# Appendix (Supplementary tables)

Table A1 Positive processing based indicator types for the ecosystem health assessment in Laizhou Bay

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Indicator | Type | Indicator | Type | Indicator | Type | Indicator | Type |
| D1 | mimimum | P3 | mimimum | P13 | mimimum | S10 | mimimum |
| D2 | maximum | P4 | mimimum | S1 | maximum | S11 | mimimum |
| D3 | mimimum | P5 | mimimum | S2 | maximum | I1 | mimimum |
| D4 | mimimum | P6 | mimimum | S3 | maximum | I2 | mimimum |
| D5 | maximum | P7 | mimimum | S4a | intermediate | I3 | mimimum |
| D6 | mimimum | P8a | intermediate | S5 | maximum | I4b | intermediate |
| D7 | mimimum | P9a | intermediate | S6 | maximum | R1 | maximum |
| D8 | maximum | P10 | mimimum | S7 | mimimum | R2 | maximum |
| P1 | mimimum | P11a | intermediate | S8 | maximum | R3 | maximum |
| P2 | mimimum | P12 | mimimum | S9 | maximum | R4 | maximum |

Note: aThe average value of nearly 40 years is used to represent the best value in the intermediate-style indicator series for the four indicators of P8, P9, P11 and S4; b16 is selected as the intermediate value for I4.

Table A2 Deviation standardization based indicator values for the ecosystem health assessment in Laizhou Bay

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Indicator | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2019 |
| D1 | 1.0000 | 0.8887 | 0.5011 | 0.4754 | 0.3534 | 0.2284 | 0.0767 | 0.0368 | 0.0000 |
| D2 | 0.0000 | 0.0064 | 0.0202 | 0.0715 | 0.1364 | 0.3016 | 0.6211 | 0.9690 | 1.0000 |
| D3 | 1.0000 | 0.9709 | 0.9195 | 0.7642 | 0.7085 | 0.5809 | 0.3110 | 0.0431 | 0.0000 |
| D4 | 1.0000 | 0.9955 | 0.9809 | 0.9356 | 0.8836 | 0.6516 | 0.2843 | 0.0000 | 0.1230 |
| D5 | 0.0000 | 0.0024 | 0.0082 | 0.0363 | 0.0737 | 0.1887 | 0.4474 | 0.8239 | 1.0000 |
| D6 | 0.0000 | 0.0078 | 0.2211 | 0.3963 | 0.6928 | 0.8889 | 0.9686 | 1.0000 | 0.9992 |
| D7 | 0.7614 | 0.9230 | 0.5936 | 0.6498 | 0.8657 | 0.0000 | 0.1200 | 0.5102 | 1.0000 |
| D8 | 0.0000 | 0.0970 | 0.1206 | 0.3139 | 0.3560 | 0.4750 | 0.5924 | 0.7835 | 1.0000 |
| P1 | 1.0000 | 0.9574 | 0.8472 | 0.5366 | 0.0479 | 0.0000 | 0.5290 | 0.5557 | 0.7263 |
| P2 | 1.0000 | 1.0000 | 0.9959 | 0.6890 | 0.6515 | 0.4012 | 0.3183 | 0.0000 | 0.0444 |
| P3 | 1.0000 | 0.9891 | 0.7625 | 0.0000 | 0.2791 | 0.2784 | 0.4887 | 0.5625 | 0.8469 |
| P4 | 1.0000 | 0.8535 | 0.6391 | 0.3440 | 0.0797 | 0.0574 | 0.0377 | 0.0000 | 0.2309 |
| P5 | 0.0000 | 0.8729 | 1.0000 | 0.6760 | 0.5867 | 0.5538 | 0.5368 | 0.6112 | 0.6428 |
| P6 | 0.7844 | 0.6577 | 0.8107 | 0.8035 | 1.0000 | 0.9257 | 0.4280 | 0.0000 | 0.3800 |
| P7 | 1.0000 | 0.9282 | 0.8517 | 0.8433 | 0.7122 | 0.5905 | 0.2516 | 0.0000 | 0.0421 |
| P8 | 0.6488 | 0.6451 | 0.9968 | 0.4071 | 0.0000 | 0.6941 | 0.6673 | 0.3928 | 1.0000 |
| P9 | 0.5217 | 0.9120 | 0.8172 | 1.0000 | 0.0000 | 0.4311 | 0.2647 | 0.0168 | 0.4548 |
| P10 | 0.6884 | 0.1031 | 0.6492 | 0.7903 | 0.6192 | 0.0000 | 0.0696 | 1.0000 | 0.0019 |
| P11 | 0.5781 | 0.6357 | 0.8770 | 0.8828 | 0.8140 | 0.0000 | 0.2855 | 1.0000 | 0.5185 |
| P12 | 1.0000 | 0.9929 | 0.6585 | 0.3562 | 0.6896 | 0.0000 | 0.5494 | 0.8742 | 0.8320 |
| P13 | 1.0000 | 0.9756 | 0.7907 | 0.7663 | 0.6206 | 0.4504 | 0.3215 | 0.1423 | 0.0000 |
| S1 | 1.0000 | 0.8669 | 0.7028 | 0.4126 | 0.1923 | 0.0132 | 0.0000 | 0.6130 | 0.3839 |
| S2 | 1.0000 | 0.9792 | 0.7292 | 0.7708 | 0.5625 | 0.3958 | 0.2500 | 0.0000 | 0.1042 |
| S3 | 0.9078 | 0.7456 | 0.6006 | 0.5674 | 0.1725 | 0.0000 | 0.9604 | 0.8026 | 1.0000 |
| S4 | 0.7187 | 0.8569 | 0.8266 | 0.6120 | 0.2098 | 0.6910 | 0.9316 | 1.0000 | 0.0000 |
| S5 | 0.1772 | 0.1861 | 0.8784 | 0.7511 | 0.8936 | 1.0000 | 0.0000 | 0.8888 | 0.9010 |
| S6 | 0.2455 | 0.3478 | 0.0815 | 0.0879 | 0.0000 | 0.6463 | 0.7976 | 0.6851 | 1.0000 |
| S7 | 0.5398 | 0.5841 | 0.0000 | 1.0000 | 0.5398 | 0.5929 | 0.9735 | 0.5752 | 0.7522 |
| S8 | 0.6671 | 1.0000 | 0.1493 | 0.8890 | 0.5551 | 0.2233 | 0.8757 | 0.0000 | 0.7727 |
| S9 | 0.0841 | 0.0429 | 0.0000 | 0.1682 | 0.0823 | 0.0519 | 0.3059 | 0.3828 | 1.0000 |
| S10 | 1.0000 | 0.8364 | 0.5636 | 0.0727 | 0.5455 | 0.0000 | 0.4727 | 0.3273 | 0.1818 |
| S11 | 0.0000 | 0.1796 | 0.3593 | 0.5928 | 0.7425 | 0.8683 | 0.9940 | 1.0000 | 0.9281 |
| I1 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 0.9531 | 1.0000 | 1.0000 | 1.0000 |
| I2 | 0.2500 | 0.6818 | 0.6364 | 1.0000 | 0.9318 | 0.8636 | 0.0000 | 0.9318 | 0.9091 |
| I3 | 1.0000 | 1.0000 | 0.7932 | 0.5054 | 0.0000 | 0.2107 | 0.2425 | 0.0637 | 0.4017 |
| I4 | 0.8527 | 0.9763 | 1.0000 | 0.9398 | 0.8449 | 0.6606 | 0.0000 | 0.3987 | 0.1355 |
| R1 | 0.0000 | 0.3464 | 0.3396 | 0.1374 | 0.2502 | 0.4820 | 0.8990 | 0.9733 | 1.0000 |
| R2 | 0.0000 | 0.2174 | 0.4674 | 0.6169 | 0.4565 | 1.0000 | 0.6522 | 0.4348 | 0.4239 |
| R3 | 1.0000 | 0.9970 | 0.4829 | 0.6415 | 0.4629 | 0.2966 | 0.1479 | 0.0232 | 0.0000 |
| R4 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9147 | 1.0000 | 1.0000 |

Table A3 The indicator weights of ecosystem health assessment in Laizhou Bay

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Indicator | Objective weight | Subjective weight | Integrated weight | Indicator | Objective weight | Subjective weight | Integrated weight |
| **D** | **0.3004** | **0.1926** | **0.2099** | **S** | **0.1092** | **0.2340** | **0.2156** |
| D1 | 0.0425 | 0.0297 | 0.0296 | S1 | 0.0005 | 0.0295 | 0.0271 |
| D2 | 0.0639 | 0.0262 | 0.0340 | S2 | 0.0004 | 0.0239 | 0.0220 |
| D3 | 0.0279 | 0.0226 | 0.0215 | S3 | 0.0017 | 0.0231 | 0.0211 |
| D4 | 0.0251 | 0.0243 | 0.0225 | S4 | 0.0184 | 0.0134 | 0.0128 |
| D5 | 0.0791 | 0.0240 | 0.0400 | S5 | 0.0003 | 0.0146 | 0.0135 |
| D6 | 0.0344 | 0.0210 | 0.0213 | S6 | 0.0022 | 0.0213 | 0.0195 |
| D7 | 0.0218 | 0.0224 | 0.0207 | S7 | 0.0154 | 0.0214 | 0.0193 |
| D8 | 0.0057 | 0.0224 | 0.0203 | S8 | 7.4426×10-7 | 0.0134 | 0.0124 |
| **P** | **0.3470** | **0.3816** | **0.3552** | S9 | 0.0169 | 0.0232 | 0.0210 |
| P1 | 0.0256 | 0.0301 | 0.0273 | S10 | 0.0313 | 0.0251 | 0.0240 |
| P2 | 0.0300 | 0.0322 | 0.0295 | S11 | 0.0221 | 0.0251 | 0.0229 |
| P3 | 0.0218 | 0.0321 | 0.0287 | **I** | **0.0877** | **0.1087** | **0.0993** |
| P4 | 0.0537 | 0.0330 | 0.0350 | I1 | 0.0121 | 0.0284 | 0.0254 |
| P5 | 0.0146 | 0.0260 | 0.0233 | I2 | 0.0177 | 0.0175 | 0.0162 |
| P6 | 0.0167 | 0.0361 | 0.0320 | I3 | 0.0354 | 0.0308 | 0.0291 |
| P7 | 0.0288 | 0.0373 | 0.0334 | I4 | 0.0225 | 0.0320 | 0.0286 |
| P8 | 0.0171 | 0.0222 | 0.0201 | **R** | **0.1558** | **0.0831** | **0.1199** |
| P9 | 0.0329 | 0.0201 | 0.0203 | R1 | 0.0071 | 0.0210 | 0.0190 |
| P10 | 0.0473 | 0.0265 | 0.0285 | R2 | 0.0199 | 0.0229 | 0.0209 |
| P11 | 0.0177 | 0.0187 | 0.0172 | R3 | 0.0158 | 0.0220 | 0.0199 |
| P12 | 0.0165 | 0.0275 | 0.0247 | R4 | 0.1130 | 0.0172 | 0.0601 |
| P13 | 0.0243 | 0.0398 | 0.0352 |  |  |  |  |