**Supplementary figure s1. *Fuxianhuia protensa* stages 8 and 9.**

(a-j) Stage 8; (a and b)ELI 0722A; (c and d) ELI 0723A; (e and f)ELI 0731; (g and h)ELI MU76A-c; (I and j) ELI MU76B-b;(k and l) ELI 0728, stage 9.

Ab*n*, abdominal tergite; ant, antennae; asc, anterior sclerite; hs, head shield; rt, reduced anterior tergites; SPA, specialized post-antennal appendage; tf, tail flukes; Th*n,* thoracic tergite; *wl*, walking legs.

**Supplementary figure s2. *Fuxianhuia protensa* stage 24.**

(a and b)ELI 0034, stage 24a; (c and d)ELI 0373A, stage 24b; (e and f) ELI 0373B; counterpart, stage 24b.

Ab*n*, abdominal tergite; ant, antennae; asc, anterior sclerite; hs, head shield; rt, reduced anterior tergites; SPA, specialized post-antennal appendage; tf, tail flukes; Th*n,* thoracic tergite; *wl*, walking legs.

**Supplementary figure s3. *Fuxianhuia protensa* stage 25.**

(a-d) Stage 25a; (a and b) ELI 0469; (c and d)ELI 0591; (e-h) Stage 25b; (e and f) ELI 0076; (g and h) ELI 0050; (I and j) ELI 0276, stage 25 individual with 14 thoracic tergites and 11 abdominal tergites.

Ab*n*, abdominal tergite; ant, antennae; hs, head shield; rt, reduced anterior tergites; tf, tail flukes; Th*n,* thoracic tergite.

**Supplementary figure s4. *Fuxianhuia protensa* stage 26.**

(a and b) ELI 0073, Stage 26a; (c-g) Stage 26b; (c) ELI 0006A; (d and e) ELI 0052B; (f and g) ELI 0001A.

Ab*n*, abdominal tergite; asc, anterior sclerite; hs, head shield; rt, reduced anterior tergites; tf, tail flukes; Th*n,* thoracic tergite.

**Supplementary figure s5. *Fuxianhuia protensa* stage 27.**

(a and b) ELI 0073A, stage 27a; (b-g) Stage 27b; (c) ELI 0131A; (d and e) ELI 0092A; (f and g) ELI 0123B.

Ab*n*, abdominal tergite; hs, head shield; rt, reduced anterior tergites; tf, tail flukes; Th*n,* thoracic tergite.

**Supplementary figure s6. *Fuxianhuia protensa* stage 28 and 29.**

(a and b) ELI 520-27A, Stage 28a; (c and d) ELI 0641, stage 28b; (e) ELI MU76A, part, stage 29; (f) ELI MU76B, counterpart, Stage 29.

Ab*n*, abdominal tergite; hs, head shield; rt, reduced anterior tergites; tf, tail flukes; Th*n,* thoracic tergite.

**Supplementary figure s7. *Fuxianhuia protensa* stage 30b.**

(a and b) ELI 0011. Ab*n*, abdominal tergite; hs, head shield; rt, reduced anterior tergites; tf, tail flukes; Th*n,* thoracic tergite.

**Supplementary figure s8. Reconstruction of the trunk segmentation schedule of *Fuxianhuia protensa*.**

Note that stage 29a specimens have not been found.

**Supplementary figure s9. Patterns of ontogenetic development in *Fuxianhuia*.**

(a) Ontogenetic trajectory of *Fuxianhuia protensa*, illustrating alternation between phases of posterior segment addition (slopes), and abdominal to thoracic tergite transformation (plateaus). Dashed lines denote unavailable ontogenetic stages.

(b) Relationship between ontogenetic stage and body size, as expressed by thoracic length, in articulated individuals of *F. protensa* (*n* =57) (Figures 1, 3, s1-s7) and *Fuxianhuia xiaoshibaensis* (*n* = 4) (Supplementary table s1). Note that the Y axis excludes the three reduced tergites that typify *Fuxianhuia* from total tergite count.