Supplementary materials for:

Morphological selectivity of the Permian-Triassic ammonoid mass extinction

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\textbf{Figure DR1.} Ammonoid morphospaces and distances between centroids. \textit{Otoceras concavum} and \textit{Hypophiceras triviale} were grouped into Griesbachian. (A) Morphospaces of the Changhsingian and Griesbachian ammonoids. (B) The distribution of distances between the null hypothesis simulation 1 (random extinction...
with 42 survivors) and Changhsingian centroid. The blue arrow is empirical distance between the centroids of the Changhsingian and Griesbachian species. (C) Morphospaces of the Changhsingian ammonoids, survivors and newcomers. (D) The distribution of distances between the null hypothesis simulation 2 (random extinction with 14 survivors) and Changhsingian centroid. The blue arrows are empirical distance between the centroids of the Changhsingian species and survivors. The white symbols are the centroid of each groups. The red lines indicate 95% quantile.

Figure DR2. Disparity of all Changhsingian species, survivors, newcomers and all Griesbachian species. *Otoceras concavum* and *Hypophiceras triviale* were grouped into Griesbachian. (A) Sum of variance. (B) Sum of range. Vertical bars indicate 95% confidence interval.
### Table DR1. Data matrix of 22 characters for 127 studied ammonoids species.

| No. | Species                                      | Stage        | Character code | Reference |
|-----|---------------------------------------------|--------------|----------------|-----------|
| 1   | Abichites abichi Shevyrev, 1965             | Changhsingian| 1 1 3 2 0 1 0 0 0 0 0 1 1 0 2 2 1 0 0 0 0 | MB.C.25389, Korn et al., 2016 |
| 2   | Abichites alibashiensis Korn et al., 2016   | Changhsingian| 0 1 3 2 2 0 0 0 0 0 0 1 0 0 2 1 1 0 1 0 1 0 | MB.C.25399, holotype Korn et al., 2016 |
| 3   | Abichites araii Korn et al., 2016           | Changhsingian| 1 1 3 1 0 0 0 0 0 0 0 1 1 0 2 1 1 1 0 0 0 0 | MB.C.25410, holotype Korn et al., 2016 |
| 4   | Abichites paucimodus Korn et al., 2016       | Changhsingian| 1 1 3 2 0 2 0 0 0 0 0 1 1 0 2 2 1 0 1 0 0 0 0 | MB.C.25439, holotype Korn et al., 2016 |
| 5   | Abichites shahriari Korn et al., 2016       | Changhsingian| 1 1 3 1 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 1 1 0 0 | MB.C.25445, holotype Korn et al., 2016 |
| 6   | Abichites stbyowni Shevyrev, 1965           | Changhsingian| 1 1 3 1 1 0 0 0 0 0 0 1 1 0 2 1 1 0 1 0 0 0 0 | MB.C.25420, Korn et al., 2016 |
| 7   | Abichites subtrapezoidalis Korn et al., 2016| Changhsingian| 1 1 3 2 1 1 0 0 0 0 0 1 0 0 1 2 0 1 1 0 0 0 0 | MB.C.25371, holotype Korn et al., 2016 |
| 8   | Abichites terminalis Korn et al., 2016      | Changhsingian| 1 1 3 1 0 0 0 0 0 1 0 0 0 1 0 1 0 1 1 0 0 0 | MB.C.25447, holotype Korn et al., 2016 |
| 9   | Abichites ferdowsii Korn et al., 2016       | Changhsingian| 1 2 3 2 2 0 0 0 0 0 1 1 0 2 2 1 1 1 0 1 0 0 | MB.C.25327, holotype Korn et al., 2016 |
| 10  | Abichites mojaisovci Korn (Styanov, 1910)   | Changhsingian| 1 1 3 1 2 0 0 0 0 0 1 1 0 2 2 1 1 0 0 0 0 0 | MB.C.25308, Korn et al., 2016 |
| 11  | Abichites steapanovi Korn et al., 2016      | Changhsingian| 1 0 3 1 2 1 0 0 0 0 1 1 0 2 2 0 1 1 0 0 0 0 | MB.C.25345, holotype Korn et al., 2016 |
| 12  | Abichites auncinatus Korn et al., 2016      | Changhsingian| 1 1 3 2 2 0 0 0 0 0 1 1 0 2 1 1 1 1 1 0 0 0 | MB.C.25335, holotype Korn et al., 2016 |
| 13  | Arasella minuta (Zakharov, 1983)             | Changhsingian| 1 0 3 2 0 0 0 0 0 1 0 0 0 1 0 1 0 1 0 0 0 0 | MB.C.25462, Korn et al., 2016 |
| 14  | Araxocelites cristatus Korn et al., 2019    | Changhsingian| 1 1 3 2 0 2 0 0 0 0 1 1 0 2 2 0 1 1 0 0 0 0 | MB.C.22706, holotype Korn et al., 2019 |
| 15  | Araxocelites laterocostatus Korn et al., 2019| Changhsingian| 1 1 3 2 2 0 0 0 0 0 1 0 0 1 1 1 0 1 1 0 0 0 | MB.C.29164, holotype Korn et al., 2019 |
| 16  | Araxocelites sanctaplanus Korn et al., 2019 | Changhsingian| 1 0 3 2 2 0 0 0 0 0 1 1 0 1 1 1 0 1 1 0 0 0 | MB.C.29156, holotype Korn et al., 2019 |
| 17  | Changhsingoceras changhsinense               | Changhsingian| 3 2 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 | 34356, Zhao et al., 1978 |
| 18  | Chaotianoceras minutum Zhao, Liang et Zheng, 1978 | Changhsingian| 1 1 3 2 2 0 0 0 0 1 0 0 0 1 1 1 1 1 0 1 1 0 | 14955, holotype Zhao et al., 1978 |
| 19  | Chaotianoceras modestum Zhao, Liang et Zheng, 1979 | Changhsingian| 1 0 3 1 2 0 0 0 0 1 0 0 0 1 1 2 1 1 1 0 1 0 | 14950, holotype Zhao et al., 1978 |
| 20  | Dushanoceras rotaliarum Zhao, Liang et Zheng, 1978 | Changhsingian| 1 2 3 1 2 0 0 0 0 1 1 1 1 2 1 1 1 0 1 1 0 | 15000, holotype Zhao et al., 1978 |
| 21  | Dzhulfites hebes Korn et al., 2016           | Changhsingian| 1 1 3 2 2 0 0 0 0 0 1 0 0 0 1 0 2 0 0 1 1 0 | MB.C.25181, holotype Korn et al., 2016 |
| 22  | Dzhulfites zalenais Korn et al., 2016        | Changhsingian| 1 1 2 2 2 0 0 0 0 0 1 0 0 0 1 0 2 0 0 1 1 0 | MB.C.25176, holotype Korn et al., 2016 |
| 23  | Jiranites transcaucasiai (Shevyrev, 1965)    | Changhsingian| 1 0 3 2 2 0 0 0 0 1 0 0 0 0 3 1 1 1 1 0 0 0 | MB.C.29149, Korn et al., 2019 |
| 24  | Juffenichites kozrini Korn et al., 2016      | Changhsingian| 1 1 3 1 2 0 0 0 0 0 1 0 0 0 1 0 1 0 0 1 0 0 | MB.C.25305, holotype Korn et al., 2016 |
| 25  | Liuchengoceras minutum Zhao, Liang et Zheng, 1978 | Changhsingian| 2 1 2 2 2 0 0 0 0 1 0 0 0 1 0 0 0 1 0 1 1 0 | 14832, holotype Zhao et al., 1978 |
| 26  | Meitianoceras pauleum Yang et Yang, 1992     | Changhsingian| 1 1 3 1 0 0 0 0 0 1 0 0 0 1 0 1 0 1 0 1 0 | 87015, holotype Yang et Yang, 1992 |
| 27  | Meitianoceras tphaeolobatum Yang et Yang, 1992 | Changhsingian| 2 1 2 1 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 | 87007, holotype Yang et Yang, 1992 |
| 28  | Mingyuexiaoceras radiatum Zhao, Liang et Zheng, 1978 | Changhsingian| 2 1 2 1 0 0 0 0 0 1 0 0 0 1 0 1 0 1 0 1 0 | 14834, holotype Zhao et al., 1978 |
| 29  | Neogaganiodes costatus Yang et Yang, 1992    | Changhsingian| 4 2 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 1 0 1 0 | 87017, holotype Yang et Yang, 1992 |
| 30  | Neogaganiodes laevigatus Yang et Yang, 1992  | Changhsingian| 4 3 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 1 0 1 0 | 87024, holotype Yang et Yang, 1992 |
| # | Taxon Name                                      | Author(s) | Age       | Location | Holotype Code | Remarks                  |
|---|------------------------------------------------|-----------|-----------|----------|---------------|--------------------------|
| 31 | Neoaganides ultimus                          | Korn et al., 2016 | Changhsingian |           | MB.C.25169, holotype | Kom et al., 2016 |
| 32 | Pachydiscoceras changhsingense               | Zhao et Liang | Changhsingian |           |                |                          |
| 33 | Pachydiscoceras flexoplicatum               | Zhao, Liang et Zheng, 1978 | Changhsingian |           |                |                          |
| 34 | Pachydiscoceras obtusum                      | Zhao, Liang et Zheng, 1978 | Changhsingian |           |                |                          |
| 35 | Paratirolites birunii                       | Korn et al., 2016 | Changhsingian |           | MB.C.25200, holotype | Kom et al., 2016 |
| 36 | Paratirolites coronatus                      | Korn et al., 2016 | Changhsingian |           | MB.C.25195, holotype | Kom et al., 2016 |
| 37 | Paratirolites kittii                        | Stoyanov, 1910 | Changhsingian |           | MB.C.25210 |                          |
| 38 | Paratirolites multicornus                    | Korn et al., 2016 | Changhsingian |           | MB.C.25298, holotype | Kom et al., 2016 |
| 39 | Paratirolites quadratus                      | Korn et al., 2016 | Changhsingian |           | MB.C.25296, holotype | Kom et al., 2016 |
| 40 | Paratirolites serus                         | Korn et al., 2016 | Changhsingian |           | MB.C.25300, holotype | Kom et al., 2016 |
| 41 | Paratirolites trapezoidalis                 | Shevyrev, 1965 | Changhsingian |           | MB.C.25185 |                          |
| 42 | Paratirolites vediensis                     | Shevyrev, 1965 | Changhsingian |           | MB.C.25264 |                          |
| 43 | Pentagonoceras attenuatum                   | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14941, holotype |                          |
| 44 | Pentagonoceras chaotianense                  | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14981, holotype |                          |
| 45 | Pentagonoceras costatum                      | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14940, holotype |                          |
| 46 | Pentagonoceras guizhouense                   | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14939, holotype |                          |
| 47 | Pentagonoceras spinosum                      | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14946, holotype |                          |
| 48 | Pentagonoceras? guangyuense                  | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14942, holotype |                          |
| 49 | Pseudococeras robustum                       | Chao et Liang | Changhsingian |           | 14989, holotype | Zhao et al., 1978 |
| 50 | Pseudomonoceras multinosum                   | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14974, holotype | Hao et al., 1978 |
| 51 | Pseudomonoceras carinatum                    | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14976, holotype | Hao et al., 1978 |
| 52 | Pseudomonoceras dayenensis                   | Yang et Yang, 1992 | Changhsingian |           | 87045, holotype | Yang et Yang, 1992 |
| 53 | Pseudomonoceras densiplicatum                | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14978 | Hao et al., 1978 |
| 54 | Pseudomonoceras multiotinctus                | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14974, holotype | Hao et al., 1978 |
| 55 | Pseudomonoceras radiatum                     | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14977, holotype | Hao et al., 1978 |
| 56 | Pseudogastrioceras guangxiense               | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14912, holotype | Hao et al., 1978 |
| 57 | Pseudogastrioceras guizhouense               | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14911, holotype | Hao et al., 1978 |
| 58 | Pseudogastrioceras aecuanus                 | Chao et Liang | Changhsingian |           | 14914 | Hao et al., 1978 |
| 59 | Pseudostephanites costatus                  | Chao et Liang | Changhsingian |           | 14941, holotype | Hao et al., 1978 |
| 60 | Pseudostephanites nodosus                   | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14940 | Hao et al., 1978 |
| 61 | Pseudotrirotilex acutostatus                 | Zhao, Liang et Zheng, 1978 | Changhsingian |           | 14935, holotype | Hao et al., 1978 |
| 62 | Pseudotrirotilex diabates                   | Zheng, 1981 | Changhsingian |           | 34437, holotype | Zheng, 1981 |
| 63 | Pseudotrirotilex orientalis                 | Chao et Liang | Changhsingian |           | 14921, holotype | Hao et al., 1978 |
| No. | Taxon Name                        | Age         | Author(s)          | First Reference | Type          | Other References                                      |
|-----|----------------------------------|-------------|--------------------|-----------------|--------------|------------------------------------------------------|
| 64  | Pseudotirolites qinglongensis     | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34435                                      |
| 65  | Qinglongites compressus           | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34403                                      |
| 66  | Qinglongites costatus             | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34401                                      |
| 67  | Qinglongites curvatus             | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34399                                      |
| 68  | Qinglongites obesus               | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34405                                      |
| 69  | Rongjiangoceras lenticulare       | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14829, holotype: 87046                     |
| 70  | Rotodiscoceras hubiense            | Changhsingian | Yang et Yang, 1992 |                 |              | Holotype: 87046                                     |
| 71  | Rotodiscoceras kwangsiense        | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14971                                     |
| 72  | Rotodiscoceras langdiensis        | Changhsingian | Zheng, 1981      |                 |              | Holotype: 34453                                     |
| 73  | Rotodiscoceras latiobatum         | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14967, holotype: 87040                     |
| 74  | Sabaliceras wangrenense           | Changhsingian | Yang et Yang, 1992 |                 |              | Holotype: 87040                                     |
| 75  | Shevyrevites nodosus             | Changhsingian | Korn et al., 2019 |                 |              | Holotype: MB.C.29155                                |
| 76  | Shevyrevites shevyrevi            | Changhsingian | Korn et al., 2019 |                 |              | Holotype: MB.C.29153                                |
| 77  | Sinocellites sichuanensis        | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14867, holotype: 87040                     |
| 78  | Stacheceras chaotianense          | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14826, holotype: 87048                     |
| 79  | Stoyanowites aspinosus            | Changhsingian | Korn et al., 2016 |                 |              | Holotype: MB.C.25458, holotype: MB.C.25451          |
| 80  | Stoyanowites dieneri              | Changhsingian | Korn et al., 2016 |                 |              | Holotype: MB.C.25451                                |
| 81  | Tapashanites chaotianensis        | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14860, holotype: 87040                     |
| 82  | Tapashanites foriformis           | Changhsingian | Zhao et al., 1978 |                 |              | Holotype: 14851, holotype: 87040                     |
| 83  | Wangrenoceras rotalum             | Changhsingian | Yang et Yang, 1992 |                 |              | Holotype: 87048, holotype: 87048                     |
| 84  | Xenodiscus dorashamensis         | Changhsingian | Korn et al., 2019 |                 |              | Holotype: MB.C.29142, MB.C.22703                    |
| 85  | Phisonites triangulus             | Changhsingian | Korn et al., 2019 |                 |              | Holotype: MB.C.22703                                |
| 86  | Ooceras concaicum                 | Changhsingian | Tozer, 1967      |                 |              | Holotype: YG.921/164                                 |
| 87  | Hypophiceras trivialis           | Changhsingian | Tozer, 1967      |                 |              | Holotype: YG.921/164                                 |
| 88  | Episageceras dalinanae           | Griesbachian | Diener, 1897     |                 |              | Holotype: pl. 6, 1, 6                                 |
| 89  | Ooceras woodwardii               | Griesbachian | Tozer, 1967      |                 |              | Holotype: GSI.5928                                   |
| 90  | Ooceras boreale                   | Griesbachian | Tozer, 1967      |                 |              | Holotype: Kummel, 1972                              |
| 91  | Hypophiceras graciile             | Griesbachian | Tozer, 1967      |                 |              | Holotype: pl. 17, 6, 4                               |
| 92  | Hypophiceras minimum             | Griesbachian | Tozer, 1967      |                 |              | Holotype: pl. 17, 6, 4                               |
| 93  | Hypophiceras minor               | Griesbachian | Tozer, 1967      |                 |              | Holotype: pl. 17, 6, 4                               |
| 94  | Metophiceras subdemissum         | Griesbachian | Tozer, 1967      |                 |              | Holotype: pl. 17, 6, 4                               |
| 95  | Metophiceras noe-rygaardi        | Griesbachian | Tozer, 1967      |                 |              | Holotype: pl. 17, 6, 4                               |
| #  | Name                                              | Status                  | Age                     | Locality                   | Page |
|----|---------------------------------------------------|-------------------------|-------------------------|-----------------------------|------|
| 97 | "Metophiceras praecursor" Spath, 1935             | Griesbachian (Survivor) | Griesbachian            | Griesbach PM23240           | 103  |
| 98 | Tompophiceras extremum (Spath, 1935)              | Griesbachian (Survivor) | Griesbachian            | Griesbach PM23240           | 103  |
| 99 | Tompophiceras nielseni (Spath, 1935)              | Griesbachian (Survivor) | Griesbachian            | Griesbach PM23240           | 103  |
| 100| Ophiceras grebanianicum Spath, 1930               | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 101| Ophiceras subgibbosum Spath, 1935                 | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 102| Ophiceras commune Spath, 1930                     | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 103| Ophiceras tibeticum Spath, 1880                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 104| Ophiceras medium Griesbach, 1880                  | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 105| Ophiceras dubium * Spath, 1935                    | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 106| Aldanoceras tenere Dagys et Ermakov, 1996         | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 107| Anotoceras nala Diener, 1897                      | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 108| Discophiceras subkyokitum (Spath, 1930)           | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 109| Vishnuites pralambha Diener, 1897                 | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 110| Vishnuites kummeli Tozer, 1994                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 111| Vishnuites striatus Spath, 1935                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 112| Vishnuites oxynotus Spath, 1935                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 113| Wordieoceras wordei (Spath, 1930)                 | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 114| Wordieoceras decipiens (Spath, 1930)              | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 115| Wordieoceras tompoense Dagys and Ermakova, 1996  | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 116| Jieshaniceras guizhouense (Zakharov and Mu in Mu et al., 2007) | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 117| Multilococeras guiaojencae Dai et al., 2019      | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 118| Pseudovishnuites guisingensis (Zakharov and Mu in Mu et al., 2007) | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 119| Gyronitidae gen. indet. sp. indet.               | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 120| Hubelitoceras yanjaensis (Xu, 1988)               | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 121| Bukkenites nildus Tozer, 1994                    | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 122| Bukkenites striatus Tozer, 1994                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 123| Bukkenites maclentus Tozer, 1994                  | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 124| Bukkenites incisus Tozer, 1994                   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 125| Bukkenites nanus Tozer, 1994                     | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 126| Pseudoproptychites hiemalis (Diener, 1895)       | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
| 127| Pachyproptychites otoce1atoïdes (Diener, 1895)   | Griesbachian (Newcomer) | Griesbachian            | Griesbach PM23240           | 103  |
Table DR2. List of 22 shell characters for studied ammonoids.

| No. | Definition |
|-----|------------|
| 1   | H/D: <0.3 (0); 0.3~0.4 (1); 0.4~0.5 (2); 0.5~0.6 (3); >0.6 (4) |
| 2   | W/D: <0.25 (0); 0.25~0.4 (1); 0.4~0.55 (2); 0.55~0.7 (3); >0.7 (4) |
| 3   | U/D: <0.12 (0); 0.15~0.3 (1); 0.3~0.45 (2); 0.45~0.6 (3); >0.6 (4) |
| 4   | Rib: absent (0); weak (1); strong (2) |
| 5   | Node on ventral-lateral shoulder: absent (0); weak (1); strong (2) |
| 6   | Node on umbilical shoulder: absent (0); weak (1); strong (2) |
| 7   | Sharp Venter: absent (0); present (1) |
| 8   | Angular venter: absent (0); present (1) |
| 9   | Narrow rounded venter: absent (0); present (1) |
| 10  | Rounded venter: absent (0); present (1) |
| 11  | Tabulate venter: absent (0); present (1) |
| 12  | Change in ventral shape through ontogeny: no (0); yes (1) |
| 13  | Ventral keel: absent (0); present (1) |
| 14  | Ventro-lateral (VL) shoulder shape: absent (0); rounded (1); angular (2) |
| 15  | Flank shape: convex (0); flattened (1); concave (2) |
| 16  | Flank slope from umbilical shoulder to VL shoulder: convergent (0); parallel (1); divergent (2) |
| 17  | Change in flank shape or slope through ontogeny: no (0); yes (1) |
| 18  | Umbilical shoulder shape: absent (0); rounded (1); acute (2) |
| 19  | Orientation of umbilical wall: vertical (0); slope (1) |
| 20  | Depth of umbilicus: shallow (0); deep (1) |
| 21  | Constrictions: absent (0); present (1) |
| 22  | Strigation: absent (0); present (1) |

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