Species composition and functional traits of macrofauna in different mangrove habitats in the Persian Gulf

Table S1. The geographical coordinates of the sampled areas.

|  |  |  |
| --- | --- | --- |
| Area | Latitude | Longitude |
| Tabl - beach | 26° 46’24. 42” | 55° 43’39.23” |
| Tabl - creek | 26° 49’29.48” | 55° 42’57.92” |
| Gavarzin - beach | 26° 49’08.72” | 55° 47’30.49” |
| Gavarzin - creek | 26° 48’44.12” | 55° 47’25.92” |
| Laft - beach | 26° 53’08.36” | 55° 46’17.08” |
| Laft - creek | 26° 51’21.30” | 55° 45’50.13” |
| Khamir1 - beach | 26° 59’03.38” | 55° 39’24.48” |
| Khamir1- creek | 26° 59’01.60” | 55° 39’24.84” |
| Khamir2 - beach | 26° 58’37.06” | 55° 38’02.12” |
| Khamir2- creek | 26° 58’20.29” | 55° 37’57.89” |

Table S2. Analysis of variance (two-way ANOVA) of salinity and temperature data exploring differences between habitats and seasons in the mangrove forest. PERMANOVA was used to analyse differences in sediment total organic matter (TOM), as the data did not fulfil requirements of ANOVA (i.e. normality assumptions).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Environmental variable | Factor | df | SS | MS | F | p |
| Salinity | Habitat | 5 | 181.2 | 36.24 | 6.849 | <0.001 |
| Season | 3 | 348.3 | 116.09 | 25.1 | <0.001 |
| Habitat\*Season | 15 | 297 | 19.8 | 6.34 | <0.001 |
| Temperature | Habitat | 5 | 66 | 13.24 | 0.76 | 0.58 |
| Season | 3 | 4022 | 1340.8 | 539.7 | <0.001 |
| Habitat\*Season | 15 | 95.42 | 6.36 | 3.02 | 0.0002 |
| PERMANOVA | **Factor** | **df** | **SS** | **MS** | **pseudo-F** | **p(perm)** |
| TOM | Habitat | 5 | 211.88 | 42.377 | 3.957 | 0.002 |
| Season | 3 | 67.189 | 22.396 | 2.091 | >0.05 |
| Habitat\*Season | 15 | 69.674 | 4.6449 | 0.433 | 0.964 |

Table S3. The number of species collected in the six habitats during winter and summer, B = beach, C = creek.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Faunal group** | **Order** | **Habitat/Winter** | | | | | | **Habitat/Summer** | | | | | |
|  |  | B1 | B2 | B3 | C1 | C2 | C3 | B1 | B2 | B3 | C1 | C2 | C3 |
| Crustacea | Decapoda | 5 | 9 | 6 | 7 | 11 | 8 | 4 | 4 | 4 | 8 | 8 | 9 |
|  | Isopoda | - | - | - | 1 | - | - | - | - | - | - | - | - |
|  | Stomatopoda | - | - | - | 1 | - | 1 | - | - | - | - | - | - |
|  | Sessilia | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Annelida | Polychaeta | 4 | 6 | 6 | 11 | 8 | 12 | 1 | 5 | 7 | 9 | 9 | 8 |
|  | Sipuncula | - | - | - | 1 | - | - | - | - | - | 1 | - | - |
| Mollusca | Gastropoda | 4 | 10 | 6 | 9 | 7 | 8 | 5 | 10 | 10 | 20 | 23 | 9 |
|  | Bivalvia | - | 1 | 1 | 2 | 2 | 3 | 3 | 8 | 6 | 16 | 13 | 4 |
| **Total species richness** | | 13 | 26 | 20 | 33 | 29 | 33 | 14 | 28 | 28 | 55 | 54 | 31 |

Table S4. List of all species found in the different seasons.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Faunal group | Species | Winter | Spring | Summer | Fall |
| Crustacea | *Alpheus euphrosyne* | \* |  | \* | \* |
| *Alpheus lutosus* | \* | \* | \* | \* |
| *Amphibalanus amphitrite* | \* | \* | \* | \* |
| *Austruca iranica* | \* | \* |  |  |
| *Austruca sindensis* | \* |  |  |  |
| *Eurycarcinus orientalis* | \* | \* | \* | \* |
| *Ilyograpsus rhizophorae* | \* | \* | \* | \* |
| *Ilyoplax frater* | \* | \* | \* | \* |
| *Ilyoplax stevensi* | \* | \* | \* | \* |
| *Manningis arabicum* | \* | \* | \* | \* |
| *Nasima dotilliformis* | \* | \* | \* | \* |
| *Olibrinus antennatus* | \* |  |  | \* |
| *Opusia indica* | \* | \* | \* | \* |
| *Parasesarma persicum* | \* | \* | \* | \* |
| Stomatopoda sp. | \* |  |  |  |
| *Synalpheus* sp. | \* | \* | \* | \* |
| *Venitus dentipes* |  | \* |  |  |
| Annelida | Amphinomidaesp. |  |  | \* |  |
| Capitellidae sp. A | \* | \* | \* | \* |
| Capitellidae sp. B | \* | \* | \* | \* |
| Cirratulidaesp*.* | \* |  |  |  |
| Echiuridaesp. | \* |  |  |  |
| Eunicidae sp. A | \* | \* | \* | \* |
| Eunicidae sp. B | \* |  |  | \* |
| Glyceridae sp. | \* |  | \* | \* |
| Goniadidae sp. A | \* | \* | \* | \* |
| Goniadidae sp. B |  | \* | \* | \* |
| Lumbrineridae sp. | \* | \* | \* | \* |
| Nereididae sp. A | \* | \* | \* | \* |
| Nereididae sp. B | \* | \* | \* | \* |
| Nereididae sp. C |  | \* | \* | \* |
| *Nereis persica* | \* |  | \* | \* |
| *Perinereis horsti* | \* |  | \* | \* |
| *Perinereis* sp. | \* | \* | \* | \* |
| Phyllodocidae sp. | \* |  |  |  |
| Pilargidae sp. |  |  | \* |  |
| Poecilochaetidae sp. | \* |  |  |  |
| *Raricirrus* sp. |  |  |  | \* |
| *Simplisetia erythraeensis* | \* |  |  |  |
| *Simplisetia qeshmensis* | \* |  |  |  |
| *Simplisetia* sp. | \* |  | \* | \* |
| Sipuncula sp. | \* | \* | \* | \* |
| Mollusca | *Acar plicata* |  | \* |  | \* |
| *Acrilla acuminata* |  | \* | \* | \* |
| *Acteocina* sp. |  |  |  | \* |
| *Acteocina inconspicua* |  | \* | \* | \* |
| *Aliculastrum cylindricum* |  |  |  | \* |
| *Amphilepida* sp. |  |  | \* | \* |
| *Anadara ehrenbergi* |  |  | \* | \* |
| *Ancilla farsiana* |  | \* | \* | \* |
| *Arcuatula senhousia* | \* | \* | \* | \* |
| *Assiminea* sp. | \* | \* | \* | \* |
| *Brachidontes variabilis* |  | \* | \* | \* |
| *Calyptraea pellucida* |  |  |  | \* |
| *Carditopsis majeeda* |  |  |  | \* |
| *Cerithidium cerithinum* |  |  |  | \* |
| *Cerithidium* sp. |  |  | \* |  |
| *Chicoreus ramosus* |  |  |  | \* |
| *Chrysallida* sp. |  | \* |  | \* |
| *Clanculus scabrosus* | \* |  |  |  |
| *Clypeomorus bifasciata* | \* | \* | \* |  |
| *Congetia chesneyi* |  | \* | \* | \* |
| *Coralliophaga coralliophaga* |  | \* | \* | \* |
| *Corbula taitensis* |  | \* | \* | \* |
| *Crassispira* sp. | \* | \* |  | \* |
| *Cyclostrema ocrinium* |  | \* | \* | \* |
| *Didimacar tenebrica* | \* | \* | \* | \* |
| *Diodora funiculata* | \* | \* |  |  |
| *Diodora singaporensis* |  | \* |  |  |
| *Diplodonta* sp. |  | \* |  | \* |
| *Discopsis* sp. |  | \* |  | \* |
| *Dosinia* sp. |  | \* | \* | \* |
| *Ellobium* sp. |  | \* |  |  |
| *Epitonium* sp. | \* | \* | \* | \* |
| *Euchelus asper* | \* | \* | \* |  |
| *Eulimella* sp. |  |  |  | \* |
| *Eulimastoma eutropia* |  | \* | \* | \* |
| *Eurytellina nitens* |  | \* | \* |  |
| *Exolaternula erythraea* |  | \* | \* | \* |
| *Gibberula mazagonica* |  | \* | \* | \* |
| *Granulina oodes* |  |  | \* | \* |
| *Haminoea vitrea* | \* | \* | \* | \* |
| *Indothais lacera* | \* | \* |  | \* |
| *Iravadia quadrasi* | \* | \* | \* | \* |
| *Irus irus* |  | \* | \* | \* |
| *Laemodonta monilifera* |  |  |  | \* |
| *Littoraria intermedia* | \* | \* | \* | \* |
| *Mitrella blanda* | \* | \* | \* | \* |
| *Notomyrtea fabula* |  |  | \* |  |
| *Nassarius castus* |  | \* | \* | \* |
| *Natica* sp. |  | \* |  |  |
| *Naticarius* sp. |  |  |  | \* |
| *Neotrapezium sublaevigatum* | \* | \* | \* | \* |
| *Nerita albicilla* |  | \* |  | \* |
| *Oscilla evanida* |  | \* | \* | \* |
| *Pirenella cingulata* | \* | \* | \* | \* |
| *Pitar pellucidus* |  |  | \* | \* |
| *Platevindex tigrinus* | \* |  | \* | \* |
| *Pseudominolia biangulosa* |  |  |  | \* |
| *Pseudonoba* sp. |  |  | \* | \* |
| *Ptychobela opisthochetos* |  | \* |  |  |
| Pyramidellidae sp. |  |  |  | \* |
| *Salinator fragilis* | \* | \* | \* | \* |
| *Septifer cumingii* | \* |  |  |  |
| *Serratina capsoides* |  |  | \* |  |
| *Serratina serrata* |  |  | \* |  |
| *Stenothyra* sp. |  | \* | \* | \* |
| *Stosicia annulata* |  |  |  | \* |
| *Tellina* sp. |  | \* | \* | \* |
| *Terebra* sp. |  | \* |  | \* |
| *Theora mesopotamica* |  | \* | \* | \* |
| *Timoclea arakana* |  | \* |  | \* |
| *Tornatina persiana* |  |  |  | \* |
| *Tornus* sp. |  | \* | \* | \* |
| *Trochus fultoni* |  | \* | \* | \* |
| *Trochus* sp. |  | \* | \* |  |
| *Turbonilla icela* |  |  | \* | \* |
| *Turbonilla linjaica* |  |  |  | \* |
| *Turritella* sp. A |  | \* | \* | \* |
| *Turritella* sp. B |  | \* |  |  |
| *Umbonium vestiarium* | \* | \* | \* | \* |
| *Zafra* sp. |  |  | \* | \* |

Table S5. The number of species, average total abundance (ind. m-2) and biomass (g wwt m-2) in the six habitats during the four seasons.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Season | Habitat | Species richness | Abundance | Biomass |
| Winter | B1 | 13 | 719 | 134 |
|  | B2 | 26 | 1414 | 240 |
|  | B3 | 20 | 1625 | 466 |
|  | C1 | 33 | 434 | 69 |
|  | C2 | 29 | 255 | 16 |
|  | C3 | 33 | 434 | 71 |
| Spring | B1 | 24 | 603 | 92 |
|  | B2 | 26 | 1914 | 277 |
|  | B3 | 58 | 2082 | 404 |
|  | C1 | 40 | 885 | 108 |
|  | C2 | 43 | 1271 | 177 |
|  | C3 | 41 | 1086 | 129 |
| Summer | B1 | 14 | 535 | 71 |
|  | B2 | 28 | 3168 | 511 |
|  | B3 | 28 | 482 | 85 |
|  | C1 | 55 | 2077 | 241 |
|  | C2 | 54 | 1231 | 179 |
|  | C3 | 31 | 423 | 61 |
| Fall | B1 | 22 | 824 | 157 |
|  | B2 | 29 | 1298 | 125 |
|  | B3 | 47 | 1235 | 177 |
|  | C1 | 76 | 2231 | 362 |
|  | C2 | 39 | 775 | 123 |
|  | C3 | 44 | 396 | 103 |

Table S6. Pairwise comparisons of abundance, biomass and traits between habitats and seasons. The analyses were performed with two-way PERMANOVA, if the main test was significant (p<0.05; Table 3). Habitats: B=beach, C=creek. Seasons: W=winter, Sp=spring, Su=summer, F=fall.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Abundance | | Biomass | | Traits | |
| Habitats | t | P(perm) | t | P(perm) | t | P(perm) |
| B1-B2 | 2.125 | 0.003 | 2.292 | 0.002 | 2.159 | 0.005 |
| B1-B3 | 2.262 | 0.001 | 2.567 | 0.000 | 2.475 | 0.002 |
| B1-C1 | 2.268 | 0.000 | 2.345 | 0.000 | 2.593 | 0.000 |
| B1-C2 | 2.469 | 0.000 | 2.728 | 0.000 | 2.850 | 0.000 |
| B1-C3 | 2.165 | 0.001 | 2.407 | 0.000 | 2.551 | 0.000 |
| B2-B3 | 1.095 | 0.268 | 1.143 | 0.202 | 1.156 | 0.242 |
| B2-C1 | 2.404 | 0.000 | 2.268 | 0.000 | 2.005 | 0.010 |
| B2-C2 | 2.467 | 0.000 | 2.405 | 0.000 | 2.318 | 0.001 |
| B2-C3 | 2.288 | 0.000 | 2.171 | 0.000 | 2.528 | 0.002 |
| B3-C1 | 2.159 | 0.000 | 2.265 | 0.000 | 1.376 | 0.116 |
| B3-C2 | 1.951 | 0.000 | 2.025 | 0.000 | 1.448 | 0.093 |
| B3-C3 | 1.666 | 0.013 | 1.609 | 0.013 | 1.757 | 0.039 |
| C1-C2 | 1.133 | 0.201 | 1.291 | 0.070 | 0.647 | 0.822 |
| C1-C3 | 1.670 | 0.001 | 1.788 | 0.000 | 1.232 | 0.176 |
| C2-C3 | 1.386 | 0.026 | 1.437 | 0.017 | 1.270 | 0.151 |
| Seasons |  |  |  |  |  |  |
| W-Sp | 1.481 | 0.021 | 2.056 | 0.000 |  |  |
| W-Su | 1.705 | 0.003 | 2.165 | 0.000 |  |  |
| W-F | 1.398 | 0.028 | 1.788 | 0.000 |  |  |
| Sp-Su | 0.791 | 0.835 | 1.010 | 0.405 |  |  |
| Sp-F | 1.295 | 0.069 | 1.524 | 0.014 |  |  |
| Su-F | 1.139 | 0.183 | 1.122 | 0.219 |  |  |

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Figure S1. Salinity (ppt) and temperature (℃, avg. ± SD) in the six different habitats during the four seasons.

Figure S2. Percentage of the grain size fractions in the six habitats. The values are averaged across all seasons and sampling areas.

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Figure S3. nMDS ordinations illustrating the differences in macrofauna community abundance and biomass between the six habitats in summer and winter, A) abundance in summer and B) in winter, C) biomass in summer and D) in winter.