhlenbeck process (OU), which resembles stabilizing selection towards an optimum. We also show mean values for sexual and PTH species, the degrees of freedom (df) associated with *t*-tests that contrasted mean values of sexual versus PTH reproduction, and their associated *P*-value. For regression models that incorporated the OU process we show the parameter *d*, which we calculated using restricted maximum likelihood, and varies between 1 when traits evolve via a random walk process and 0 when traits evolve independently of phylogeny.

**Table S4** Summary statistics and best-fitting substitution models for individual and combined datasets for phylogenetic analysis of *Oenothera* sect. *Oenothera*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dataset | No. characters | No. variable characters | No. parsimony-informative characters | Best-fitting model of substitution |
| ITS | 631 | 222 | 84 | GTR+Γ |
| *trnL*-*trnF* spacer | 1058 | 161 | 56 | GTR+Γ |
| *PgiC* | 1707 | 723 | 273 | GTR+Γ (introns)  HKY+Γ (exons) |
| Combined | 3396 | 1106 | 413 | GTR+Γ |

Best-fitting models (HKY+Γ or GTR+ Γ) were applied to each data partition (gene or region) in Bayesian analyses. In the combined likelihood search, the GTR+ Γ model was used with parameter values free to vary across partitions.