**Supplementary Information**

**Effects of nitrogen and phosphorus on chlorophyll a in lakes of China: a meta-analysis**

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**Table S1.** The 61 study sites included in the eutrophication meta-analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| The research location | Latitude | Location | Amount of data | References |
| Hongze Lake | 33.4 | 118.6 | 63 | Li1, Huo22 |
| Yangcheng Lake | 31.5 | 120.5 | 28 | Chen43 |
| Taihu Lake | 33.5 | 120.5 | 256 | Wen7, Chen8, Wang15, Feng18, Huo22, Tong24, Wang30, Shi36, Li38, Li39, Wang40, Zhang48, Ye49, Zeng54, Chen60, Jing61 |
| Dianchi Lake | 24.9 | 102.7 | 48 | Hou11, Huo22, Tong24, Liang31, Zhou56, |
| Hongfeng Lake | 26.5 | 106.4 | 21 | Zhan12 |
| Wuliangsuhai Lake | 40.9 | 108.9 | 68 | Ba17 |
| Chao Lake | 31.5 | 117.6 | 37 | Feng18, Huo22, Tong24, Wang26, Yang52 |
| Cihu Lake | 24.8 | 121.3 | 6 | Yan20 |
| Wanfeng Lake | 24.8 | 104.9 | 8 | Liu25 |
| Luhu Lake | 30 | 114.2 | 6 | Rao34 |
| Songhua Lake | 43.6 | 126.8 | 6 | Liu35 |
| Erhai Lake | 25.8 | 100.2 | 125 | He16, Chen37, Chen46, Jiao57 |
| Qiandao Lake | 29.6 | 119 | 52 | Wang41 |
| Nanhu Lake | 29.3 | 113.1 | 8 | Ge45 |
| Dianshan Lake | 31.2 | 120.9 | 4 | Chen43, Cheng50 |
| Dongting Lake | 28.9 | 112.6 | 25 | Huo22, Huang53 |
| Danjiangkou | 32.6 | 110.8 | 72 | Li3 |
| Dongqian Lake | 29.8 | 121.7 | 3 | Jing47 |
| Kunchenghu | 31.6 | 120.7 | 6 | Chen43 |
| Simeitang Lake | 30.6 | 114.2 | 9 | Wu19 |
| Lakes in the middle and lower reaches of Yangtze River | 30 | 115 | 27 | Zhu10 |
| Luoyandao Lake | 30.5 | 114.4 | 18 | Pei55 |
| Qingjiang Lake | 39.2 | 117.8 | 34 | Xiong13, Zheng33 |
| Qilu Lake | 24.2 | 102.8 | 1 | Liu 32 |
| Qinshan Lake | 30.2 | 119.8 | 12 | Zhang44 |
| Shahu Lake | 38.8 | 106.3 | 4 | Qiu27 |
| Shanghu Lake | 31.7 | 120.7 | 1 | Chen43 |
| South lake changchun | 43.9 | 125.3 | 11 | Peng23 |
| Tianjin park Lake | 39.1 | 117.2 | 1 | Jia42 |
| Wapu Lake | 31.8 | 116.5 | 7 | Wang14 |
| Weishan Lake | 34.6 | 117.2 | 10 | Chen29 |
| Wudalianchi Lake | 48.6 | 126.2 | 10 | Wang51 |
| Wingyun Lake | 24.5 | 102 | 12 | Liu 5 |
| Wuli Lake | 31.5 | 120.3 | 6 | Zhang 28 |
| Yungui plateau Lake | 25 | 105 | 25 | Hou21 |
| Yuandanghu Lake | 30 | 110 | 1 | Chen43 |
| Changdanghu | 31.6 | 119.6 | 1 | Chen43 |
| Dalian Lake | 31.1 | 121 | 9 | Tan9 |
| Eastern plain ecoregion Lakes | 30 | 110 | 5 | Hou22 |
| Gehu Lake | 31.6 | 119.8 | 1 | Chen43 |
| Kuileihu Lake | 31.4 | 120.9 | 1 | Chen43 |
| Lakes of Jiangsu | 32.9 | 119.3 | 8 | HU59 |

**Table S2.** Fixed effect model results of the meta-analysis for the effect of overall nutrients on Chla.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nutrients | Category | Eutrophication | Average Effect Size | 95% Confidence Interval | P-value | Significantly |
| TN | Lake | TN≤0.75 | 0.64 | (0.27, 1.13) | 4.57e-06 | \*\*\* |
| 0.75<TN≤1.4, | 0.99 | (0.60, 1.47) | 1.08e-09 | \*\*\* |
| TN>1.4 | 0.66 | (0.34, 1.06) | 1.55e-04 | \*\*\* |
| **Overall** | 0.055 | (0.017, 0.094) | 0.004 | \*\* |
| TP | Lake | TP≤0.025 | 0.28 | (-0.039, 0.71) | 0.091 | NS |
| 0.025<TP≤0.05 | 1.70 | (1.12, 2.43) | 2.45e-15 | \*\*\* |
| TP>0.05 | 0.46 | (0.19, 0.78) | 3.02e-04 | \*\*\* |
| **Overall** | 2.72 | (1.43, 4.71) | 2.32e-09 | \*\*\* |
| TN/TP | Lake | <16 | 2.13 | (1.61, 2.75) | 1.13e-32 | \*\*\* |
| ≥16 | -0.12 | (-0.23, -0.05) | 0.05 | \* |
| **Overall** | -0.005 | (-0.007, -0.003) | 1.60e-05 | \*\*\* |

Significance codes: “\*\*\*” means p<0.001, “\*\*” means 0.001<p<0.01, “\*” means 0.01<p<0.05 and “NS” means p>0.05.

**Table S3.** Effects of Chla trophic states under different combinations of TN and TP concentrations.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Eutrophication | Count | Mean | Data range | SD |
| LowTNLowTP | Oligo-meso | 55 | 0.825 | (0, 2.3) | 0.601 |
| Eutro | 27 | 2.41 | (0.031, 3.3) | 0.728 |
| Hyper | —— | —— | —— | —— |
| MidTNLowTP | Oligo-meso | 84 | 0.653 | (0, 4.34) | 0.758 |
| Eutro | 25 | 2.49 | (0.713, 3.04) | 0.548 |
| Hyper | —— | —— | —— | —— |
| HighTNLowTP | Oligo-meso | 60 | 0.644 | (0, 2.08) | 0.745 |
| Eutro | 1 | 4.14 | 4.14 | NA |
| Hyper | —— | —— | —— | —— |
| LowTNMidTP | Oligo-meso | 18 | 0.906 | (0, 2.30) | 0.634 |
| Eutro | 52 | 1.65 | (0, 3.46) | 0.879 |
| Hyper | —— | —— | —— | —— |
| MidTNMidTP | Oligo-meso | 30 | 0.663 | (0, 2.98) | 0.682 |
| Eutro | 18 | 1.28 | (0, 2.37) | 0.813 |
| Hyper | 1 | 1.92 | 1.92 | NA |
| HighTNMidTP | Oligo-meso | 12 | 0.413 | (0, 1.22) | 0.385 |
| Eutro | 20 | 1.39 | (0, 3.25) | 1.22 |
| Hyper | 2 | 2.4 | (2.4, 2.40) | 0.00101 |
| LowTNHighTP | Oligo-meso | 6 | 0.0956 | (0, 0.23) | 0.0977 |
| Eutro | 7 | 1.53 | (0, 2.70) | 0.89 |
| Hyper | 9 | 1.94 | (0.762, 2.80) | 0.686 |
| MidTNHighTP | Oligo-meso | 14 | 0.768 | (0, 2.27) | 0.709 |
| Eutro | 58 | 1.21 | (0, 3.59) | 0.854 |
| Hyper | 19 | 1.73 | (0.357, 3.30) | 0.875 |
| HighTNHighTP | Oligo-meso | 115 | 0.733 | (0, 2.45) | 0.519 |
| Eutro | 244 | 1.1 | (0, 4.72) | 0.971 |
| Hyper | 201 | 1.56 | (0, 5.00) | 0.905 |

**Table S4.** Effects of Chla trophic states under different combinations of TN and TN/TP trophic states.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Eutrophication | Count | Mean | Data range | SD |
| LowTNLowTN/TP | Oligo-meso | 37 | 0.784 | (0, 2.30) | 0.607 |
| Eutro | 28 | 1.34 | (0, 2.70) | 0.754 |
| Hyper | 9 | 1.94 | (0.762, 2.80) | 0.686 |
| LowTNHighTN/TP | Oligo-meso | 42 | 0.791 | (0, 2.30) | 0.63 |
| Eutro | 58 | 2.14 | (0.061, 3.46) | 0.866 |
| Hyper | —— | —— | —— | —— |
| MidTNLowTN/TP | Oligo-meso | 10 | 0.702 | (0, 2.27) | 0.677 |
| Eutro | 43 | 1.36 | (0, 3.59) | 0.857 |
| Hyper | 16 | 1.79 | (0.357, 3.30) | 0.908 |
| MidTNHighTN/TP | Oligo-meso | 118 | 0.665 | (0, 4.34) | 0.738 |
| Eutro | 58 | 1.68 | (0, 3.04) | 0.998 |
| Hyper | 4 | 1.55 | (0.704, 2.19) | 0.654 |
| HighTNLowTN/TP | Oligo-meso | 36 | 0.828 | (0, 2.45) | 0.662 |
| Eutro | 89 | 1.53 | (0, 4.72) | 1.01 |
| Hyper | 93 | 1.66 | (0, 5.00) | 1.09 |
| HighTNHighTN/TP | Oligo-meso | 97 | 0.653 | (0, 2.08) | 0.457 |
| Eutro | 176 | 0.929 | (0, 4.14) | 0.948 |
| Hyper | 110 | 1.49 | (0, 3.67) | 0.708 |

**Table S5.** Effects of Chla trophic states under different combinations of TP and TN/TP trophic states.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Eutrophication | Count | Mean | Data range | SD |
| LowTPLowTN/TP | Oligo-meso | 18 | 0.876 | (0.073, 2.15) | 0.498 |
| Eutro | 3 | 1.25 | (0.031, 2.55) | 1.26 |
| Hyper | —— | —— | —— | —— |
| LowTPHighTN/TP | Oligo-meso | 127 | 0.695 | (0, 4.34) | 0.725 |
| Eutro | 50 | 2.56 | (0.713, 4.14) | 0.568 |
| Hyper | —— | —— | —— | —— |
| MidTPLowTN/TP | Oligo-meso | 13 | 0.975 | (0, 2.3) | 0.68 |
| Eutro | 18 | 1.28 | (0, 2.56) | 0.645 |
| Hyper | —— | —— | —— | —— |
| MidTPHighTN/TP | Oligo-meso | 47 | 0.606 | (0, 2.98) | 0.604 |
| Eutro | 72 | 1.58 | (0, 3.46) | 1.01 |
| Hyper | 3 | 2.24 | (1.92, 2.40) | 0.274 |
| HighTPLowTN/TP | Oligo-meso | 52 | 0.719 | (0, 2.45) | 0.661 |
| Eutro | 139 | 1.47 | (0, 4.72) | 0.957 |
| Hyper | 118 | 1.7 | (0, 5.00) | 1.04 |
| HighTPHighTN/TP | Oligo-meso | 83 | 0.702 | (0, 2.21) | 0.46 |
| Eutro | 170 | 0.843 | (0, 3.77) | 0.845 |
| Hyper | 111 | 1.47 | (0, 3.67) | 0.46 |

**Table S6**

|  |  |  |  |
| --- | --- | --- | --- |
| TP trohic state | Oligo-meso | Eutro | Hyper |
| Lower | 0.644 | 4.14 | -- |
| Middle | 0.733 | 1.1 | 1.56 |
| High | 0.413 | 1.39 | 2.4 |

**Table S7**

|  |  |  |  |
| --- | --- | --- | --- |
| TN trophic state | Oligo-meso | Eutro | Hyper |
| Lower | 0.0956 | 1.53 | 1.94 |
| Middle | 0.768 | 1.21 | 1.56 |
| High | 0.733 | 1.1 | 1.73 |

**Fig S1**. Residual graphs (a) residuals vs. the order of the data, (b) histograms of residuals, (c) residuals vs. fitted values and (d) normal probability plot for residuals (TN).

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**Fig S2**. Residual graphs (a) residuals vs. the order of the data, (b) histograms of residuals, (c) residuals vs. fitted values and (d) normal probability plot for residuals (TP).

D:\article\反馈2\Residual-TP.tif

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