Table S1. Eight categories of seabed substrates and their composition among bedrock, gravel, and sediment.

|  |  |  |
| --- | --- | --- |
| Substrate type | Covered percentage | value |
| Sediment (%) | Bedrock (%) | Gravel (%) |
| Bedrock | <5 | >95 | - | 0.025 |
| Bedrock and gravel | <5 | >50 | 30–50 | 0.025 |
| Bedrock and sediment | 30–50 | >50 | - | 0.4 |
| Slightly clayed gravel | 5–30 | - | >70 | 0.175 |
| Clayed gravel | 30–50 | - | >50 | 0.4 |
| Gravelly sediment | 50–70 | - | 30–50 | 0.6 |
| Slightly gravelly sediment | 70–95 | - | 5–30 | 0.825 |
| Sediment | >95 | - | <5 | 0.975 |

Table S2. Pairwise correlation of the six environmental factors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | depth | slope | temperature | substrate | latitude | longitude |
| depth | - |  |  |  |  |  |
| slope | -0.4847 | - |  |  |  |  |
| temperature | **0.9838** | -0.4742 | - |  |  |  |
| substrate | 0.7714 | -0.6422 | 0.7361 | - |  |  |
| latitude | -0.3099 | -0.1041 | -0.1599 | -0.2239 | - |  |
| longitude | -0.1393 | -0.1843 | 0.0186 | -0.1043 | **0.9669** | - |

Table S3. Taxa list of megafauna of the Yap Trench.

|  |  |
| --- | --- |
| **Taxa** | **Dives** |
| **DV109** | **DV110** | **DV111** | **DV112** | **DV113** | **DV149** | **DV150** | **DV151** | **DV152** |
| **PORIFERA** |  |  |  |  |  |  |  |  |  |
| Hexactinellida |  |  |  |  |  |  |  |  |  |
| Lyssacinosida |  |  |  |  |  |  |  |  |  |
| Euplectellidae (Bolosominae) |  |  |  |  |  |  |  |  |  |
| *Rhizophyta yapensis* Shen et al., 2019 | 2 |  |  |  |  |  |  |  |  |
| Euplectellidae (Bolosominae) sp.1 | 1 |  |  |  |  |  |  |  |  |
| Euplectellidae (Bolosominae) sp.2 |  |  |  |  |  | 2 |  |  |  |
| Demospongiae |  |  |  |  |  |  |  |  |  |
| Poecilosclerida |  |  |  |  |  |  |  |  |  |
| Cladorhizidae |  |  |  |  |  |  |  |  |  |
| *Chondrocladia (Chondrocladia)* cf. *lampadiglobus* Vacelet, 2006 | 1 |  |  |  |  | 1 |  |  |  |
| *Chondrocladia (Symmetrocladia)* cf. *lyra* Lee et al., 2012 |  |  |  |  |  | 1 |  |  |  |
| *Cladorhiza* sp. |  |  |  |  |  |  |  |  |  |
| Porifera sp.1 |  |  |  |  | 1 |  |  |  |  |
| Porifera sp.2 |  |  | 1 |  |  |  |  |  |  |
| **CNIDARIA** |  |  |  |  |  |  |  |  |  |
| **Anthozoa** |  |  |  |  |  |  |  |  |  |
|  Antipatharia |  |  |  |  |  |  |  |  |  |
|  Schizopathidae |  |  |  |  |  |  |  |  |  |
|  *Abyssopathes* sp. | 1 |  |  |  |  |  |  |  |  |
|  Actiniaria |  |  |  |  |  |  |  |  |  |
|  Relicanthidae |  |  |  |  |  |  |  |  |  |
|  *Relicanthus* sp. | 1 |  |  |  |  |  |  |  |  |
|  Enthemonae sp.1 | 1 |  |  |  |  |  |  |  |  |
|  Enthemonae sp.2 |  |  |  |  |  | 3 |  |  |  |
|  Actiniaria sp.1 | 2 |  |  |  |  |  |  |  |  |
|  Actiniaria sp.2 |  | 2 |  |  |  |  |  |  |  |
|  Actinaria sp.3 |  | 1 |  |  | 1 |  |  |  |  |
|  Cnidaria sp. | 1 | 6 |  |  | 3 |  |  | 4 | 1 |
| **CTENOPHORA** |  |  |  |  |  |  |  |  |  |
|  Ctenophora sp. |  |  | 1 |  |  |  |  |  |  |
| **ANNELIDA** |  |  |  |  |  |  |  |  |  |
| **Polychaeta** |  |  |  |  |  |  |  |  |  |
|  Phylodocida |  |  |  |  |  |  |  |  |  |
|  Polynoidae sp.1 | 15 | 10 |  | 2 | 3 |  | 10 | 1 | 8 |
|  Polynoidae sp.2 |  |  |  | 5 | 1 |  | 4 | 4 | 11 |
|  Polychaeta sp.1 | 1 |  |  | 1 |  |  |  |  |  |
|  Polychaeta sp.2 | 2 |  |  |  |  | 1 |  |  |  |
|  Polychaeta sp.3 |  |  |  |  |  |  | 20 | 8 | 5 |
| **ARTHROPODA** |  |  |  |  |  |  |  |  |  |
| **Malacostraca** |  |  |  |  |  |  |  |  |  |
|  Mysida |  |  |  |  |  |  |  |  |  |
|  Mysidae sp. | 6 | 16 | 6 | 59 | 34 | 10 | 51 | 77 | 342 |
|  Amphipoda |  |  |  |  |  |  |  |  |  |
|  Amphipoda sp. | 5 | 7 |  | 12 | 9 | 1 | 9 | 10 | 15 |
|  Decapoda |  |  |  |  |  |  |  |  |  |
|  Benthesicymidae |  |  |  |  |  |  |  |  |  |
|  *Benthesicymus* cf. *crenatus* |  | 1 |  | 2 |  | 1 |  |  | 2 |
|  Decapoda sp.1 |  |  | 1 | 1 | 2 |  | 1 |  | 1 |
|  Decapoda sp.2 | 2 | 1 |  | 3 |  | 1 | 2 | 2 | 5 |
|  Isopoda |  |  |  |  |  |  |  |  |  |
|  Munnopsidae |  |  |  |  |  |  |  |  |  |
|  Munnopsidae sp. | 4 | 1 | 1 | 3 |  | 1 | 6 | 2 | 10 |
| **ECHINODERMATA** |  |  |  |  |  |  |  |  |  |
| **Holothuroidea** |  |  |  |  |  |  |  |  |  |
|  Synallactida |  |  |  |  |  |  |  |  |  |
|  Synallactidae |  |  |  |  |  |  |  |  |  |
|  Paelopatides sp.1 |  |  |  |  |  |  |  |  | 1 |
|  Paelopatides sp.2 |  |  |  |  |  |  | 1 |  |  |
|  Synallactidae sp.1 |  |  |  | 1 |  |  |  |  | 1 |
|  Synallactidae sp.2 |  |  |  |  | 1 |  |  |  |  |
|  Persiculida |  |  |  |  |  |  |  |  |  |
|  Persiculida sp.1 |  |  |  |  |  |  |  | 2 | 8 |
|  Persiculida sp.2 |  |  |  | 1 |  |  |  |  |  |
|  cf. *Hansenothuria* sp. | 1 |  |  |  |  | 1 |  |  |  |
|  Elasipodida |  |  |  |  |  |  |  |  |  |
|  Elpidiidae |  |  |  |  |  |  |  |  |  |
|  Elpidiidae sp.1 |  |  |  |  |  |  |  |  | 2 |
|  Elpidiidae sp.2 |  | 79 |  |  |  |  |  |  |  |
|  *Peniagone* sp.1 |  |  |  |  |  | 5 |  |  |  |
|  *Peniagone* sp.2 |  |  |  |  |  |  | 1 |  |  |
|  *Peniagone* sp.3 |  |  |  |  |  | 4 |  |  |  |
|  Pelagothuriidae |  |  |  |  |  |  |  |  |  |
|  cf. *Enypniastes* sp.1 |  |  |  |  |  |  |  |  | 1 |
|  cf. *Enypniastes* sp.2 |  | 1 |  |  |  |  |  |  |  |
|  Holothuroidea sp.1 |  |  |  | 1 | 1 |  |  |  |  |
| Holothuroidea sp.2 |  |  |  |  |  |  |  | 1 |  |
| Holothuroidea sp.3 |  |  |  |  | 1 |  |  |  | 1 |
| Holothuroidea sp.4 | 4 |  |  |  |  | 1 |  |  |  |
| Holothuroidea sp.5 | 1 |  |  | 2 |  |  |  |  |  |
| Holothuroidea sp.6 |  | 2 |  |  |  |  |  |  |  |
| Holothuroidea sp.7 |  |  |  | 1 | 1 |  | 2 |  |  |
| Holothuroidea sp.8 |  |  |  |  |  | 1 | 2 |  | 3 |
|  **Asteroidea** |  |  |  |  |  |  |  |  |  |
|  Brisingida |  |  |  |  |  |  |  |  |  |
|  Freyellidae |  |  |  |  |  |  |  |  |  |
|  *Freyella* sp. |  | **2** |  |  |  |  |  |  |  |
|  *Freyastera* sp.1 | 4 |  |  |  |  |  |  |  |  |
|  *Freyastera* sp.2 |  |  |  | 1 |  |  | 1 |  | 2 |
|  *Freyastera* *basketa* Zhang et al., 2019 |  |  |  |  |  | 1 |  |  |  |
|  Velatida |  |  |  |  |  |  |  |  |  |
|  Pterasteridae |  |  |  |  |  |  |  |  |  |
|  *Pteraster* sp.1 |  |  |  | 1 |  |  |  |  |  |
|  *Pteraster* sp.2 |  |  |  |  |  |  |  | 1 |  |
|  Paxillosida |  |  |  |  |  |  |  |  |  |
|  Porcellanasteridae |  |  |  |  |  |  |  |  |  |
|  *Styracaster yapensis* Zhang et al., 2017 |  |  |  | 4 | 13 |  | 3 | 5 | 2 |
|  Asteroidea sp. |  |  |  |  | 1 |  |  | 1 | 2 |
| **Ophiuroidea** |  |  |  |  |  |  |  |  |  |
|  Ophiurida |  |  |  |  |  |  |  |  |  |
|  Ophiopyrgidae |  |  |  |  |  |  |  |  |  |
|  Ophiopyrgidae sp.1 |  |  |  |  |  | 5 |  |  |  |
|  Ophiopyrgidae sp.2 |  |  | 1 |  |  |  |  |  | 6 |
|  Ophiuroidea sp.1 |  |  |  |  |  | 8 |  |  |  |
| Ophiuroidea sp.2 |  |  |  |  |  | 2 |  |  |  |
| **Crinoidea** |  |  |  |  |  |  |  |  |  |
|  Comatulida |  |  |  |  |  |  |  |  |  |
|  Bathycrinidae |  |  |  |  |  |  |  |  |  |
|  *Bathycrinus* sp. |  |  |  |  |  |  |  |  | 1 |
| **HEMICHORDATA** |  |  |  |  |  |  |  |  |  |
| Enteropneusta sp. |  | 1 |  |  |  |  |  |  | 2 |
| **CHORDATA** |  |  |  |  |  |  |  |  |  |
| Actinopterygii |  |  |  |  |  |  |  |  |  |
|  Ophidiiformes |  |  |  |  |  |  |  |  |  |
|  Ophidiidae |  |  |  |  |  |  |  |  |  |
|  *Typhlonus nasus* Günther, 1878 | 2 |  |  |  |  | 2 |  |  |  |
|  Ophidiidae sp. |  |  |  |  |  | 1 |  |  |  |
|  Scorpaeniformes |  |  |  |  |  |  |  |  |  |
|  Liparidae |  |  |  |  |  |  |  |  |  |
|  Liparidae sp.1 |  | 1 |  | 1 |  |  |  |  |  |
|  Liparidae sp.2 |  |  |  |  |  |  |  | 1 | 1 |
|  *Pseudoliparis swirei* Gerringer & Linley, 2017 |  |  |  |  |  |  |  |  | 1 |
|  Perciformes |  |  |  |  |  |  |  |  |  |
|  Zoarcidae |  |  |  |  |  |  |  |  |  |
|  Zoarcidae sp. |  |  |  | 1 |  |  |  |  |  |
| Chordata sp.1 | 4 |  |  |  |  |  |  |  |  |
| Chordata sp.2 | 1 | 15 |  | 1 |  |  |  |  | 1 |
| Chordata sp.3 |  | 4 |  |  |  |  |  |  |  |
| Chordata sp.4 |  | 6 |  |  | 1 |  |  |  |  |
| Chordata sp.5 |  |  |  |  |  |  |  | 1 |  |
| Ascidiacea |  |  |  |  |  |  |  |  |  |
|  Ascidiacea sp. |  |  |  | 1 |  |  |  |  |  |
| unknown 1 |  | 1 |  |  |  |  |  |  |  |
| unknown 2 |  | 1 |  |  |  |  |  |  |  |
| unknown 3 |  |  |  |  |  | 1 |  |  |  |
| unknown 4 |  |  |  |  |  | 1 |  |  |  |
| unknown 5 |  | 1 |  |  |  |  |  |  |  |