湖泊科学动态

本期导读

- ***Nature Climate Change:*** 气溶胶减排或使亚洲高山湖泊生态退化
- ***PNAS:*** 美研究人员开发出有害藻华发生预警方法
- 地球上湖泊的深浅对气候变化的影响
- ***Science News:*** 智利冰川湖融化构成的新威胁
- **OECD** 计划召开第八次水治理倡议会

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联合编制

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热点文章

➢ Aerosol-weakened summer monsoons decrease lake fertilization on the Chinese Loess Plateau

Jianbao Liu; Kathleen M. Rühland; Jianhui Chen; et al

Anthropogenic aerosol increases over the past few decades have weakened the Asian summer monsoon with potentially far-reaching socio-economic and ecological repercussions. However, it is unknown how these changes will affect freshwater ecosystems that are important to densely populated regions of Asia. High-resolution diatom records and other proxy data archived in lake sediment cores from the Chinese Loess Plateau allow the comparison of summer monsoon intensity, lake trophic status and aquatic ecosystem responses during warming periods over the past two millennia. Here we show that an abrupt shift towards eutrophic limnological conditions coincided with historical warming episodes, marked by increased wind intensity and summer monsoon rainfall leading to phosphorus-laden soil erosion and natural lake fertilization. In contrast, aerosol-affected Anthropocene warming catalysed a marked weakening in summer monsoon intensity leading to decreases in soil erosion and lake mixing. The recent warm period triggered a strikingly different aquatic ecosystem response with a limnological regime shift marked by turnover in diatom species composition now dominated by oligotrophic taxa, consistent with reductions in nutrient fertilization, reduced ice cover and increased thermal stratification. Anthropogenic aerosols have altered climate–monsoon dynamics that are unparalleled in the past ~2,000 years, ushering in a new ecological state.

（来源：Nature Climate Change, 2017, 7: 190-194）

中文点评：

气溶胶减排或使亚洲高山湖泊生态退化

近日，《自然·气候变化》首次刊发兰州大学陈发虎院士团队关于亚洲高山湖泊生态系统历史影响的研究成果，该成果指出“人为排放气溶胶正在对亚洲高山湖泊生态系统产生深刻影响，减缓了亚洲高山湖泊的富营养化”。

陈发虎团队根据黄土高原近 2000 年来的湖泊沉积物记录，首次揭示出在自然暖期（公元 540 年至 760 年和公元 900 年至 1300 年）的环境下，亚洲高山湖泊发生了显著的湖泊富营养化，富营养化藻类种属平均占比 60%以上，营养物质磷平均含量在 1100ppm 以上。在当前 50 年来自然暖期环境下，人类活动排放的气溶胶阻止了亚洲夏季风增强，贫营养化的藻类种属平均占比 75%以上，沉积物磷含量保持在 850ppm 以下，亚洲高山湖泊没有富营养化发生。“如果未来人类活动排放的气溶胶减少，形成地表温度下降和亚洲季风增强的状态，将导致高山湖泊富营养化状态。”陈发虎认为。

课题组研究发现，人为排放气溶胶形成的全球变暖，事实上已经改变了自然状态下气候对生态系统的影响方式，而且这种人为影响明显超越了过去 2000 年的自然变率。研究表明，亚洲地区气溶胶减排将减弱对夏季风的影响，导致亚洲高山水生生态系统返回到自然变暖环境下的状态，从而加速亚洲高山湖泊发生富营养化，加剧高山湖泊生态系统退化，可能挑战

这一地区日益紧张的淡水供应形势。“在目前全球气候变暖背景下，该项研究首次揭示了气溶胶污染对生态系统的可能潜在影响，为评估亚洲水生生态环境变化提供了科学依据。”陈发虎说。

（来源：科技日报 2017-02-28）

➢ Reversal of a cyanobacterial bloom in response to early warnings

Michael L. Pacea; Ryan D. Battb; Cal D. Buelo; et al.

Directional change in environmental drivers sometimes triggers regime shifts in ecosystems. Theory and experiments suggest that regime shifts can be detected in advance, and perhaps averted, by monitoring resilience indicators such as variance and autocorrelation of key ecosystem variables. However, it is uncertain whether management action prompted by a change in resilience indicators can prevent an impending regime shift. We caused a cyanobacterial bloom by gradually enriching an experimental lake while monitoring an unenriched reference lake and a continuously enriched reference lake. When resilience indicators exceeded preset boundaries, nutrient enrichment was stopped in the experimental lake. Concentrations of algal pigments, dissolved oxygen saturation, and pH rapidly declined following cessation of nutrient enrichment and became similar to the unenriched lake, whereas a large bloom occurred in the continuously enriched lake. This outcome suggests that resilience indicators may be useful in management to prevent unwanted regime shifts, at least in some situations. Nonetheless, a safer approach to ecosystem management would build and maintain the resilience of desirable ecosystem conditions, for example, by preventing excessive nutrient input to lakes and reservoirs.

（来源：PNAS, 2017, 114(2): 352-357）

中文点评:

美研究人员开发出有害藻华发生预警方法

近日，美国《国家科学院院刊》发表题为《蓝藻水华逆转的早期预警响应》的文章，展示了一个能识别藻华发展态势的自动化监测系统，如水体中藻类的快速生长及氧气的消耗。该系统能提前预测藻华的全面爆发，为及时阻止藻华进一步发展提供了帮助。

来自美国弗吉尼亚大学和新泽西州立大学等机构的研究人员测试了未发生藻华的早期预警是否可被用来作为干预（即停止营养的增加），以阻止向蓝藻细菌占主导地位的条件转变。研究人员利用密歇根的彼得湖和保罗湖作为实验场所进行 3 组实验：第一个湖中每日添加无机氮和磷逐步使其富营养化而诱发藻华（实验湖）；第二个湖没有进行富营养化处理（参照湖）；第三个湖持续进行富营养化处理（周二湖）。他们测量了 3 个生态系统变量-色素叶绿素 a、藻青蛋白、溶解氧的百分饱和度，并计算了两个弹性指标。

当弹性指标超过预设界限，马上停止实验湖泊中营养物质的流入。此时，海藻色素、溶解氧饱和度和 pH 值迅速下降，实验湖泊最终的水体状况与没有进行富营养处理的湖泊相似，而持续进行富营养化的湖泊形成了大规模藻华。该监测系统能在藻华爆发前两周作提前预警。

一旦营养物质停止流入，则藻华可被逆转。

（来源：中国科学报 2017-2-22）

摘要精选

Does eutrophication-driven evolution change aquatic ecosystems?

Timothy J. Alexander; Pascal Vonlanthen; Ole Seehausen

Eutrophication increases primary production and changes the relative abundance,taxonomic composition and spatial distribution of primary producers within an aquatic ecosystem. The changes in composition and location of resources alter the distribution and flow of energy and biomass throughout the foodweb. Changes in productivity also alter the physico-chemical environment, which has further effects on the biota. Such ecological changes influence the direction and strength of natural and sexual selection experienced by populations. Besides altering selection, they can also erode the habitat gradients and/or behavioural mechanisms that maintain ecological separation and reproductive isolation among species. Consequently, eutrophication of lakes commonly results in reduced ecological specialization as well as genetic and phenotypic homogenization among lakes and among niches within lakes. We argue that the associated loss in functional diversity and niche differentiation may lead to decreased carrying capacity and lower resource-use efficiency by consumers. We show that in central European whitefish species radiations, the functional diversity affected by eutrophication-induced speciation reversal correlates with community-wide trophic transfer efficiency (fisheries yield per unit phosphorus). We take this as an example of how evolutionary dynamics driven by anthropogenic environmental change can have lasting effects on biodiversity and ecosystem functioning. This article is part of the themed issue ‘Human influences on evolution, and the ecological and societal consequences’.

（来源：Philosophical Transactions of the Royal Society of London, 2017, 372(1712): 20160041）

Rehabilitation of shallow lakes: time to adjust expectations?

Mark A. Hanson; Brian R. Herwig; Kyle D. Zimmer; et al.

Shallow lake managers seek strategies to improve water quality and ecological features of these habitats, but lake responses are unpredictable and factors responsible for changes are often unclear. We summarized results of eight whole-lake rehabilitation projects in Minnesota, USA, an area with many shallow waters highly impacted by anthropogenic activities. To assess lake responses, we compared characteristics of managed sites to those of other regional shallow lakes manifesting clear- or turbidstate conditions. Managed lakes showed modest similarity to clear-water reference lakes in terms of phytoplankton (as chlorophyll a), nutrients, and submerged aquatic plants. Responses of aquatic invertebrate communities were more equivocal, with relativelylittlesimilaritytoclear-watersites following management. These patterns indicate that these lakes either failed to undergo transitions to clear-water states, or that clear-water conditions did not persist throughout the 2–3 year period following treatment and prior to our evaluation. We believe these results showresponsesofshallowlakesthathavebeenpushed beyond boundaries where they maintain sufficient natural resilience to resist local stressors. This means that shallow lake rehabilitation efforts will not always succeed and that, when improvements occur,

management may need to be repeated to maintain favorable ecological conditions in highly modified landscapes.

（来源：Hydrobiologia, 2017, 787(1): 45-59）

Sedimentary n-alkanes record of precipitation D/H ratios in arid regions of the Tibetan Plateau

TIAN Qian; FANG XiaoMin; WANG MingDa

The hydrogen isotope ratios of sedimentary leaf waxes have been investigated in various environments and are considered as a promising proxy for paleohydrological and paleoclimatic reconstruction. However, there is a growing concern regarding whether or not sedimentary leaf waxes can be used as an environmental proxy in extremely arid regions, where intensified evaporation strongly enriches the deuterium both in water and in leaf waxes. Here we present a record of the n-alkane D/H ratios of surface sediments from 21 lakes. The data were collected from 2012–2014. The n-alkanes extracted from lake surface sediments range from nC16 to nC35, with the most abundant compounds being nC23, nC25, nC29 and nC31. In addition, there is an evident odd-over-even preference for long-chain n-alkanes, with carbon preference index (CPI) values varying between 3.41 and 10.75, suggesting that the long-chain sedimentary n-alkanes mainly originated from terrestrial plants in arid regions on the Tibetan Plateau. The D/H ratios of the precipitation (δDp) atall the lakes in this studywere calculated using the Online Isotopes in Precipitation Calculator. The OIPC calculates precipitation isotope ratios at a given site by combining an empirical model for isotopic trends related to latitude and altitude with detrended interpolation based on the isotope data from stations in the Global Network of Isotopes in Precipitation. The mean annual hydrogen isotopes ratios of precipitation (δDann) at the lakes in this study vary from -78‰ to -115‰, with lower precipitation δD values occurring in the southern TP and higher values in the northern TP and the Qaidam Basin. The δD values for summer precipitation (July–September, δDsum) range from -68‰ to -126‰, with a similar range of variation for δDann. The sedimentary n-alkane D/H ratios are strongly correlated with the D/H ratios of annual precipitation (r^2=0.84) and summer precipitation (r^2=0.91), suggesting that the hydrogen isotope signal in sedimentary n–alkanes is mainly derived from precipitation, and that the n-alkane D/H ratios may reflect the D/H ratios of precipitation in arid regions on the Tibetan Plateau. Water is the ultimate source of hydrogen in plant tissues, and organic matter derived from terrestrial plants should record the isotopic ratio of soil water, which is ultimately recharged by precipitation. The δD values of n-alkanes in lake surface sediments could thus be expected to be correlated with the δD values of precipitation, on a large spatial scale. Furthermore, precipitation on the Tibetan Plateau mainly occurs from July to September, which accounts for ~70% during the year, and the n-alkanes of leaf wax are synthesized during the plant growing season. Therefore, it is unsurprising that the best correlation between D/H ratios of sedimentary leaf wax and precipitation occurs in the summer months. The apparent hydrogen isotopic fractionation between sedimentary n-alkanes and precipitation averages -113‰, evidently smaller than that in relatively humid regions. A possible reason for the smaller apparent fractionation might be spatial differences in soil evaporation and plant transpiration. Mean annual precipitation amount and mean annual evaporation at the studied lakes is 207 and 2343 mm, respectively. However, in the humid areas, such as the southeastern TP, the mean annual precipitation amount and mean annual evaporation are 1298 and 795 mm, respectively. Due to the strong evaporation in arid regions, the δD values of soil water and plant water are more isotopically-enriched relative to precipitation than those in humid regions. Overall, our

results demonstrate that sedimentary n-alkanes can be used as a proxy indicator of variations in the isotopic composition of summer precipitation, in order to document past changes in summer monsoon intensity and hydrology.

（来源：Chinese Science Bulletin, 2017, 62(7): 700-710）

Extreme drought causes distinct water acidification and eutrophication in the Lower Lakes (Lakes Alexandrina and Albert), Australia

Li, Siyue; Bush, Richard T.; Mao, Rong; et al.

Droughts are set to increase in frequency and magnitude with climate change and water extraction, and understanding their influence on ecosystems is urgent in the Holocene. Low rainfall across the Murray-Darling Basin (MDB) of Australia resulted in an unprecedented water level decline in the Lower Lakes (Lakes Alexandrina and Albert) at the downstream end of the river system. A comprehensive data covering pre-drought (2004-2006), drought (2007-2010) and post-drought (2010-2013) was firstly used to unravel drought effects on water quality in the contrasting main parts and margins of the two Lakes, particularly following water acidification resulting from acid sulfate soil oxidation. Salinity, nutrients and Chl-a significantly increased during the drought in the Lake main waterbody, while pH remained stable or showed minor shifts. In contrast to the Lake Alexandrina, total dissolved solid (TDS) and electrical conductivity (EC) during the post-drought more than doubled the pre-drought period in the Lake Albert as being a terminal lake system with narrow and shallow entrance. Rewetting of the exposed pyrite containing sediment resulted in very low pH (below 3) in Lake margins, which positively contributed to salinity increases via SO_4^{2-} release and limestone dissolution. Very acidic water (pH 2-3) was neutralised naturally by lake refill, but aerial limestone dosing was required for neutralisation of water acidity during the drought period. The Lower Lakes are characterized as hypereutrophic with much higher salinity, nutrient and algae concentrations than guideline levels for aquatic ecosystem. These results suggest that, in the Lower Lakes, drought could cause water quality deterioration through water acidification and increased nutrient and Chl-a concentrations, more effective water management in the lake catchment is thus crucial to prevent the similar water quality deterioration since the projected intensification of droughts. A comparative assessment on lake resilience and recovering processes should be undertaken with a post-drought monitoring program.

（来源：JOURNAL OF HYDROLOGY, 2017, 544: 133-146）

Regional trends in evaporation loss and water yield based on stable isotope mass balance of lakes: The Ontario Precambrian Shield surveys

Gibson, J. J.; Birks, S. J.; Jeffries, D.; et al.

Stable isotopes of water, oxygen-18 and deuterium, were measured in water samples collected from a network of 300 lakes sampled in six similar to 100 km(2) blocks (centred at 49.72 degrees N, 91.46 degrees W; 48.49 degrees N, 91.58 degrees W; 50.25 degrees N, 86.62 degrees W; 49.78 degrees N, 83.98 degrees W; 48.24 degrees N, 85.49 degrees W; 47.73, 84.52 degrees W) within Precambrian shield drainages in the vicinity of Lake Superior, northern Ontario, Canada. Additional sampling was also conducted within the Turkey Lakes watershed (47.03 degrees N, 84.38 degrees W), a research basin situated in the Algoma region located 50 km north of Sault Saint Marie, Ontario. The studies were

undertaken to gain a better understanding of hydrology and geochemistry of watersheds in the region in order to better predict acid sensitivity of lakes. The main objective of this paper is to describe the hydrologic variations observed based on stable isotope results. Evaporative isotopic enrichment of lake water was found to be systematic across the region, and its deviation from the isotopic composition of precipitation was used to estimate the evaporation/inflow to the lakes as well as runoff (or water yield) based on a simple isotope mass balance model. The analysis illustrates significant variability in the water yield to lakes and reveals a pattern of positively skewed distributions in all six widely spaced blocks, suggesting that a high proportion of lakes have relatively limited runoff whereas relatively few have greater runoff. Such basic information on the drainage structure of an area can be valuable for site-specific hydrologic assessments but also has significant implications for critical loads assessment, as low runoff systems tend to be less buffered and therefore are more sensitive to acidification. Importantly, the Turkey Lakes sampling program also suggests that isotope-based water yield is comparable in magnitude to hydrometric gauging estimates, and also establishes that uncertainty related to stratification can be as high as +/- 20% or more for individual lakes, although it likely has only a minor influence on regional survey results. While further analysis in gauged lake watersheds would be beneficial to constraining the accuracy of the method or calibrating it for operational use, it is nevertheless a powerful tool in its present form for lake-to-lake and regional runoff inter-comparisons.

（来源：JOURNAL OF HYDROLOGY, 2017, 544: 500-510）

Fingerprints of upstream catchment land use in suspended particulate organic matter (SPOM) at the river discharge sites in Lake Victoria (Kenya): insights from element, stable isotope and lipid biomarker analysis

Ngugi, Charles C.; Oyoo-Okoth, Elijah; Gichuki, John; et al.

Riverine transport and discharge are the primary pathways for terrigenous organic matter (OM) input to lacustrine environment. Understanding the influence of catchment land use on the source, composition and fate of terrigenous particulate OM in a lake is therefore vital. We used C/N, delta C-13, delta N-15 and lipid biomarkers in the suspended particulate OM (SPOM) at the seven river discharge sites in Lake Victoria, in an effort to evaluate the potential of upstream catchment land use on the biogeochemistry of SPOM. The total fatty acids (FAs), alcohols and sterols in SPOM ranged from 4.61 to 7.42 mu g/g, 1.52 to 3.32 mu g/g and 3.01 to 5.81 mu g/g respectively. At sites receiving discharge from industrial effluent the FAs were dominated by short chain FAs (SCFAs), polyunsaturated FAs (PUFAs), monounsaturated FA (MUFAs) and branched FAs (brFAs); the alcohols were dominated by short chain alcohols (SCOHs) and phytol; sterols were dominated by 27 Delta(5), 27 Delta(0), 28 Delta(5,22), 28 Delta(5), which are associated either with phytoplankton or zooplankton. Sites receiving discharge from substantial agricultural activity in the catchment were dominated by long chain FAs (LCFAs), long chain alcohols (LCOHs) and 29 Delta(5,22) and 29 Delta(5) sterols, reflecting vascular plant terrigenous input. There was also evidence of OM from mixed autochthonous and allochthonous sources at the sites regardless of the upstream catchment land use activities. The findings suggest that human land use in upstream watersheds affect the source, composition and distribution of SPOM discharged by rivers, which may not only impact nutrient cycling in the lacustrine environment, but may also change the quality of SPOM.

（来源：AQUATIC SCIENCES, 2017, 79(1): 73-87）

When soft waters becomes softer; drivers of critically low levels of Ca in Norwegian lakes

Hessen, D. O.; Andersen, T.; Tominaga, K.; et al.

In this study, we analyzed long-term trends in calcium (Ca) concentrations for 70 Norwegian lakes spanning a broad geographical range and for a wide range of ambient drivers. A striking decline in Ca concentrations was observed during the past 30 yr. The trend was most pronounced in southern, previously acidified localities, while there were weaker and less consistent patterns for central and northern regions. For previously acidified areas, this observed decline in Ca is likely related to base cation depletion or reduced Ca mobilization as a consequence of reduced H2SO4-deposition. However, lower chloride concentrations, increased runoff and forest density (represented by Normalized Difference Vegetation Index, NDVI) also exerted strong negative impacts on Ca-concentrations. For lakes with a significant negative trend (n=34), the average decline was -11.05% per decade, corresponding to -0.023 mg Ca L-1 yr(-1). This trend may pull levels of Ca in these already Ca-deficient poor lakes toward, or below, critically low levels for a range of organisms. A somewhat paradoxical effect of the successful battle against anthropogenic acidification is thus that it may impose an increased Ca-deficiency of freshwater ecosystems.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(1): 289-298）

The influence of an in-network lake on the timing, form, and magnitude of downstream dissolved organic carbon and nutrient flux

Kalinin, Alexey; Covino, Tim; McGlynn, Brian.

Within fluvial networks, lakes can be sinks or sources of dissolved organic carbon (DOC) and nutrients, yet the controls over sink-source behavior remain unclear. We investigated the influence that an in-network lake exerted on DOC and nutrient export. Our investigation consisted of: (1) injecting a conservative tracer to determine lake travel times and flow paths; (2) sampling lake inflow, outflow, and surrounding groundwater to determine water and nutrient budgets; and, (3) sampling internal lake profiles to ascertain in-lake physico-chemical patterns through time. Conservative tracer data indicated considerable in-lake retention and combined with inflow-outflow discharge measurements revealed a decoupling of kinematic and solute pulses. Nitrate (NO_3) was the dominant form of dissolved inorganic nitrogen (DIN) at lake inflow whereas ammonium (NH4) became the dominant component at lake outflow. The lake was a sink for NO_3-N and PO_4, but a source for NH_4-N, DON, TDN, and DOC. We observed hydrologic controls on DOC concentrations and export patterns, but redox controls on DIN dynamics. Our results indicate that lakes within fluvial networks can be sources of dissolved organic material and reduced nitrogen (NH_4) while simultaneously being sinks for NO_3-N and PO_4-P. Determining controls on sink-source behavior and the cumulative effect of lakes on DOC and nutrient budgets is a necessary first step toward improved understanding of the role of lakes in network-to regional-scale dynamics.

（来源：WATER RESOURCES RESEARCH, 2017, 52(11): 8668-8684）

Bayesian Monte Carlo and maximum likelihood approach for uncertainty estimation and risk management: Application to lake oxygen recovery model

Chaudhary, Abhishek; Hantush, Mohamed M.

Model uncertainty estimation and risk assessment is essential to environmental management and informed decision making on pollution mitigation strategies. In this study, we apply a probabilistic methodology, which combines Bayesian Monte Carlo simulation and Maximum Likelihood estimation (BMCML) to calibrate a lake oxygen recovery model. We first derive an analytical solution of the differential equation governing lake-averaged oxygen dynamics as a function of time-variable wind speed. Statistical inferences on model parameters and predictive uncertainty are then drawn by Bayesian conditioning of the analytical solution on observed daily wind speed and oxygen concentration data obtained from an earlier study during two recovery periods on a eutrophic lake in upper state New York. The model is calibrated using oxygen recovery data for one year and statistical inferences were validated using recovery data for another year. Compared with essentially two-step, regression and optimization approach, the BMCML results are more comprehensive and performed relatively better in predicting the observed temporal dissolved oxygen levels (DO) in the lake. BMCML also produced comparable calibration and validation results with those obtained using popular Markov Chain Monte Carlo technique (MCMC) and is computationally simpler and easier to implement than the MCMC. Next, using the calibrated model, we derive an optimal relationship between liquid film-transfer coefficient for oxygen and wind speed and associated 95% confidence band, which are shown to be consistent with reported measured values at five different lakes. Finally, we illustrate the robustness of the BMCML to solve risk-based water quality management problems, showing that neglecting cross-correlations between parameters could lead to improper required BOD load reduction to achieve the compliance criteria of 5 mg/L.

（来源：Water research, 2017, 108: 301-311）

Effects of climate change on deepwater oxygen and winter mixing in a deep lake (Lake Geneva): Comparing observational findings and modeling

Schwefel, Robert; Gaudard, Adrien; Wuest, Alfred; et al.

Low concentrations of dissolved oxygen remain a global concern regarding the ecological health of lakes and reservoirs. In addition to high nutrient loads, climate-induced changes in lake stratification and mixing represent additional anthropogenic menace resulting in decreased deepwater oxygen levels. The analysis of 43 years of monitoring data from Lake Geneva shows no decreasing trend neither in the areal hypolimnetic mineralization rate nor in the extent of hypoxia. Instead, hypoxic conditions are predominantly controlled by deep mixing in winter and much less by the trophic variations over the past decades. To reproduce winter mixing, the one-dimensional hydrodynamic model SIMSTRAT was specially adapted to deep lakes and run for several climate scenarios. The simulations predicted a decrease in the maximum winter mixing depth from an average of similar to 172 m for 1981-2012 to similar to 136 m and similar to 127 m in response to predicted atmospheric temperatures between 2045-2076 and 2070-2101 according to Intergovernmental Panel on Climate Change scenarios.

Concurrently, events with complete homogenization of temperature and oxygen in winter will decrease by similar to 50%. Consequently, the hypolimnetic oxygen concentrations will significantly decrease. These results demonstrate that changes in deep mixing can have stronger impact than eutrophication on the deepwater oxygen levels of oligomictic lakes.

（来源：WATER RESOURCES RESEARCH, 2017, 52(11): 8794-8809）

Groundwater flow and heterogeneous discharge into a seepage lake: Combined use of physical methods and hydrochemical tracers

Kazmierczak, J.; Muller, S.; Nilsson, B.; et al.

Groundwater discharge into a seepage lake was investigated by combining flux measurements, hydrochemical tracers, geological information, and a telescopic modeling approach using first two-dimensional (2-D) regional then 2-D local flow and flow path models. Discharge measurements and hydrochemical tracers supplement each other. Discharge measurements yield flux estimates but rarely provide information about the origin and flow path of the water. Hydrochemical tracers may reveal the origin and flow path of the water but rarely provide any information about the flux. While aquifer interacting with the lake remained under seemingly steady state conditions across seasons, a high spatial and temporal heterogeneity in the discharge to the lake was observed. The results showed that part of the groundwater flowing from the west passes beneath the lake and discharges at the eastern shore, where groundwater springs and high discharge zones (HDZs) are observed at the lake bottom and at seepage faces adjacent to the lake. In the 2-D cross section, surface runoff from the seepage faces delivers 64% of the total groundwater inputs to the lake, and a 2 m wide offshore HDZ delivers 13%. Presence of HDZs may control nutrient fluxes to the lake.

（来源：WATER RESOURCES RESEARCH, 2017, 52(11):9109-9130）

Monitoring recent lake level variations on the Tibetan Plateau using CryoSat-2 SARIn mode data

Jiang, Liguang; Nielsen, Karina; Andersen, Ole B.; et al.

Lakes on the Tibetan Plateau (TP) are of great interest due to their value as water resources but also as an important indicator of climate change. However, in situ data in this region are extremely scarce and only a few lakes have gauge measurements. Satellite altimetry has been used successfully to monitor lake levels. In this study, Cryosat-2 SARIn mode data over the period 2010-2015 are used to investigate recent lake level variations. The estimated water levels of the 70 largest lakes (> 100 km(2)) on the TP show that 48 lakes reveal a rising trend (avg. 0.28 +/- 0.06 m/yr) while the other 22 show a slightly decreasing trend (avg. -0.10 +/- 0.04 m/yr). To compare with the change rates during 2003-2009, ICESat data which cover 42 of the 70 lakes are also used. When combining the data, the results show that during the period of 2003-2015, 28 lakes maintained a rising trend and the change rates are comparable. Lakes in the northern part of the TP experienced pronounced rising (avg. 0.37 +/- 0.10 m/yr), while lakes in southern part were steady or decreasing even in glaciated basins with high precipitation. Factor analysis indicates that driving factors for lake change are variable due to high spatial heterogeneity. However, autumn/winter temperature plays an important role in lake level change. These results demonstrate that lakes on the TP are still rapidly changing under climate change, especially in northern part of the TP, but

the driving factors are variable and more research is needed to understand the mechanisms behind observed changes.

（来源：JOURNAL OF HYDROLOGY, 2017, 544: 109-124）

The importance of physical transport and oxygen consumption for the development of a metalimnetic oxygen minimum in a lake

Kreling, Julika; Bravidor, Jenny; Engelhardt, Christof; et al.

Although the occurrence of metalimnetic oxygen minima (MOM) in lakes during summer stratification was described by early limnologists, not much is known about the processes leading to its formation. Generally, dissolved oxygen (DO) consumption and net transport contribute to the observed DO decrease, but the latter was rarely considered in former studies. To examine the importance of both processes to MOM development in Lake Arendsee, Germany, we measured DO concentration and temperature with high spatial and temporal resolution during a complete stratification period. Vertical turbulent diffusivities were estimated from temporal changes of the heat content of the lake. The MOM development was not caused by locally enhanced DO consumption rates, but rather by a combination of vertical gradients in DO concentration and consumption. A vertical DO mass balance revealed that net DO transport into the metalimnion was in the same order of magnitude as DO consumption in the MOM. We found that DO consumption was governed by microbial respiration and the vertical variations of DO depletion rates in the metalimnion could be explained by a minor contribution of temperature and a higher contribution of turbidity, implying that the downward flux of particulate organic carbon promoted the MOM development. The intensive metalimnetic respiration in lakes forming a MOM can be expected to accelerate nutrient cycling close to the photic zone and thus, may further stimulate primary production.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(1): 348-363）

Ice cover, winter circulation, and exchange in Saginaw Bay and Lake Huron

Nguyen, Tuan D.; Hawley, Nathan; Phanikumar, Mantha S, et al

Winter circulation exerts a strong control on the release and timing of nutrients and contaminants from bays into the adjoining lakes. To estimate winter residence times of solutes in the presence of ice cover, we used an ice model coupled to hydrodynamic, thermal and solute transport models of Saginaw Bay and Lake Huron for two low (2010 and 2013) and two high (2009 and 2014) ice years. The models were tested using temperature data from thermistor chains and current data from ADCP moorings deployed during the wintertime. Simulated water temperatures compared favorably to lake-wide average surface temperatures derived from NOAA's AVHRR satellite imagery. Simulated results of ice cover are in agreement with observed data from the Great Lakes Ice Atlas. Our results indicate that ice cover significantly dampens water movement producing almost stagnant conditions around February. Estimates of residence times for Saginaw Bay (defined as the e-folding flushing time based on vertically integrated dye concentrations) show that the mean residence times in a low ice year (2013) are 2.2 months for the inner bay, and 3.5 months for the entire bay. The corresponding numbers for a high ice year (2014) are 4.9 and 5.3 months, respectively. Considering the entire bay, solutes stored in the bay can be expected to be released into the lake between March (low ice year) and April (high ice year).

These results are expected to aid in understanding the behavior of contaminants in the Great Lakes during the winter months and in early spring.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 61(1): 376-393）

Trace element stoichiometry of submerged macrophytes in Yangtze floodplain lakes and Yunnan plateau lakes (China)

Xing, Wei; Wu, Haoping; Hao, Beibei; et al.

Trace element balance is a key parameter in ecological stoichiometry. However, little is known about trace element stoichiometry of submerged macrophytes. We hypothesized that lake nutrients (N and P) and taxonomy strongly affect tissue trace element (Al, As, Ba, Cd, Co, Cr, Li, Pb and Sr) composition and homeostasis of submerged macrophytes in Yangtze floodplain lakes and Yunnan plateau lakes (China). Submerged macrophytes had Co stoichiometric homeostasis in these two sets of lakes. Moreover, submerged macrophytes in Yangtze floodplain lakes had higher Cd stoichiometric homeostasis, whereas submerged macrophytes in Yunnan plateau lakes had higher Cr, Li and Pb stoichiometric homeostasis. Lake nutrients altered trace element composition of submerged macrophytes as shown by canonical correspondence analysis (CCA). Total nitrogen in water (WTN) positively correlated with tissue As and tissue Cd for all lake types, indicating WTN influenced the concentration and composition of tissue As and tissue Cd in submerged macrophytes. Canonical discriminant analysis (CDA) successfully discriminated among submerged macrophyte taxa, revealing there are significant differences in multielement composition of submerged macrophytes among taxonomy. Some similar relationships of taxa and trace elements between Yangtze floodplain lakes and Yunnan plateau lakes indicated that certain families of submerged macrophytes accumulate specific elements. Differences in relationships of taxa and trace elements between Yangtze floodplain lakes and Yunnan plateau lakes indicated that trace element composition of submerged macrophytes could be affected both by taxonomy and the ambient environment.

（来源：AQUATIC SCIENCES, 2017, 79(1): 89-98）

Paradigm shifts required to promote ecosystem modeling for ecosystem-based fishery management for African inland lakes

Musinguzi, Laban; Natugonza, Vianny; Ogutu-Ohwayo, Richard.

Ecosystem-based fishery management (EBFM) is the best option where other fishery management objectives have failed. This makes EBFM important for the African inland lakes and fisheries resources that are among the most threatened in the world despite existing management interventions. Ecosystem modeling provides information that guides EBFM, and, to promote EBFM for the African inland lakes and fisheries, we present strategies required to promote ecosystem modeling. The strategies are based on an examination, presented herein, of (i) publication trends in literature applying two leading aquatic ecosystem modeling platforms, Ecopath with Ecosim (EwE) and Atlantis, on the African Great Lakes as representatives of African inland lakes and (ii) deficiencies in data eminent in ecosystem models existing on these lakes. The examination indicated that ecosystem modeling is inactive on the African Great Lakes, and there is limited local and regional capacity for ecosystem modeling with existing models predominantly led by foreign researchers and marred by data deficiencies. The implications of these

observations for ecosystem modeling and EBFM for the African Great Lakes are discussed. The strategies required to promote ecosystem modeling include supporting short-term training workshops to equip local scientists with basic skills for ecosystem modeling, mainstreaming ecosystem modeling in fisheries training curriculum of local universities, and conducting data collection surveys to fill data deficiencies. These are envisaged to increase capacity and activate ecosystem modeling, and consequently promote EBFM.

（来源：JOURNAL OF GREAT LAKES RESEARCH, 2017, 43(1): 1-8）

Porewater methane transport within the gas vesicles of diurnally migrating *Chaoborus spp.*: An energetic advantage

Daniel F. McGinnis, Sabine Flury, Kam W. Tang; et al.

Diurnally-migrating Chaoborus spp. reach populations of up to 130,000 individuals m−2 in lakes up to 70 meters deep on all continents except Antarctica. Linked to eutrophication, migrating Chaoborus spp. dwell in the anoxic sediment during daytime and feed in the oxic surface layer at night. Our experiments show that by burrowing into the sediment, Chaoborus spp. utilize the high dissolved gas partial pressure of sediment methane to inflate their tracheal sacs. This mechanism provides a significant energetic advantage that allows the larvae to migrate via passive buoyancy rather than more energy-costly swimming. The Chaoborus spp. larvae, in addition to potentially releasing sediment methane bubbles twice a day by entering and leaving the sediment, also transport porewater methane within their gas vesicles into the water column, resulting in a flux of 0.01–2 mol m−2 yr−1 depending on population density and water depth. Chaoborus spp. emerging annually as flies also result in 0.1–6 mol m−2 yr−1 of carbon export from the system. Finding the tipping point in lake eutrophication enabling this methane-powered migration mechanism is crucial for ultimately reconstructing the geographical expansion of Chaoborus spp., and the corresponding shifts in the lake's biogeochemistry, carbon cycling and food web structure.

（来源：Scientific Reports, 2017, doi:10.1038/srep44478）

Ancient hybridization fuels rapid cichlid fish adaptive radiations

Joana I. Meier, David A. Marques, Salome Mwaiko; et al.

Understanding why some evolutionary lineages generate exceptionally high species diversity is an important goal in evolutionary biology. Haplochromine cichlid fishes of Africa's Lake Victoria region encompass >700 diverse species that all evolved in the last 150,000 years. How this 'Lake Victoria Region Superflock' could evolve on such rapid timescales is an enduring question. Here, we demonstrate that hybridization between two divergent lineages facilitated this process by providing genetic variation that subsequently became recombined and sorted into many new species. Notably, the hybridization event generated exceptional allelic variation at an opsin gene known to be involved in adaptation and speciation. More generally, differentiation between new species is accentuated around variants that were fixed differences between the parental lineages, and that now appear in many new combinations in the radiation species. We conclude that hybridization between divergent lineages, when coincident with ecological opportunity, may facilitate rapid and extensive adaptive radiation.

（来源：Nature Communications, 2017, doi:10.1038/ncomms14363）

Effects of abiotic factors on ecosystem health of Taihu Lake, China based on eco-exergy theory

Ce Wang, Jun Bi; Brian D. Fath.

A lake ecosystem is continuously exposed to environmental stressors with non-linear interrelationships between abiotic factors and aquatic organisms. Ecosystem health depicts the capacity of system to respond to external perturbations and still maintain structure and function. In this study, we explored the effects of abiotic factors on ecosystem health of Taihu Lake in 2013, China from a system-level perspective. Spatiotemporal heterogeneities of eco-exergy and specific eco-exergy served as thermodynamic indicators to represent ecosystem health in the lake. The results showed the plankton community appeared more energetic in May, and relatively healthy in Gonghu Bay with both higher eco-exergy and specific eco-exergy; a eutrophic state was likely discovered in Zhushan Bay with higher eco-exergy but lower specific eco-exergy. Gradient Boosting Machine (GBM) approach was used to explain the non-linear relationships between two indicators and abiotic factors. This analysis revealed water temperature, inorganic nutrients, and total suspended solids greatly contributed to the two indicators that increased. However, pH rise driven by inorganic carbon played an important role in undermining ecosystem health, particularly when pH was higher than 8.2. This implies that climate change with rising CO_2 concentrations has the potential to aggravate eutrophication in Taihu Lake where high nutrient loads are maintained.

（来源：Scientific Reports, 2017, doi:10.1038/srep42872）

Terrestrial support of lake food webs: Synthesis reveals controls over cross-ecosystem resource use

Andrew J. Tanentzap; Brian W. Kielstra; Grace M. Wilkinson; et al.

Widespread evidence that organic matter exported from terrestrial into aquatic ecosystems supports recipient food webs remains controversial. A pressing question is not only whether high terrestrial support is possible but also what the general conditions are under which it arises. We assemble the largest data set, to date, of the isotopic composition (δ2H, δ13C, and δ15N) of lake zooplankton and the resources at the base of their associated food webs. In total, our data set spans 559 observations across 147 lakes from the boreal to subtropics. By predicting terrestrial resource support from within-lake and catchment-level characteristics, we found that half of all consumer observations that is, the median were composed of at least 42% terrestrially derived material. In general, terrestrial support of zooplankton was greatest in lakes with large physical and hydrological connections to catchments that were rich in aboveground and belowground organic matter. However, some consumers responded less strongly to terrestrial resources where within-lake production was elevated. Our study shows that multiple mechanisms drive widespread cross-ecosystem support of aquatic consumers across Northern Hemisphere lakes and suggests that changes in terrestrial landscapes will influence ecosystem processes well beyond their boundaries.

（来源：Science Advances, 2017, 3(3): e1601765）

中国湖泊微生物组研究

吴庆龙; 江和龙.

我国湖泊数量大、分布广、类型多，被认为是世界上湖泊生态类型最为丰富的国家之一。多样化的湖泊环境孕育了丰富的微生物多样性和资源，但迄今人们对其结构和功能尚知之甚少。通过大规模的湖泊微生物组分析和比较基因组研究，可揭示我国湖泊微生物多样性的分布规律、形成机理和维持机制，阐明典型湖泊微生物功能基因的组成，探索极端环境条件下湖泊微生物的适应机制，发现新的微生物功能和代谢途径，并通过比较不同环境条件下驱动地球元素循环的微生物功能基因组、环境转录组成和蛋白组，揭示微生物驱动湖泊生态系统中关键元素循环的过程、机制及其环境调控机理。这些研究结果的获得，将不仅有助于深入了解湖泊生态系统结构与功能，促进地球科学与生物学间的交叉与融合，推动学科持续发展，而且将为我国湖泊微生物资源的保护与可持续利用及湖泊生态环境的治理与保护提供科技支撑。

（来源：中国科学院院刊，2017，32(3)：274-279）

Annual time-series analysis of aqueous eDNA reveals ecologically relevant dynamics of lake ecosystem biodiversity

Iliana Bista, Gary R. Carvalho, Kerry Walsh; et al.

The use of environmental DNA (eDNA) in biodiversity assessments offers a step-change in sensitivity, throughput and simultaneous measures of ecosystem diversity and function. There remains, however, a need to examine eDNA persistence in the wild through simultaneous temporal measures of eDNA and biota. Here, we use metabarcoding of two markers of different lengths, derived from an annual time series of aqueous lake eDNA to examine temporal shifts in ecosystem biodiversity and in an ecologically important group of macroinvertebrates (Diptera: Chironomidae). The analyses allow different levels of detection and validation of taxon richness and community composition (β-diversity) through time, with shorter eDNA fragments dominating the eDNA community. Comparisons between eDNA, community DNA, taxonomy and UK species abundance data further show significant relationships between diversity estimates derived across the disparate methodologies. Our results reveal the temporal dynamics of eDNA and validate the utility of eDNA metabarcoding for tracking seasonal diversity at the ecosystem scale.

（来源：Nature Communications，2017，doi:10.1038/ncomms14087）

Unexpected pattern of pearl millet genetic diversity among ethno-linguistic groups in the Lake Chad Basin

A K Naino Jika; Y Dussert; C Raimond; et al.

Despite of a growing interest in considering the role of sociological factors in seed exchanges and their consequences on the evolutionary dynamics of agro-biodiversity, very few studies assessed the link

between ethno-linguistic diversity and genetic diversity patterns in small-holder farming systems. This is key for optimal improvement and conservation of crop genetic resources. Here, we investigated genetic diversity at 17 SSR markers of pearl millet landraces (varieties named by farmers) in the Lake Chad Basin. 69 pearl millet populations, representing 27 landraces collected in eight ethno-linguistic farmer groups, were analyzed. We found that the farmers' local taxonomy was not a good proxy for population's genetic differentiation as previously shown at smaller scales. Our results show the existence of a genetic structure of pearl millet mainly associated with ethno-linguistic diversity in the western side of the lake Chad. It suggests there is a limit to gene flow between landraces grown by different ethno-linguistic groups. This result was rather unexpected, because of the highly outcrossing mating system of pearl millet, the high density of pearl millet fields all along the green belt of this Sahelian area and the fact that seed exchanges among ethno-linguistic groups are known to occur. In the eastern side of the Lake, the pattern of genetic diversity suggests a larger efficient circulation of pearl millet genes between ethno-linguistic groups that are less numerous, spatially intermixed and, for some of them, more prone to exogamy. Finally, other historical and environmental factors which may contribute to the observed diversity patterns are discussed.

（来源：Heredity, 2017, doi: 10.1038/hdy.2016.128）

Molecular composition of organic matter controls methylmercury formation in boreal lakes

Andrea G. Bravo, Sylvain Bouchet, Julie Tolu; et al.

A detailed understanding of the formation of the potent neurotoxic methylmercury is needed to explain the large observed variability in methylmercury levels in aquatic systems. While it is known that organic matter interacts strongly with mercury, the role of organic matter composition in the formation of methylmercury in aquatic systems remains poorly understood. Here we show that phytoplankton-derived organic compounds enhance mercury methylation rates in boreal lake sediments through an overall increase of bacterial activity. Accordingly, in situ mercury methylation defines methylmercury levels in lake sediments strongly influenced by planktonic blooms. In contrast, sediments dominated by terrigenous organic matter inputs have far lower methylation rates but higher concentrations of methylmercury, suggesting that methylmercury was formed in the catchment and imported into lakes. Our findings demonstrate that the origin and molecular composition of organic matter are critical parameters to understand and predict methylmercury formation and accumulation in boreal lake sediments.

（来源：Nature Communications, 2017, doi:10.1038/ncomms14255）

Hydrologic, land cover, and seasonal patterns of waterborne pathogens in Great Lakes tributaries

Lenaker, P L; Corsi, S R; Borchardt, M A; et al.

Great Lakes tributaries are known to deliver waterborne pathogens from a host of sources. To examine the hydrologic, land cover, and seasonal patterns of waterborne pathogens (i.e. protozoa (2), pathogenic bacteria (4) human viruses, (8) and bovine viruses (8)) eight rivers were monitored in the Great Lakes Basin over 29 months from February 2011 to June 2013. Sampling locations represented a wide variety

of land cover classes from urban to agriculture to forest. A custom automated pathogen sampler was deployed at eight sampling locations which provided unattended, flow-weighted, large-volume (120-1630L) sampling. Human and bovine viruses and pathogenic bacteria were detected by real-time qPCR in 16%, 14%, and 1.4% of 290 samples collected while protozoa were never detected. The most frequently detected pathogens were: bovine polyomavirus (11%), and human adenovirus C, D, F (9%). Human and bovine viruses were present in 16.9% and 14.8% of runoff-event samples (n=189) resulting from precipitation and snowmelt, and 13.9% and 12.9% of low-flow samples (n=101), respectively, indicating multiple delivery mechanisms could be influential. Data indicated human and bovine virus prevalence was different depending on land cover within the watershed. Occurrence, concentration, and flux of human viruses were greatest in samples from the three sampling locations with greater than 25% urban influence than those with less than 25% urban influence. Similarly, occurrence, concentration, and flux of bovine viruses were greatest in samples from the two sampling locations with greater than 50 cattle/km2 than those with less than 50 cattle/km2. In seasonal analysis, human and bovine viruses occurred more frequently in spring and winter seasons than during the fall and summer. Concentration, occurrence, and flux in the context of hydrologic condition, seasonality, and land use must be considered for each watershed individually to develop effective watershed management strategies for pathogen reduction.

（来源：Water research, 2017, 113: 11-21）

Influence of blooms of phytoplankton on concentrations of hydrophobic organic chemicals in sediments and snails in a hyper-eutrophic, freshwater lake

Shi, Wei; Yu, Nanyang; Jiang, Xia; et al.

Blooms of phytoplankton, which are common in freshwater ecosystems, might not only affect quality of water but also influence biogeochemical processing of pollutants. Based on three years of field observations in sediments of Tai Lake, China, concentrations of organochlorine (OC) pesticides and polycyclic aromatic hydrocarbons (PAHs) in areas where blooms occurred were 2.4 and 3.4 times greater than concentrations in areas without blooms. Concentrations of octylphenol (OP), nonylphenol (NP) and bisphenol A (BPA) in areas where blooms did not occur were 3.8, 4.4 and 2.6 times greater than concentrations in areas where blooms did occur. To explain the differences, simultaneous, seasonally determinations of the water-sediment-phytoplankton-snails disequilibria were determined empirically. Greater sinking and lesser diffusion were shown to be probable drivers of the burial of delta-HCH, 4-ring and 5-ring PAHs in surface sediments of areas in which blooms occurred, being as much as 0.58, 38 and 45gmonth-1. Large biodegradation and low burial was shown to be the probable reason of the inverse proportion of NP, OP and BPA in both water and sediment to biomass which might be due to the enhanced metabolic capacity of bacterial community associated with algae blooms. These phenomena further influence the persistent hydrophobic organic chemicals in the snail species (Bellamya quadrata) being greater in winter but lesser in summer, which is probably due to the positive relationship with the concentrations in sediment when snails were dormant and with the concentrations in water after dormancy. Thus, in Tai Lake, the fate and distribution of persistent and biodegradable contaminants in sediments and snails is influenced by blooms of phytoplankton, which should be included in models of environmental fates of contaminants.

（来源：Water research, 2017, 113: 22-31）

Bioavailable phosphorus (P) reduction is less than mobile P immobilization in lake sediment for eutrophication control by inactivating agents

Wang, Changhui; He, Rui; Wu, Yu; et al.

Phosphorus (P) immobilization by inactivating agents in the sediment of eutrophic lakes to reduce immediately available P in lake water is often crucial for mitigating nuisance eutrophication symptoms, such as cyanobacterial blooms. Macrophytes and phytoplankton, however, can directly utilize P from the sediment for growth. Accordingly, a comprehensive analysis of the P bioavailability in lake sediment amended with two promising P-inactivation agents, namely Phoslock((R)) and drinking water treatment residue (DWTR), was investigated in both short-and long-term studies (20 and 180 d). Phosphorus availability was assessed using six chemical extraction methods and Hydrilla verticillata and Microcystis aeruginosa growth tests. The results showed that Phoslock((R)) and DWTR significantly reduced mobile P (NH_4Cl and $Na_2S_2O_4/NaHCO_3$ extractable P) in lake sediment, while P bioavailability that was assessed by different methods showed considerable deviations. Interestingly, appropriate bioavailable P chemical extraction methods were determined based on linear correlation analysis, and further comparison indicated that reduction of bioavailable P by DWTR (<55% for macrophyte available P) and Phoslock((R)) (<17% for cyanobacteria available P) were clearly less than the mobile P immobilization (>75%) at recommended dosages, which was probably caused by the capability of macrophyte and cyanobacteria to utilize various fractions of P (except the residual P) in amended sediment under proper illumination. Therefore, DWTR and Phoslock((R)) can effectively reduce P release from lake sediment, but the potential bioavailable P may pose uncertainties for eutrophication control in lakes that typically have regular sediment re-suspension. Overall, an evaluation of the bioavailable P pool in the lake ecosystem should be essential for successful lake geo-engineering.

（来源：Water research, 2017, 109: 196-206）

Nutrients associated with terrestrial dissolved organic matter drive changes in zooplankton: phytoplankton biomass ratios in an alpine lake

Kissman, Carrie E. H.; Williamson, Craig E.; Rose, Kevin C.; et al.

1. Dissolved organic matter (DOM) is increasing in many lakes due to climate change and other environmental forcing. A 21-day microcosm experiment that manipulated terrestrial DOM was used to determine the effect of DOM on zooplankton: phytoplankton biomass ratios (z:p). We predicted that if DOM additions increase the amount of fixed carbon available for higher trophic levels through stimulation of the microbial loop and hence zooplankton, the z: p will increase. However, if DOM additions increase other nutrients besides fixed carbon, we predict stable or decreasing z: p due to nutrient stimulation of phytoplankton that subsequently enhances zooplankton.

2. The effects of experimental additions of terrestrially derived DOM on zooplankton, phytoplankton, z: p and zooplankton net grazing were assessed in microcosms (sealed bags) incubated in the epilimnion

(shallow; 1.5 m) and hypolimnion (deep; 8.0 m) strata of an alpine lake.

3. DOM addition treatments (DOM+) had a 6.0- to 7.5-fold increase in phytoplankton biomass relative to controls, but only a 1.3- to 1.5-fold increase in zooplankton biomass, on day 21 of the experiment. The z: p was, thus, lower in the DOM+ treatments (ratios: 2.3 deep and 4.4 shallow) than in the control treatments (ratios: 13.4 deep and 17.5 shallow), providing evidence that DOM additions provide nutrient subsidies besides fixed carbon that stimulate phytoplankton biomass accumulation.

4. The increase in zooplankton biomass during the experiment was similar in magnitude to the total amount of dissolved organic carbon (DOC) in the DOM added in the sealed bags at the beginning of the experiment, which suggests zooplankton biomass stimulation due to increased phytoplankton biomass, and not from DOM through the microbial loop, which would have greater trophic transfer losses. The consumer net grazing effect in the DOM+ treatments was reduced by 2.8-fold in the shallow stratum and by 2.9-fold in the deep stratum relative to the control treatments, indicating that zooplankton were unable to exert strong top-down control on the primary producers.

5. The role of nutrients needs to be considered when examining the response of pelagic ecosystems to inputs of terrestrial DOM, especially in lakes with lower DOC concentrations.

（来源：FRESHWATER BIOLOGY, 2017, 61(1): 40-51）

Effects of mixing on the pelagic food web in shallow lakes

Blottiere, Lydie; Jaffar-Bandjee, Mourad; Jacquet, Stephan; et al.

1. We examined the effects of wind-induced mixing and particle resuspension on the pelagic food web in eutrophic shallow lakes. These processes are known to have a major impact on a variety of biological, physical or chemical parameters such as the underwater light climate, the nutrient availability in the water column and the abundance and composition of the phytoplankton community. However, little is known about the effects of these processes on other compartments of the freshwater food web.

2. We conducted a 9-week experiment comprising a manipulation of mixing intensity in 15 m 3 mesocosms equipped with wavemakers in order to explore the impact of two mixing regimes on water chemistry as well as viral, bacterial, phytoplankton and zooplankton communities.

3. The turbidity level in mixed mesocosms (compared to calm conditions) was higher on average, especially at the bottom, indicating a successful resuspension of the sediment bed. Mixing increased chlorophyll a concentration without any clear increase in algal abundance, measured as cell counts by flow cytometry, which pointed to a change in species composition or a physiological adaptation to mixing. pH increased strongly in mixed mesocosms, suggesting enhanced primary productivity in perturbed conditions. Zooplankton responses to mixing were neutral for cladocerans and negative for copepods, which potentially mediated top-down controls on the rotifer population.

4. Bacterial and viral abundances were not significantly changed by the mixing regimes; however, peaks of viral lysis of heterotrophic bacteria were seen in each mixed mesocosm, while none were observed in calm mesocosms. These results suggest that viral lysis is enhanced by the water column mixing.

5. Our experiment demonstrates that mixing is likely to influence shallow lake functioning through a complex combination of direct and indirect effects on the underwater light climate and water chemistry,

phytoplankton physiology and productivity, zooplankton growth and possibly virus-host interactions. These complex effects could play a major role in structuring pelagic and benthic communities in shallow lakes.

（来源：FRESHWATER BIOLOGY, 2017, 62(1): 161-177）

Lake bacterioplankton dynamics over diurnal timescales

Grubisic, Lorena M.; Bertilsson, Stefan; Eiler, Alexander; et al.

1. Planktonic bacterial community dynamics over short timescales can be of great importance for food webs and ecosystem functioning but are rarely described when microbial community and composition are assessed. To study the significance of such dynamics we sampled the surface water at the deepest point of a mesotrophic lake (Lake Erken, Sweden) every third hour over two days.

2. By combining 454 pyrosequencing of 16S rRNA genes with bromodeoxyuridine immunocapturing of DNA, replicating populations were identified and compared to the community retrieved from total DNA samples. This comparison revealed a significant difference between the actively replicating and total community.

3. The high-frequency diurnal sampling was compared to a year-long survey conducted in the same lake in order to compare the diurnal and seasonal variation in bacterioplankton community composition. At the diurnal-scale, the variation was significantly higher in the replicating than in the total community. However, variation in both active and total diurnal community was significantly lower than the variation in the seasonal total community.

4. Our analysis revealed pronounced short-term dynamics of individual bacterial populations uncoupled from the diurnal light cycle. For example, the proliferating fraction of the most abundant bacterial tribe (LD12) followed a cyclic pattern that covaried with viral abundance. This implies that environmental factors other than light may act as important drivers of microbial community composition, at least in mesotrophic Lake Erken.

（来源：FRESHWATER BIOLOGY, 2017, 62(1): 191-204）

Iron-dependent nitrogen cycling in a ferruginous lake and the nutrient status of Proterozoic oceans

Céline C. Michiels; François Darchambeau; Fleur A. E. Rolan; et al.

Nitrogen limitation during the Proterozoic has been inferred from the great expanse of ocean anoxia under low-O_2 atmospheres, which could have promoted NO_3^- reduction to N_2 and fixed N loss from the ocean. The deep oceans were Fe rich (ferruginous) during much of this time, yet the dynamics of N cycling under such conditions remain entirely conceptual, as analogue environments are rare today. Here we use incubation experiments to show that a modern ferruginous basin, Kabuno Bay in East Africa, supports high rates of NO_3^- reduction. Although 60% of this NO_3^- is reduced to N_2 through canonical denitrification, a large fraction (40%) is reduced to NH_4^+, leading to N retention rather than loss. We also find that NO_3^- reduction is Fe dependent, demonstrating that such reactions occur in natural ferruginous water columns. Numerical modelling of ferruginous upwelling systems, informed by our results from

Kabuno Bay, demonstrates that NO_3^- reduction to NH_4^+ could have enhanced biological production, fuelling sulfate reduction and the development of mid-water euxinia overlying ferruginous deep oceans. This NO_3^- reduction to NH_4^+ could also have partly offset a negative feedback on biological production that accompanies oxygenation of the surface ocean. Our results indicate that N loss in ferruginous upwelling systems may not have kept pace with global N fixation at marine phosphorous concentrations (0.04–0.13 μM) indicated by the rock record. We therefore suggest that global marine biological production under ferruginous ocean conditions in the Proterozoic eon may thus have been P not N limited.

（来源：Nature Geoscience, 2017, 10: 217-221）

Microbial community dynamics in Inferno Crater Lake, a thermally fluctuating geothermal spring

Laura Ward; Michael W Taylor; Jean F Power; et al.

Understanding how microbial communities respond and adjust to ecosystem perturbation is often difficult to interpret due to multiple and often simultaneous variations in observed conditions. In this research, we investigated the microbial community dynamics of Inferno Crater Lake, an acidic geothermal spring in New Zealand with a unique thermal cycle that varies between 30 and 80 °C over a period of 40–60 days. Using a combination of next-generation sequencing, geochemical analysis and quantitative PCR we found that the microbial community composition was predominantly chemolithotrophic and strongly associated with the thermal cycle. At temperatures >65 °C, the microbial community was dominated almost exclusively by sulphur-oxidising archaea (Sulfolobus-like spp.). By contrast, at mesophilic temperatures the community structure was more mixed, comprising both archaea and bacteria but dominated primarily by chemolithotrophic sulphur and hydrogen oxidisers. Multivariate analysis of physicochemical data confirmed that temperature was the only significant variable associated with community turnover. This research contributes to our understanding of microbial community dynamics in variable environments, using a naturally alternating system as a model and extends our limited knowledge of acidophile ecology in geothermal habitats.

（来源：The ISME Journal, 2017, doi:10.1038/ismej.2016.193）

Anthropogenic shift of planktonic food web structure in a coastal lagoon by freshwater flow regulation

Deevesh A. Hemraj; A. Hossain; Qifeng Ye; et al.

Anthropogenic modification of aquatic systems has diverse impacts on food web interactions and ecosystem states. To reverse the adverse effects of modified freshwater flow, adequate management of discharge is required, especially due to higher water requirements and abstractions for human use. Here, we look at the effects of anthropogenically controlled freshwater flow regimes on the planktonic food web of a Ramsar listed coastal lagoon that is under recovery from degradation. Our results show shifts in water quality and plankton community interactions associated to changes in water flow. These shifts in food web interactions represent modifications in habitat complexity and water quality. At high flow, phytoplankton-zooplankton interactions dominate the food web. Conversely, at low flow, bacteria, viruses and nano/picoplankton interactions are more dominant, with a substantial switch of the food web towards

heterotrophy. This switch can be associated with excess organic matter loading, decomposition of dead organisms, and synergistic and antagonistic interactions. We suggest that a lower variability in flow amplitude could be beneficial for the long-term sustaining of water quality and food web interactions, while improving the ecosystem health of systems facing similar stresses as the Coorong.

（来源：Scientific Reports, 2017, doi:10.1038/srep44441）

Effects of hydrological regime on development of Carex wet meadows in East Dongting Lake, a Ramsar Wetland for wintering waterbirds

Lei Jing; Cai Lu; Yan Xia; et al.

Wet meadows are one of the most important ecological components in floodplain, and are among the most dynamic ecosystems. Understanding the development of wet meadows and contributing environmental factors can provide better support for wetland management. Carex meadows in East Dongting Lake National Nature Reserve (EDLNNR) provide vital wintering ground for thousands of migratory waterbirds, and their ecological functions are under threated due to hydrological alternation. We measured wet meadow expansion in EDLNNR from 1989 to 2014, and explored its responses to hydrological and climatic factors within the generalised additive models (GAM) framework. We found an overall expansion of wet meadows over the study period. However, in contrast to many previous studies, our results showed that water level fluctuations at the hydrologic indicator site had only limited impacts on their development. Instead, sampling year, timing of water level recession, and local rainfall exerted significant effects. The effects of sampling year reflected the changes in sedimentation within Dongting Lake; and effects of timing of water withdrawal might be explained by the life history of the dominant sedge species. Our study suggested that the impacts of large scale hydrological alternation on vegetation may operate indirectly through its effects on sediment balance.

（来源：Scientific Reports, 2017, doi:10.1038/srep41761）

Broad-scale lake expansion and flooding inundates essential wood bison habitat

Jennifer B. Korosi, Joshua R. Thienpont, Michael F. J. Pisaric; et al.

Understanding the interaction between the response of a complex ecosystem to climate change and the protection of vulnerable wildlife species is essential for conservation efforts. In the Northwest Territories (Canada), the recent movement of the Mackenzie wood bison herd (Bison bison athabascae) out of their designated territory has been postulated as a response to the loss of essential habitat following regional lake expansion. We show that the proportion of this landscape occupied by water doubled since 1986 and the timing of lake expansion corresponds to bison movements out of the Mackenzie Bison Sanctuary. Historical reconstructions using proxy data in dated sediment cores show that the scale of recent lake expansion is unmatched over at least the last several hundred years. We conclude that recent lake expansion represents a fundamental alteration of the structure and function of this ecosystem and its use by Mackenzie wood bison, in response to climate change.

（来源：Nature Communications, 2017, doi:10.1038/ncomms14510）

Long-term MODIS observations of cyanobacterial dynamics in Lake Taihu: Responses to nutrient enrichment and meteorological factors

Kun Shi, Yunlin Zhang, Yongqiang Zhou; et al.

We developed and validated an empirical model for estimating chlorophyll a concentrations (Chla) in Lake Taihu to generate a long-term Chla and algal bloom area time series from MODIS-Aqua observations for 2003 to 2013. Then, based on the long-term time series data, we quantified the responses of cyanobacterial dynamics to nutrient enrichment and climatic conditions. Chla showed substantial spatial and temporal variability. In addition, the annual mean cyanobacterial surface bloom area exhibited an increasing trend across the entire lake from 2003 to 2013, with the exception of 2006 and 2007. High air temperature and phosphorus levels in the spring can prompt cyanobacterial growth, and low wind speeds and low atmospheric pressure levels favor cyanobacterial surface bloom formation. The sensitivity of cyanobacterial dynamics to climatic conditions was found to vary by region. Our results indicate that temperature is the most important factor controlling Chla inter-annual variability followed by phosphorus and that air pressure is the most important factor controlling cyanobacterial surface bloom formation followed by wind speeds in Lake Taihu.

（来源：Scientific Reports, 2017, doi:10.1038/srep40326）

Citizen science shows systematic changes in the temperature difference between air and inland waters with global warming

Gesa A. Weyhenmeyer, Murray Mackay, Jason D. Stockwell; et al.

Citizen science projects have a long history in ecological studies. The research usefulness of such projects is dependent on applying simple and standardized methods. Here, we conducted a citizen science project that involved more than 3500 Swedish high school students to examine the temperature difference between surface water and the overlying air (Tw-Ta) as a proxy for sensible heat flux (QH). If QH is directed upward, corresponding to positive Tw-Ta, it can enhance CO_2 and CH_4 emissions from inland waters, thereby contributing to increased greenhouse gas concentrations in the atmosphere. The students found mostly negative Tw-Ta across small ponds, lakes, streams/rivers and the sea shore (i.e. downward QH), with Tw-Ta becoming increasingly negative with increasing Ta. Further examination of Tw-Ta using high-frequency temperature data from inland waters across the globe confirmed that Tw-Ta is linearly related to Ta. Using the longest available high-frequency temperature time series from Lake Erken, Sweden, we found a rapid increase in the occasions of negative Tw-Ta with increasing annual mean Ta since 1989. From these results, we can expect that ongoing and projected global warming will result in increasingly negative Tw-Ta, thereby reducing CO_2 and CH_4 transfer velocities from inland waters into the atmosphere.

（来源：Scientific Reports, 2017, doi:10.1038/srep43890）

Carbon sequestration in an expanded lake system during the Toarcian oceanic anoxic event

Weimu Xu; Micha Ruhl; Hugh C. Jenkyns; et al.

The Early Jurassic Toarcian oceanic anoxic event (~183 Ma) was marked by marine anoxia–euxinia and

globally significant organic-matter burial, accompanied by a major global carbon-cycle perturbation probably linked to Karoo–Ferrar volcanism. Although the Toarcian oceanic anoxic event is well studied in the marine realm, accompanying climatic and environmental change on the continents is poorly understood. Here, utilizing radioisotopic, palynological and geochemical data from lacustrine black shales, we demonstrate that a large lake system developed contemporaneously with the Toarcian oceanic anoxic event in the Sichuan Basin, China, probably due to enhanced hydrological cycling under elevated atmospheric pCO_2. We attribute increased lacustrine organic productivity to elevated fluvial nutrient supply, which resulted in the burial of ~460 Gt of organic carbon in the Sichuan Basin alone, creating an important negative feedback in the global exogenic carbon cycle. We suggest that enhanced nutrient delivery to marine and large lacustrine systems was a key component in the global carbon cycle recovery during the Toarcian oceanic anoxic event and acted to shorten the duration of the recovery of global δ13C values.

（来源：Nature Geoscience, 2017, 10: 129-134）

Estimates of sediment trapping rates for two reservoirs in the Lake Erie watershed: Past and present scenarios

Alighalehbabakhani, Fatemeh; Miller, Carol J.; Selegean, James P.; et al.

Sediment accumulation can significantly impact the useful life of dams and the multiple functions served by those dams such as flood attenuation, hydropower, and water supply. However, there is only limited information, and even fewer physical measurements, assessing the rate of sediment accumulation in reservoirs behind dams. Many of the dams within the Great Lakes Watershed were constructed between 100 and 120 years ago, and there is reasonable concern that these dams and their associated reservoirs may be reaching capacity with respect to sediment storage. As a reservoir reaches its sediment storage capacity, there are numerous risks. Excess sediment can compromise the water intake for supply systems. Dam failure or removal can potentially allow large quantities of impounded sediment to migrate downstream, negatively impacting fish habitat and water quality. This research investigates the historical function of dams as sediment storage points. Also, this research assesses the effect of anthropogenic influences including land use change and dam construction on sediment yield and accumulation within the Lake Rockwell and Ballville Dam watershed. To better understand the historical and current sediment yield within the Lake Erie watershed, Soil and Water Assessment Tool (SWAT) models of the Lake Rockwell and Ballville Dam watersheds were developed. The resulting model suggests that the average of sediment accumulation rate within Lake Rockwell Dam reservoir varies between the minimum of 1.6 and the maximum of 4.6 g/cm(2)/yr from 1988 to 2007. Within the Ballville Dam reservoir, the rate varies between the minimum of 2.6 and the maximum of 23.2 g/cm(2)/yr from 1980 to 1999.

（来源：JOURNAL OF HYDROLOGY, 2017, 544: 147-155）

Historical changes in the aquatic environment and input of polycyclic aromatic hydrocarbons over 1000 years in Lake Kitaura, Japan

Itoh, Nobuyasu; Naya, Tomonori; Kanai, Yutaka; et al.

We examined the vertical distributions of total organic carbon (TOC), total nitrogen (TN), total sulfur (TS), and 21 polycyclic aromatic hydrocarbons (PAHs) in a 100-cm-long sediment core collected from Lake Kitaura, a small and shallow eutrophic freshwater lake in central Japan, to elucidate changes in its

aquatic environment and the input of PAHs with respect to human activity over the last 1000 years. Using a cross-plot of TOC and TS, the aquatic environment of this lake was well classified into four stages: a marine-brackish water period (ae1321 AD), a brackish-freshwater period (1394-1646 AD), a freshwater period (1726-1958 AD), and a eutrophication period (ae1971 AD). During the current eutrophication period, both TOC and TN have increased dramatically and TOC/TN (which is a useful indicator for distinguishing between aquatic and terrestrial plant sources) has decreased because algal production has markedly increased recently due to eutrophication. The vertical distributions of PAHs (which have derived primarily from combustion over the last 1000 years) showed increases in layers corresponding to periods of volcanic activity in the 18th century, as well as dramatic increases from 1971 to the present. Thus, both the aquatic environment and the input of PAHs in Lake Kitaura have been strongly affected by recent human activity. On the other hand, among all of the PAHs, only perylene-which is known to be of biological origin-was consistently formed via first-order kinetics over the period covered by the core. Its formation was barely influenced by fluctuations in the input of the precursor of perylene or how reductive the environment in the bottom water was.

（来源：LIMNOLOGY, 2017, 18(1): 51-62）

Paleolimnological evidence of the consequences of recent increased dissolved organic carbon (DOC) in lakes of the northeastern USA

Brown, Robert E.; Nelson, Sarah J.; Saros, Jasmine E

As a result of reductions in sulfate deposition and changing climate, dissolved organic carbon (DOC) concentrations have increased in many lakes situated in forests of northeastern North America and northern Europe since the 1990s. Although this increase is well documented, the associated ecological implications remain unclear. In particular, DOC strongly influences the vertical temperature structure of lakes, with increasing DOC often leading to a shallower epilimnion. We investigated the effect of increased DOC concentrations on lake thermal structure using fossil diatom records from six remote Maine lakes. Sedimentary diatom profiles from three pairs of small (< 0.5 km(2)) lakes were compared, with each pair containing one lake with a documented significant increase in DOC and the other experiencing no change in DOC since the early 1990s. Lake thermal structure was inferred from changes in the relative abundance of Discostella stelligera and Aulacoseira species, two diatom taxa that are associated with changes in thermal stratification. The three lakes without increasing DOC showed no change in diatom-inferred mixing depth over the past few decades. Of the lakes with documented increases in DOC, two showed the highest turnover in diatom community structure over time. Profiles from both of these lakes also indicated directional change in diatom-inferred mixing depth over the past 20 years, but the direction of change differed. This study demonstrates that recent increases in DOC have the potential to alter the physical and biological structure of lakes, but that these responses may differ across lakes.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2017, 57(1): 19-35）

Porewater salinity reveals past lake-level changes in Lake Van, the Earth’s largest soda lake

Yama Tomonaga; Matthias S. Brennwald; David M. Livingstone; et al.

In closed-basin lakes, sediment porewater salinity can potentially be used as a conservative tracer to reconstruct past fluctuations in lake level. However, until now, porewater salinity profiles did not allow quantitative estimates of past lake-level changes because, in contrast to the oceans, significant salinity changes (e.g., local concentration minima and maxima) had never been observed in lacustrine sediments. Here we show that the salinity measured in the sediment pore water of Lake Van (Turkey) allows straightforward reconstruction of two major transgressions and a major regression that occurred during the last 250 ka. We observed strong changes in the vertical salinity profiles of the pore water of the uppermost 100 m of the sediments in Lake Van. As the salinity balance of Lake Van is almost at steady-state, these salinity changes indicate major lake-level changes in the past. In line with previous studies on lake terraces and with seismic and sedimentological surveys, we identify two major transgressions of up to +105 m with respect to the current lake level at about 135 ka BP and 248 ka BP starting at the onset of the two previous interglacials (MIS5e and MIS7), and a major regression of about −200 m at about 30 ka BP during the last ice age.

（来源：Scientific Reports, 2017, doi:10.1038/s41598-017-00371-w）

Holocene carbonate record of Lake Kivu reflects the history of hydrothermal activity

Jillian E. Votava; Thomas C. Johnson; Robert E. Hecky

The sediment record of Lake Kivu reveals a complex volcanogenic and climatic Holocene history. Investigation of the inorganic carbonate record dates the onset of carbonate deposition in the mid-Holocene in Kivu's deep northern and eastern basins and identifies conditions enabling deposition. The magnitude and timing of carbonate-rich sedimentation is not so much controlled by climate but, instead, linked strongly to hydrothermal activity in the basin. Sublacustrine springs supply the vast majority of the calcium and carbonate ions required for supersaturation with respect to aragonite. This major hydrothermal activity that permanently stratifies Lake Kivu today was initiated ~3,100 y before present (3.1 ka), when carbonate-rich sediments first appeared in the Holocene record. Aragonite is the dominant CaCO3 mineral present in the lake deposits. Both δ13C and δ18O of the aragonite are enriched above the expected kinetic fractionation of meteoric waters, suggesting a volcanogenic influence on the formation waters. Repeated major fluctuations in the carbonate record after 3.1 ka therefore most likely reflect the historical variation in hydrothermal inputs.

（来源：PNAS, 2017, 114(2): 251-256）

Ecological response of a shallow boreal lake to biomanipulation and catchment land-use: integrating paleolimnological evidence with information from limnological surveys and maps

Marzecova, Agata; Avi, Egle; Mikomagi, Annika; et al.

We reconstructed 150 years of ecological change in a shallow boreal lake located on the east shore of the Baltic Sea by integrating different types of environmental evidence: paleolimnological records (XRF-measured elements, fossil pigments and Cladocera assemblages), information from historical limnological surveys and archival maps. We assessed the role of biomanipulation by liming and fish-removal in the disappearance of submerged macrophytes, such as Lobelia dortmanna L., and their

replacement by persistent cyanobacterial blooms. The combination of different strands of evidence revealed that the shift from macrophyte to cyanobacterial dominance was part of a long-term ecological response to eutrophication and increased sediment load from catchment disturbances. The findings demonstrate that a gradual loss of wetlands and increase of ditches in a catchment had a more significant effect on the lake ecosystem, compared to the direct, but short-term impact of biomanipulation. The study highlights the importance of catchment land-use and disturbance by ditches in changing the ecology of boreal water bodies. Also, it illustrates that a thorough understanding of the long-term ecosystem dynamics and differentiation among responses to multiple anthropogenic impacts are essential preconditions for addressing the deterioration of habitats and change in aquatic environments.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2017, 57(1): 1-18）

重点关注

地球上湖泊的深浅对气候变化的影响

美国物理学会：世界上的湖泊实际上要浅的多，只有原来想象深度的三分之二。如果这种说法正确，它将有助于科学家更为准确地模拟出世界气候变化图像，因为浅湖可以产生出更多吸收热量的甲烷。 卫星扫描显示，分布在地球上的有1亿个面积大于1公顷的湖泊，它们的总面积超过300亿公顷，大约是地球表面面积的2%。但是要估算出这些湖泊的深度是一件很棘手的事情，因为湖泊的深度差异太大了。以苏格兰境内著名的尼斯湖为例，其平均深度为132米，四倍于北美伊利湖的平均深度，尽管伊利湖的面积是尼斯湖的4500倍。

本周在路易斯安娜州新奥尔良召开的美国物理学会预案研究会上，Mary Silber指出：世界上的湖泊实际上要浅的多，只有原来想象深度的三分之二。如果这种说法正确，它将有助于科学家更为准确地模拟出世界气候变化图像，因为浅湖可以产生出更多吸收热量的甲烷。

卫星扫描显示，分布在地球上的有1亿个面积大于1公顷的湖泊，它们的总面积超过300亿公顷，大约是地球表面面积的2%。但是要估算出这些湖泊的深度是一件很棘手的事情，因为湖泊的深度差异太大了。以苏格兰境内著名的尼斯湖为例，其平均深度为132米，四倍于北美伊利湖的平均深度，尽管伊利湖的面积是尼斯湖的4500倍。

麻省理工学院的海洋学家此项研究的主持者B. B. Cael说：科学家所指的湖泊深度一般都是来自于方志记载，也就是说是从湖泊周边的坡度计算出来的。地球上湖泊的容积估计为16万-28万立方千米。

Cael想把这项研究搞得更好一些。他和明尼苏达州科学博物馆的生态学家亚

当 ．希思科特以及瑞典优密欧大学环境科学David ．Seekell一起，首次提出一种新模式，这种膜式可以搞清全世界的湖泊分布情况。根据一种叫“幂次法则的”数学关系式，使用多项调查得来的数据，Cael发现某些地区湖泊数量随着湖泊面的扩大而减少，简单说，就是小湖泊接二连三出现，大湖泊越来越少，只有1%的湖泊面积达到100公顷，其他都在10公顷左右。这一“幂次法则”再加上其他的数据，可以看出研究者们低估了小湖泊的数量。Cael最后对世界上小湖泊的面积做了稍微高一点的估计。

为了估量湖泊的容积和深度，Cael援用了一种地形学的数学模式。他假想地球表面是匀称碎片形状，使想象中的地球极其接近自仿射分形，换句话说就是只要山脉和河流的高度都按一定的因子系数展延，不管是放大或缩小，都可以通过等衡统计显示出来。Cael特别指出，通过几项地形学研究显示，如果按照10倍放大时，你就需要按2.5倍因子系数调整（研究结果还显示，火星也是自仿射型的，也符合2.5比例因子系数）。

这一相互关系使科学家能够在统计学上推论出他们各自地区湖泊的容积和深度。Cael说“假设湖泊下垫面地形大体上没有什么大的变化，”他估计地球上湖泊的总容积是19.9万平方千米，接近以往估计的底限。更令人瞩目的是，这种模式还显示出地球上湖泊的平均深度为42.5米，明显低于过去估计的62米。

如果地球上的湖泊平均深度明显比过去想象的低得多的话，Cael说，那么观测报告就能得出它对解释气候变化原因会产生不同影响的结论。生活在湖底的微生物不需要氧气，且能产生甲烷，如果湖泊浅，更多的吸热的甲烷气体会冒出水面进入大气层。目前地球大气层甲烷的含量中，湖泊释放的部分和海洋释放的相等，大体是地表埋藏物产生甲烷的一半。Cael说这一数据需要进行更高的修正。

芝加哥大学的应用数学家Mary Silber说，尽管这项研究应用了数学模式，研究还是需要严格贴近数据，“我很高兴看到他对手收集数据的关注，也希望这项研究能把事情解释的极其简单。”。

原文来源：http://www.sciencemag.org/news/2017/03/world-s-lakes-are-much-shallower-thought-mathematical-analysis-suggests

（来源：http://article.yeeyan.org 2017-03-20 根据相关资料编译）

Science News: 智利冰川湖融化构成的新威胁

经过上个月紧张的3天丛林开路，一支研究队伍进入了Patagonian（巴塔哥尼亚）热带雨林，最终到达了遥远的Chileno（智利诺）峡谷，并目睹了冰碛物造成的毁灭性破坏。这里有一条2公里长的冰川湖，在过去近年可能发生过2次泛滥，冰崩或山坡上的块体运动等带来大量碎屑冲刷了智利诺峡谷。目前这个山谷已杳无人烟，但

这里被破坏的景象给智利的大部分都市居民区带来了不祥的信息，包括智利首都圣地亚哥（该地附近就有一个尚处于栖息阶段的冰川湖）。随着气候变暖山体冰消，融化的冰川湖携带大量的不稳定冰块和冰碛对周边造成破坏。为了系统评估智利冰川湖的泛滥潜力，该研究组汇编了全国范围3000多个冰川湖的清单并评估了它们泛滥的可能。

原文来源: http://science.sciencemag.org/content/355/6329/1004.summary

（来源：Science, 2017，355(6329):1004-1005 根据相关资料编译）

Nature：20 世纪全球缺水之路的区域轨迹

水资源短缺已经引起人们的高度重视，但是鲜有人知道水资源是如何随着时间变化。2016 年 12 月 9 日，Nature 在线发表题为“世界缺水之路-20 世纪水资源短缺、用水压力及其可持续发展路径”（The world’s road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability）一文。来自芬兰阿尔托大学水资源开发研究组、澳大利亚国立大学地下水国家研究中心、荷兰阿姆斯特丹大学、德国卡塞尔大学及德国波恩大学科研人员开展研究，提供了对整个 20 世纪蓝色水消耗、可再生淡水可用性和水资源短缺的连续区域轨迹的第一次评估。这项研究最大的亮点是引入明确的空间灌溉地图而不是国家价值导向，这导致对一些大国的灌溉位置和程度会有较大差异。 文中水资源短缺定义为“低的人均可用性”，用水压力定义为“相对于水资源获得 性的高耗水”，这暗示了对水资源的人类用水需求以及过度的水资源消耗。研究指出 1900~2000 年期间水资源消费增加了四倍，水资源短缺的人口数量从 20 世纪的 24 亿（占全球人口的 14%）增加到 21 世纪的 38 亿（占全球总人口的 58%）。所有的 区域轨迹显示水资源缺乏呈现增长趋势。研究引入缺乏轨迹基模、形状概念（scarcity trajectory archetypes and shapes），描述水资源短缺的历史发展，并提出缓解水资源短 缺和增加可持续性的措施，建议把资源缺乏轨迹和其他数据库相联系进一步深刻理 解历史和未来资源缺乏驱动力，从而更好地帮助解决这些不断变化所带来的资源挑战。

原文来源：http://www.nature.com/articles/srep38495

（来源：科学研究动态监测快报 2017-01-01，第1期总第294期）

Nature：中国各地自来水的同位素分布特征

2017年3月2日，Nature期刊在线发表题为“中国各地自来水的同位素分布特征（Divergence of stable isotopes in tap water across China）”一文。该研究提出了第一个中国自来水同位素的国家级调查。这项研究为进一步对中国瓶装水的稳定同位素

研究建立了一个基准，是对气候敏感区水资源监测和调查的关键一步，可用于建立国家或区域水管理战略。

水中稳定同位素（δ2H 和 δ18O）是水文过程和生态模式的重要指示器。自来水中的同位素状况能够反映区域水文过程及人类活动的总体特征。中国是一个幅员辽阔的国家，具有明显的气象和地域差异。由于水文及生态过程的驱动，环境中水的同位素会发生分馏，因此水中同位素常被用来跟踪大气湿度来源、识别地下水来源、表层水的交换、蒸发及古气候重建。文中用于分析的自来水样品稳定同位素共采集2014年12月至2015年12月数据样品780个。研究基于6个GNIP（Global Network of Isotopes in Precipitation）中国站点及 CHNIP（Chinese Network of Isotopes in Precipitation）站点（2004年建立的29个站点）进行降水同位素研究。除了降水同位素研究还对地下热水中的δ2H和δ18O进行研究，基于中国90个地下热水数据进行研究讨论热水来源的不同类型。文中分析了自来水同位素的空间分布特征、自来水中同位素的时序变化特征。 最后通过研究建立了中国自来水同位素线δ2H = 7.72 δ18O + 6.57 (r^2 = 0.95)；并得出中国自来水同位素空间分布特征具有明显的“大陆效应”；自来水同位素的季节变化具有明显的区域特征，但是在国家级监测水准却没有表现出这种趋势；某些地方采集的自来水其同位素变化还会与地域和气象因素有关。

原文来源： http://www.nature.com/articles/srep43653

（来源:科学研究动态监测快报 2017-03-15,第 6 期总第 299 期）

Nature：季风降水对印度地下水位影响

2017 年 1 月 9 日，Nature 在线发表《季风降水及地下水抽取对印度地下水位变化的相对贡献研究》（Relative contribution of monsoon precipitation and pumping to changes in groundwater storage in India）一文。来自印度、加拿大及美国的联合团队，通过解读卫星数据及当地井水记录数据分析过去几十年季风降水对印度不同区域地下水储存的贡献。文中对 2002~2013 年期间水井观测的地下水储存变化及 GRACE（Gravity Recovery Climate Experiment）数据对比其月度变化（1 月、5 月、8 月、11 月），发现 2002~2013 年，印度北部地下水每年以 2cm 速度下降，而印度南部则在该期间增加了 1~2cm。对比 1996~2013 年地下水位的水井观测数据与降水量的关系，印度南部、中北部地下水位的变化主要依赖于降水的变化，印度西北部其地下水位的变化主要依赖于灌溉的地下水抽取，地下水位的变化也受到降水量的影响。最后对比了印度降水量变化与印度洋温度变化，指出印度北部降水量变化与印度洋变暖有关，并提出建议人类要注意到印度洋变暖与地下水储存之间的遥相关关系。

原文来源： http://www.nature.com/ngeo/journal/vaop/ncurrent/full/ngeo2869.html

（来源：科学研究动态监测快报 2017-2-15，第 4 期总第 297 期）

Nature：地下水-气候引起的抽水效应

地下水是水文循环的基本组件和至关重要的自然资源，不仅支持灌溉农业和粮食安全，同时也是超过20亿人饮用水的主要来源。2017年1月23日，Nature期刊在线发表《地下水的枯竭及响应气候变化引起的地下水抽取》（Depletion and response of deep groundwater to climate-induced pumping variability）一文。

来自美国宾夕法尼亚州立大学、哥伦比亚大学及纽约大学的研究团队，分析了美国水井记录的深层地下水含水层的水位情况，并与年代际和十年际气候变化指数、与每年降水数据的关系对比，研究结果表明地下水位变化响应于特定的全球气候变化。尽管气候引发的深层含水层天然补给的变化预计将有多年的时间滞后，而这项研究发现深层地下水水位响应气候变化的时间尺度不到一年的时间。该文在灌溉区域的对比研究表明，每年最深水井对当地降水的响应可能反映了气候变化引起的地下水抽取的变化。理解人类因素的加入响应气候干旱所采取的地下水抽取导致的深层地下水位变化，对于管理年代际、十年际更长时间尺度气候变化对一个国家的水资源的影响至关重要。

原文来源：http://www.nature.com/ngeo/journal/v10/n2/full/ngeo2883.html

（来源：科学研究动态监测快报 2017-03-01，第 5 期总第 298 期）

世界范围内地下水资源可能于 2050 年枯竭

近日，美国地球物理学联合会秋季年会上科学家发布最新研究称，未来几十年内，人类消费可能导致印度、欧洲和美国部分地区的地下水枯竭。科研人员基于新模型实验得出预警，阐述世界范围各个区域地下水状况并提出控制地下水过度开采的建议。新的模型研究发现：①全球干旱区地下水资源将在未来几十年耗尽；②印度恒河流域上游地区，西班牙南部和意大利的地下蓄水层将在 2040 年至 2060 年间被消耗殆尽；③在美国，加利福尼亚州中央谷(California’s Central Valley)、图雷盆地（Tulare basin）和南圣华金谷（Southern San Joaquin）的地下蓄水层可能会在 2030 年后干涸，德克萨斯州、俄克拉荷马州和新墨西哥州赖以生存的南部高平原地下蓄水层将在 2050 年 2070 年达到开采上限。美国科罗拉多矿业学院水文学家英格·德·格拉夫（Inge de Grraaf）在美国地球物理学联合会秋季年会上指出，由于人类饮用和农业灌溉过度抽取地下水，到 2050 年，全世界 18 亿人口将居住在地下水完全或接近枯竭的地区。同时也指出，从模拟数据来看，中国的地下水资源情况略好一些，与北方相比，中国南部地区的地下水资源情况更好一些。

此前，美国航空航天局（NASA）等机构利用卫星数据进行的全球地下水研究也发现，全球最大的几个蓄水层（即可存储地下水的土壤或多孔岩层）水位正在以

惊人的速度下降，不过卫星观测方法无法测量较小区域的蓄水层水位。科学家也表示，目前仍缺少蓄水层结构和存储能力的相关数据，尚不能准确测算出单一蓄水层能存储多少地下水。

原文来源：http://phys.org/news/2016-12-groundwater-resources-world-depleted-2050s.html

（来源：科学研究动态监测快报 2017-01-05，第 2 期总第 295 期）

德找到减少地下水硝酸盐污染新办法

近日，德国不莱梅大学的研究小组找到了一种解决地下水硝酸盐污染的新方法，利用多金属氧酸盐（POM）可有效降低地下水中过量的硝酸盐。参与这一项目研究的还有来自中国等国的研究人员，最新成果刊登在《欧洲无机化学杂志》上。

地下水硝酸盐污染是德国一个长期已知的问题，根据德国政府2016年的地下水硝酸盐监测报告，德国有近三分之一的地下水水质硝酸盐含量超标，这与过度使用农业化肥有关。类似的情况在许多国家也很严重。地下水硝酸盐过量，会影响饮用水质量，并对农业和工业用水产生不良后果，通常允许的地下水硝酸盐含量上限为每升50毫克。

不莱梅大学乌尔里希·库尔策教授领导的团队研究发现，一种合成的多金属氧酸盐对于减少硝酸盐水污染有特殊作用，这种纳米结构物质在水中对硝酸盐还原起电催化效果。其有效成分主要是镍和铜金属原子，含镍多金属氧酸盐可使水中的硝酸盐含量降低4倍，而含铜的金属氧酸盐甚至可以使硝酸盐含量降低达50倍。

库尔策教授对这一最新研究成果寄予厚望，因为使用多金属氧酸盐比使用传统方法处理地下水中过量硝酸盐更高效和环保，可大大减少二氧化碳的排放。现在还需进一步研究该方法是否能适用于日常生活中。

（来源：科技日报 2017-02-21）

冰川融化致珠穆朗玛峰周围可能形成杀手湖

在地球上大约198000个冰川中，超过四分之一的冰川都是在喜马拉雅山中发现，但是，即使是这种寒冷的冰雪，也正在受到气候变化的影响。许多喜马拉雅冰川正在退缩，一项关于珠穆朗玛峰周围32座冰川的新研究发现，与湖泊接壤的冰川比内陆冰川失去了更多的冰块。

图 研究人员测量珠穆朗玛峰附近与陆地和湖泊接壤的冰消量

喜马拉雅冰川是因为降雪减少和全球升温融化了现有的冰，冰川发展成湖泊，当湖泊融水膨胀时，溢出的风险增加。就在1985年发生的时候，一个位于尼泊尔东部一个冰川湖Dig Tsho积水溢出，通过冰碛大坝，冲毁了新建的电站、Khumbu山谷内的30间房屋和14座桥梁。为了避免类似的灾难，尼泊尔政府去年排放了伊姆扎湖(Imja Tsho)的一部分，伊姆扎湖是该国增长最快的冰川湖之一。

现在，利用2000年和2015年卫星获得的数字高程地图和冰川自身的图像数据揭示了在尼泊尔和西藏的9个与湖泊接壤和23个与陆地接壤的冰川在15年内发生的变化，通过比较冰块、冰面积和冰川的高度改变。发现与湖泊接壤的冰川比与陆地接壤的冰川每年减少32%的冰量，并且失去了比内陆冰川更多的高度和面积。

这是一个令人担忧的趋势，因为许多冰川湖在不稳定的碎冰坝后面形成，这些碎冰坝随时可能崩溃，蓄积的洪水倾泻而下，冲击低谷，导致沿途所过之处产生灾难性的后果。

研究人员计划在更长的时间尺度上研究喜马拉雅山的冰川变化，使用早在20世纪70年代拍摄的卫星图像。

原文来源：http://www.sciencemag.org/news/2017/02/melting-glaciers-around-mount-everest-may-be-forming-killer-lakes

（来源：http://www.zgzhuke.cn/discovery/ 2017-03-29 根据相关资料编译）

业界动态

NOAA 发布《水计划愿景及未来五年计划》

今日，美国国家海洋与大气管理局（NOAA）在线发布《水计划愿景及未来五年计划》（NOAA Water Initiative Vision and Five-Year Plan）报告。提出水资源计划的愿景，即一个国家中的每个人（从公民个人、企业到公共官方），都能够获得水资源相关的及时、可操作信息，并将这些信息理智地应用到水风险、使 用、管理、计划及水安全等方面。水资源计划的使命是通过提供水资源相关的科学信息和服务改善国家水资源安全，解决水风险的脆弱性，实现水资源管理的高效性和有效性。NOAA 将通过与决策者、合作伙伴和用户合作，改变综合水资源预测服务来推进水计划愿景实现。他们之间的合作以“用户驱动、基于科学、无缝结合、彼此协作、迅速响应”为特征。 《水计划愿景及未来五年计划》的首要目标是改变水资源信息服务传递，使其更好地满足和支持社会需求。这项目标支持了 NOAA 的使命，在极短时间面前保护 人类的生命及财产安全，创造并增强生态系统、群落及经济的恢复力。NOAA 及其合作搭档将依靠已经建立的成功的项目，致力于培养水资源信息系统和服务的综合方法来改变水资源信息服务传递。这些方法包括：对公众负责；通过与利益相关者联系，基于用户反馈的需求及问题驱动调整水信息服务的优先权；以有效的风险沟通为特征，包括不确定性的清晰沟通；与决策制定相关的跨时空尺度的信息传送，包括各种时间尺度上的模拟和情境规划；伴随着教育和宣传，使信息能被决策者有效的使用，包括一些社会、行为因素和方法被科学技术所了解，嵌入社区决策制定；补充现有的联邦机构水资源数据。这种方法考虑了水循环作为一个整体，同时关注于独特的物理、社会经济属性和特定区域的挑战。支持社区参与历史水资源挑战分析，促进跨越地理和管辖区界限水资源的综合管理。这种方法将通过一个世界级的技术企业来集成决策工具，为战略规划工作提供背景信息支持。为实现 NOAA 水倡议计划的共同目标，该机构将采取五个相互依赖的战略措施：

（1）建立水信息服务战略合作伙伴关系。在三年之内，NOAA 将识别、建立和加强三个或更多伙伴关系，让利益相关者以当前和可持续方式参与水资源信息服务。这些伙伴关系的建立将有助于利益相关者的活动。在五年之内 NOAA 将建立水资源服务传送的新模式用于水信息，指导目标风险及灾害评估并建立促进信息传送的协作解决方案。（2）加强水资源决策支持工具和网络建设。在五年之内，NOAA 将与其合作伙伴一起促进新决策支持工具的开发（比如，洪水监测工具、水资源管理工具、水质和生态模拟预报工具及导航工具），并将上述工具应用于不同领域。例如，应急人员管理、多时间尺度行业供水预测、不同水资源类型及生态功能区划分等。在三年内，NOAA 的初始水数据服务将演示至少两项新服务数据公开原则，包括跨多个平台机器可读性和关键用户社区可访问性。（3）彻底改变水建模、预测

和降水预报。在五年之内，NOAA 将与联邦合作伙伴一起进一步发展国家水模型，论证并改进大陆尺度水文预报，用于支持跨越长短时间尺度及高低水流状况的水资源管理、山洪预警、城市用水预报、沿岸及河口环境尤其是在暴雨事件中总的水位情况、包括水温在内的水质预报等领域。在五年之内，NOAA 将投资地球系统模拟改善短时间尺度比如季节尺度降水的定量预报，通过美国国家天气服务改善降水预报产品。NOAA 及其合作伙伴将在五个目标流域和它们在美国的出水口区域形成、展示用于水质及生态系统功能变化的生物地球化学建模。（4）加速水信息研究与发展(R&D)。在五年内，NOAA 与国会和所有合作伙伴将增强一系列水的投资研发项目，NOAA 将转移至少有三个新的或改进的科学概念、技术、应用程序所产生的水的研发活动到操作、应用程序、商业化或其他用途中。NOAA 也将促进特定研究过渡途径旨在迅速改善水的预测。（5）增强和维持与水资源相关的观测。两年之内，NOAA 将与其合作伙伴确定一套最优的观测准则，旨在使战略投资能够加强全国范围的水观测和数据收集以支持水资源风险管理。《水计划愿景及未来五年计划》将新建 NOAA 的国家水中心，旨在促进伙伴关系，并为跨组织的协作部门提供新一代水信息和决策支持服务。国家水中心将作为一个创新孵化器和加速器，加强对水的预测研究能力；提高国家对与水有关的灾害的防御能力；提供授权、预报信息支持已存在的（如区域干旱和洪水预警）和新的通讯网络，推进在地方、州、地区和国家水平的综合水资源管理；成为水资源管理者、预报者、利益相关者及公共官方之间的协作会议中心；在地方、州、地区和国家的层次形成事件驱动、高影响力、日常及高价值的水决策；提供支持和改善水管理工作的情报。

原文来源：http://www.noaa.gov/explainers/noaa-water-initiative-vision-and-five-year-plan

（来源：科学研究动态监测快报 2017-01-15，第 2 期总第 295 期）

OECD 计划召开第八次水治理倡议会

近日，Nature 期刊网站发布题为“让水治理提上全球议程”（Get water governance on the global agenda）报道，指出经济合作与发展组织（OECD）计划在下个月于摩洛哥拉巴特召开第八次水治理倡议会，旨在指导水治理的政策。在下一届美国总统宣誓就职前一周的会议上，代表们讨论“提高全球议程中水治理”的简况。水治理是一个政治的也是一个来之不易的人类的妥协，因此水治理是社会、经济、政治耦合系统用以控制水资源发展和管理决策制定。其目标必然为所有人都可以接纳，即确保人们没有太多的水，也不是太少，以及它不是太污染。在全球范围水治理实现的方式上反映了水的治理没有两个情况是一样的。例如，2013 年的一项研究报道，中国和澳大利亚引进流域可持续实践以维持当地环境中的水流量（而不是为人类使用的管道）。虽然中国黄河的水量变化是由政府施加的，但是墨累-达令河流域的改

善是基于市场的系统产物，该系统鼓励开采许可证的交易和不使用。这些是水资源治理成功的案例，但是摩洛哥会议的另外一个原因则是政治严峻的现实经常会涌入并影响水治理。这也是为什么水治理的学者通常喜欢关注行动者而不是关注所需的行动。再者，研究更加认识到气候变化在水资源的变化中具有重要作用，但是导致水发生变化的最大原因还是直接的人类活动造成的，因此水治理的全球议程的实施极为必要。

原文来源：

http://www.nature.com/news/get-water-governance-on-the-global-agenda-1.21104?WT.ec_id=NATURE20161208&spMailingID=52940554&spUserID=MTIyMTcwNTY1NzU5S0&spJobID=1061382989&spReportId=MTA2MTM4Mjk4OQS2

（来源：科学研究动态监测快报 2017-01-15，第 2 期总第 295 期）

WRI：中国面临严峻的水压力

2017 年 1 月 10 日，世界资源研究所（WRI）网站在线发表博客，称中国面临 的水压力正在急剧上升。我们知道在中国的很多地区由于水资源分布不均匀，高的 用水需求和低的水资源供给导致一些区域水压力加剧。采用世界资源研究所开发的 “水道”水风险工具（Aqueduct water risk atlas）使用基准水压力对比 2001~2010 年 中国水压力状况图谱（图 1）。通过基于全国 300 多个地级行政单位的取水量数据以 及高空间分辨率的网格数据，中国水压力可以更准确地反映中国水资源和用水之间 的冲突。分析发现，中国水压力位于较高和极高分类的地区占比从 2001 年的 28% 上升至 2010 年的 30%，共有 6.78 亿人口受到影响。

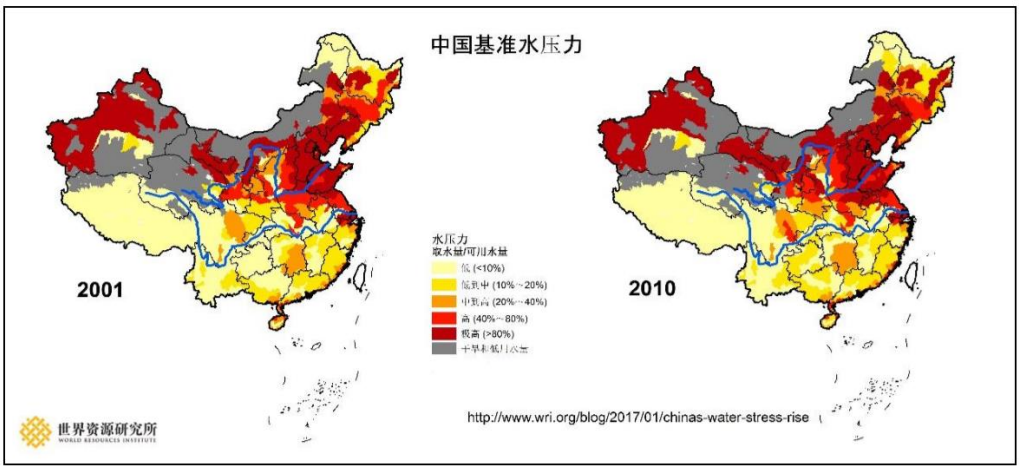


图 1 2001 基准水压力与 2010 基准水压力

水压力是指年度总取水量（生活用水、工业用水和农业灌溉用水）和可用地表水量的比值。当该比值高于40%被认为是高压力，高于80%时则属于极高压力。水

压力值越高，意味着用水竞争程度越激烈。2001年至2010年，中国有54%的地区水压力出现加剧；而同一时期，中国有8%的地区出现水压力等级加重。

造成水压力不断加剧的原因很多，工业化和城镇化是其中两个最大的原因。例如，除了北京以外，所有省份的工业取水量都出现增长。位于黄河流域中的一个靠近国家级煤炭基地的小流域出现水压力增加55%，高耗水的煤炭行业有可能加剧这个地区的用水压力。在2000年至2010年期间，中国东南沿海主要经济区之一的珠江三角洲的工业GDP 增长4.8倍，城市人口增加了56%。而同期位于西南地区的贵州省也出现工业总产值显著增加，城市人口增加22%。

一些地方政府已经开始采取行动推动工业节水措施。例如，山东省自2006年起关停用水效率较低的造纸厂和钢铁厂，在 2001年至2008年间，山东省单位工业增加值取水量减少了12.49%；其他省份也应考虑采取相似措施，控制工业用水，提高现有水资源利用率。随着人口增长和生活水平的不断提高，中国大部分地区的生活取水量也随之增加。在生活取水量增加的流域中，80%以上都出现了人均生活取水量的增长。随着收入增加，越来越多的家庭开始使用洗碗机、洗衣机等家用电器，生活方式也变得更加耗水。例如，从2001年至2010年，每100户家庭洗衣机拥有量从90.5台上升到96.2台，热水器拥有量从49.10台上升84.82台。也有一些流域的生活取水量有所降低，其主要原因可能在于这些流域位于不太适合生活的干旱地区，人们被迫迁移到其他地区。例如，2000年内蒙古某个流域的人口为4730人，2010年则下降为零。中国水资源管理的亮点：尽管工业和生活取水量整体有所上升，但是大部分地区的农业取水量出现了下降。2010年灌溉取水量比2001年下降了3%，考虑到同一时期有效灌溉面积上升了11%，灌溉取水量的下降具有重大意义。各项政策措施的实施和推广节水设施是造成农业取水量下降的主要原因。在中 国“十一五”（2006-2010）规划下，中央政府设定了到2010年实现灌溉用水量平稳的目标。在2003年至2010年间，节水灌溉面积增加了40%。

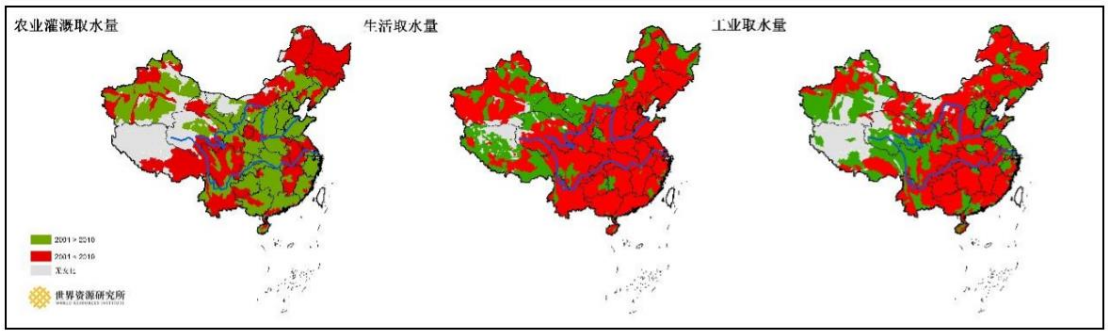


图 2 2001 年至 2010 年中国各行业取水强度变化情况

迈向水安全的未来：

在中国，水压力的不断加剧已经引起广泛关注，而这一威胁正在不断扩大。例如，预计到2040年，由于气候变化以及社会经济因素对水资源和用水需求的影响，宁夏自治区的水压力将升高40%-70%。中国已经通过采取有力的水资源政策降低了

由农业引起的水压力。根据每个流域独特的用水和水压力情况，政府和企业可以通过以下措施提高水资源利用效率和可持续性：鼓励种植低耗水农作物；在煤矿、发电等高耗水行业提高用水效率；向消费者倡导节水生活方式。也许水资源威胁正不断扩大，但中国可以通过采取合理 政策和管理手段来扭转这一趋势。

原文来源：http://www.wri.org/blog/2017/01/chinas-water-stress-rise

（来源：科学研究动态监测快报 2017-2-15，第 4 期总第 297 期）

TNC：水资源保护的环境、经济和社会效益

水源保护是获得清洁水、可靠天然水源的首要战略。2017 年 1 月 3 日，美国自然保护协会（The Nature Conservancy- TNC）发布报告《跨越水源地：源水保护的环境、经济和社会效益》(Beyond the Source-The environmental, economic and community benefits of source water protection)。该报告由美国自然保护协会与自然资本项目（Natural Capital Project）、森林趋势（Forest Trends）、美洲开发银行（Inter-American Development Bank）和拉丁美洲水基金合作伙伴关系（Latin American Water Funds Partnership）共同完成。

报告分析了全球 4000 多个城市保护水源地的措施，旨在展示健康、气候和生物多样性保护源水的好处。研究结果表明有 4/5 的城市采用三种水源保护行动为：牧草地植树造林、森林保护和覆盖作物来有效地减少从水源地到城市用水端的泥沙和养分污染。有 1/6 的城市通过能看到积极的水源保护的效益，比如每年的水治理费用减少。每年全球生态系统服务项目支出增加 420~480 亿美元，被要求必须实现全球水源减少 10%的泥沙和养分污染，这种投资至少可以改善 14 亿人的用水安全。另外，5408 个物种通过植树造林可以减少灭绝风险。

报告最后总结指出从水源地到用水端的水源自然保护可以带来四个方面的益处：改善人类健康；可以减少碳排放；提高气候的适应性；支持并保护生物多样性。

原文来源：https://global.nature.org/content/beyond-the-source?src=r.global.beyondthesource

（来源：科学研究动态监测快报 2017-03-01，第 5 期总第 298 期）

环保部：环境保护急需先进适用的环保技术

在1月6日北京召开的中国环境科学学会第八次全国会员代表大会上，环境保护部副部长黄润秋强调，按照《大气十条》等三大行动计划和生态保护工作需要，深入研究探明我国大气、水、土壤污染来源及形成机理，污染物迁移规律与效力，研究先进适用的环境分析与监测、污染控制与治理技术，推动我国环保产业发展。

据介绍，当前大气、水、土壤污染防治行动计划已取得初步效果，但我国环境

承载力已达到或接近“上限”，环境风险突出，中西部地区生态系统稳定性和生态服务功能呈下降趋势。

“当前，环保仍处于负重前行的关键期，也是大有作为的战略机遇期；既是实现环境质量总体改善的窗口期、转折期，也是攻坚期。改善环境质量任务艰巨，加快生态文明短板面临巨大挑战。”黄润秋说，因此，我国需加大环保科技体制改革力度，规范科技活动行为，营造良好科技创新环境。与我国环境问题复杂性、环保任务艰巨性相比，环保科技面临创新能力不足、支撑环境管理不够、制度不健全等问题。环保科技体制改革亟待改善，应形成环保系统、科研院所、高校科学院所企业分工明确，相互协作的高效科研体系，评价考核、人力激励、资金和成果管理等方面的体制机制；将科技等成果转化为法律法规、标准规范、技术政策，建立和完善国家环境基准体系等。

（来源：科技日报 2017-01-09）

环保部：长江流域环境承载力下降

在3月20日举行的环境保护部3月例行新闻发布会上，环保部水环境管理司司长张波说，整个长江流域的环境承载力实际是严重下降的。本来营养性物质通过浅滩湿地就可净化，但由于生态破坏，环境自净能力下降，“这些年在这方面欠账太多了”。

据介绍，京津冀在2016年6-8月汛期做了个调查，有卫星影像的333条河流中，227条是断流的。

张波说，这并非是老天爷不下雨，而是下雨后被层层截留了。但是各地只有确保一定比例水资源用于生态保护需求，河湖湿地的水生动植物才能生存，才能保证一定水平的环境自净能力。“当前的流域治污特别需要统筹减排和增容，破坏浅滩湿地的行为，河流湖岸坡硬质化只考虑人的需求，一味迎合高耗水需求，建那么多水库，层层截留，导致一些地方汛期时河湖湿地都得不到水的补充等，都要纠正和避免。原来工业污染较严重，条条河流鱼都是绝迹了，现在水质好了，开始养殖，投饵造成污染；一些地方用挖泥船挖螺蛳，把水下搞得像沙漠一样，这样的流域生态破坏行为都必须遏制。”

“我们下一步工作重点是要统筹减排和增容。这次《水污染防治法》修订的一个重点就是强化流域水生态保护，把增容放在一个更突出的位置，加以谋划和推动。”张波说。

张波特别强调，长江流域围湖造地情况较多。如巢湖从历史上的2000多平方公里湖面到现在仅剩700多平方公里，具有很高生态价值的浅滩湿地大量“消失”，长江流域环境承载力、自净能力严重下降，蓝藻水华等问题就随之而来。“所以划定

和严守生态红线是非常重要的”。

（来源：科技日报 2017-03-21）

首个“淡水鱼类”国家重点实验室落户湖南

科技日报长沙 1 月 23 日电，“我们将努力研制一批优良鱼类品种，建立名贵经济鱼类种质资源保护库并对其扩群利用，大力推进良种良养，构建优质鱼类健康养殖模式，让老百姓不仅有鱼吃，而且可以放心吃。”1 月 23 日，湖南省政府新闻办召开的发布会上，湖南师范大学党委书记李民透露，依托湖南师范大学、湖南省与科技部首个共建的淡水鱼类发育生物学国家重实验室获批成立。

湖南是“鱼米之乡”，具广阔的淡水资源和丰富的淡水鱼类资源。渔业也是该省重要产业之一。但其渔业发展大而不强。从全国看，我国淡水鱼产业面临鱼类自然捕捞量下降、种质资源逐渐减少的问题。该实验室的建设，有望进一步强化我国淡水渔业领域的自主创新研究，为我国鱼类遗传育种和健康养殖提供系统的理论基础和技术支撑，助推湖南千亿渔业目标的实现，促进湖南乃至全国现代渔业的可持续发展。

李民介绍，未来五年，该国家重点实验室将重点围绕鱼类远缘杂交等技术形成可育品系的遗传、繁殖机制这一关键科学问题，开展鱼类生殖发育及遗传育种、鱼类重要生物学性状形成机制以及鱼类健康养殖等三大方向研究。最终，力争将其建设成国际先进的淡水鱼类遗传育种及健康养殖研究的重要平台。湖南省科技厅副厅长贺修铭则表示，建设运行期内，湖南省每年为实验室提供不低于 500 万元经费，用于实验室建设、日常运行、开放课题设立和人才引进培养等。

（来源：科技日报 2017-01-24）

2016 布达佩斯峰会达成水资源可持续发展政策建议

2016年布达佩斯水资源峰会于11月30日落下帷幕。来自一百多个国家和地区的专家及官员呼吁保护水资源必须在提高认识的基础上付诸于行动。水资源峰会研究数据显示目前有8.84亿人口在使用未经净化的饮用水源，有超过80%的废水没有经过收集及净化。专家预测到2050年全球对水的需求还将增加50%。峰会认为世界与水的关系已经到达了战略关键点，与会者提出了《布达佩斯2016水资源峰会可持续发展目标施行的政策建议》（Budapest water summit 2016 policy recommendations for the implementation of SDG-6 areas）报告，指出水资源保护必须嵌入联合国2030可持续发展相关议程的政策中。峰会阐述了确保顺利实施“2030年议程”及其与水资源相

关目标所需的具体方向和指导方针。“2030年议程”涉及与水资源相关的有关问题主要有饮用水安全问题、环境卫生、水质、缺水、水资源利用及水资源相关的生态系统的完整性、恢复力等方面。这些水问题都是相互关联和相互依存的，必须以系统全球的方式来解决。2016年布达佩斯水峰会提出水可持续发展目标的十条政策建议。（1）饮用水、卫生设施安全性及供给性。饮用水的普遍、安全及其可靠性的获取是可持续发展的主要目标，应基于人权的方式使用安全的饮用水；提供高效、适当的技术、财政资源支持及人力资源规划预算和实施这些服务；投资、建造、运作和维护困难基础设施（大坝、水库及 分布系统）寻找替代自然/绿色基础设施来满足对饮用水安全日益增长的需求。（2）水资源的高效利用。从供应方面必须利用所有可用的来源，包括径流、地下水、土 壤水、雨水和地表水。另一方面不仅通过经济维度来刺激，比如作为收入来源一部分来覆盖/恢复一部分投资，而且对农民行为、生产者、消费者及决策者采用政策工具来管理，旨在促进水资源合理利用解决缺水问题。（3）加强水资源综合管理及基础设施建设。水资源综合管理和基础设施设计及操作相结合，旨在提高水资源利用的灵活性、管理效率；增加中短期对水和卫生设施的投资；加强合作，让年轻人和有经验的专业人士建立合作关系。（4）维护水质及水生生态系统安全。优先考虑水分配系统中生态与环境，把生态系统定位作为一个目标而不是作为一个限制因素；对未经处理的水减少其水污染，减少扩散源对农业、森林及农场的污染，开发和测试创新和低成本的技术，关注废水循环；保护濒危水生动物，为其提供最大保护区及水体需求。（5）关注气候和灾害对水资源的影响。识别、可视化和评估与水有关 的灾害风险，提高政治和公众意识准备有效的应急响应和恢复力；加强与水相关的国家平台建设，减少灾害风险，鼓励科学家、实践者和利益相关方密切合作；在世界各地作为“公共利益”分享气候变化知识；建立相关数据库提高气候变化的科学预测。（6）处理好水、食物和能源关系。三者是可持续发展不可或缺的元素，同时又相互依存相互联系，据预测在2035年人类对能源的需求增加50%，到2050年对粮食的需求将超过60%，这两者的联合效应导致2050年全球对水的需求会增加55%。因此，首先必须加强三者的管理，优先政治支持及对可持续发展目标持续监控，减少资源分配的跨部门竞争。再者，提出三者关系的解决方案，比如，促进技术和方法的研究，增加综合资源的利用效率，关注关联资源的稀缺性；由公共和私营部门及最终使用者共同设计和共同创造解决方案，采取适当措施保护小农和弱势群体。 最后，促进利益相关者的广泛参与。（7）城市系统水资源使用。到2050年城市人口将增加一倍，城市化将会是 21 世纪的主要趋势。城市化的本质将会导致水资源压力增加、资源匮乏及气候风险灾害加剧。建议采用综合城市水资源管理原则，包括可持续发展的其他目标，旨在实现避免城市发展及流域管理过程中碎片化和重复的政策和决策；为弱势群体设计补贴或其他利益的支持系统，确保能够反映真实成本的定价政策。（8）跨界水系统管理。大多数

的跨界流域不受任何形式的条约和合作协议的限制，大概40%的人口生活在跨界水体区域。综合考虑分水岭、跨界水体及气候变化，采取适应措施保证水资源减少不会对邻国造成水安全的影响；加强沿河国家的合作，考虑沿河国家的利益；提高集成和跨部门的水资源管理方法，促进食物能源安全，保护生态系统，增加水的生产力。（9）建立新指标及完善监测系统。从多维度对水资源可持续发展目标测量、监测和形成报告是极为必要的，建立由国家政府执行通过规范和监测工作提供水资源的详尽报告；开发适当的指标（包括治理指标）来识别解决方案解决水系统的根源问题是极为必要的，从而指导投资基础设施；开发新的数据来源高品质监控和提高准确报告与水资源相关的实现可持续发展目标的能力建设。（10）重新审视水资源管理。淡水资源管理治理格局在过去25年期间已经发生变化，引起了政界和商界的广泛关注，但是由于其责任分布在多个部门，因此，在全球和国家层面缺乏足够的机制来协调。清楚分配和区分水资源决策角色和职责，促进责任政府的合作，在综合流域治理系统适当尺度内管理水资源，促进不同尺度的协调；通过有效的跨部门协调鼓励不同部门之间政策的协调性，尤其是水和环境卫生、能源、农业、林业、渔业、工业和土地使用；对水资源数据信息能够及时的更新和共享，并用它来指导、评估和改善税政策；建立适当的地方和国家机构解决水的分配透明、公平。

原文来源：http://www.budapestwatersummit.hu/budapest-water-summit/budapest-statement/budapest-statement-2016-780/

（来源：科学研究动态监测快报 2017-01-01，第1期总第294期）

中科院专家表示太湖蓝藻水华预警有效率可达 8 成以上

据新华社南京3月24日电，太湖蓝藻水华一度大面积暴发，曾危及江苏无锡等地的饮用水安全。经过数年治理，太湖水质不断改善，记者日前从中国科学院南京地理与湖泊研究所获悉，通过建立蓝藻水华灾害监测预警机制，进一步降低了蓝藻水华暴发的概率，预警可提前72小时，准确率达80%以上。

南京地理与湖泊研究所太湖站站长秦伯强介绍，他们布设站点定期采集太湖水质和蓝藻样品，同时建立预测模型，根据藻类生物量与天气预报分析预判蓝藻水华的发展趋势，最终确定蓝藻水华暴发的概率及可能区域。

地面监测之外，南京地湖所还构建了水色遥感模型，根据不同水质遥感影像不同的原理，利用卫星遥感技术反演湖泊水体的光学特性，应用于蓝藻水华监测与预测预警。

“自2008年以来，连续8年的水华季节每周两次发布蓝藻水华预测预警，为太湖饮用水安全保障作出了重要贡献。”秦伯强说。

据了解，河道输入、大气降水等途径带来大量氮和磷，导致湖泊富营养化，是

蓝藻水华暴发的根本原因，“治本”仍需较长过程。不过，蓝藻水华暴发往往经过4个阶段：湖底休眠、水体复苏、上浮积聚、死亡分解，完善的监测预警机制，可以指引管理部门在不同阶段采取有针对性的控制和清除手段。

南京地湖所太湖站副站长朱广伟说，预警机制与打捞自动化调度相结合，显著提高了蓝藻的打捞效率，蓝藻打捞量从2008年的60万吨增加到2016年的约150万吨。

据介绍，南京地湖所通过预测预警、智能拦截、高效清除一系列措施，引导防控蓝藻灾害的环保产业发展由应急开始向主动防御转变，在太湖、巢湖、滇池、惠州西湖等重点湖泊成功实施了数十万亩的湖泊生态修复工程，有效改善湖泊水质，引领了我国湖泊生态修复的实践。

（来源：http://news.xinhuanet.com 2017-03-24）

工业废水“零排放”变现实 南工大膜技术破解“零排放”难题

“经过测试，净化后排出来的水各项指标亲近天然水，对人体无害，还能够回用。”北方药业污水处理公司环保部经理余晓峰告知记者，正因为有了超滤净化系统的支撑，这个国内最大的抗生素原料药企业将能确保在 3 月初投产。

数千公里之外的南通经济技巧开发区，又黑又臭的造纸制浆废水，正源源不断地从王子造纸公司输送到能达水务公司，经过预处理、膜过滤、蒸发结晶等工序后，化为涓涓清流和可回收利用的工业用盐和干泥。这套日处置 4 万吨的装备已经稳定运行 3 年多。

这一切的幕后功臣，都是南京工业大学膜技术科学团队展现的工业废水零排放技术。

启东，是长江入海口的小县城，这里三面环水，水产丰盛。5 年前，当江苏王子制纸公司将配建一条制浆废水排海管道的消息传到启东，世代以渔业为生的老百姓，开端担忧造纸制浆废水会影响生态和近海渔业养殖。

大众以为，造纸废水直排大海，污染环境、危及生态、损坏渔业资源。而在行业内，造纸制浆废水经处理后直排大海是国际“惯例”。王子公司是世界第三、亚洲第一大造纸企业，在日本国内和其余发达国家，都采取同样的工艺和处理办法。

专家表现，包含造纸行业在内的一批工业项目，只管是达标排放，但对水环境的损害依然不小，长此以往必定会造成水体不堪重负。这是一场事关发展与维护、经济好处与生态效益之间的摩擦。

为了赞助处所与企业走出困局，南京工业大学以徐南平院士为首的膜科学团队主动请缨，接下了造纸制浆废水“零排放”的世界性技术难题。

“制浆尾水零排放，当时国内外业界广泛认为不可能。”项目实行人、南京工业大学膜科学技术研究所教学杨刚说。

他们将要完成的任务是全天候、24 小时无前提运行，将制浆废水变成可回收利用的中水、工业用盐及干泥，实现废水全量回收利用。

“要实现‘零排放’，科学锁定制浆废水的成分非常重要。”杨刚介绍，由于制浆废水成分复杂，水质比课题组想像得更差。

从前，造纸制浆废水处理有三大技术障碍无法逾越：一是成分复杂，有 300—600 种物质，特殊是含有大批的胶体物质、木质素、短纤维等，极易造成纳米级的过滤膜污染堵塞，3 个月必需调换，本钱极高;二是含有高浓度的有机物，使得脱水不彻底，副产盐无法结晶;三是预处理过程中的臭气难以掌握，影响环境。

在对水样科学剖析的基本上，团队提出了成套设计工艺。

这套装置的工艺分为预处理、膜集成和蒸发结晶 3 个流程，每个流程都包括着诸多复杂技术与工艺，环环相扣，缺一不可。如预处理中，科研职员采用生物膜降解技术，不仅可将臭味去除，还有效解决了过滤膜的污染拥塞困难。

膜集成是要害环节，占到处理水量的 90%多。通过膜资料这个特殊的“筛子”，将大部分好水过滤出来，是实现零排放的重要保障。终极，滤出的纯水 COD(化学需氧量)小于 3，电导率小于 150，比自来水都好。

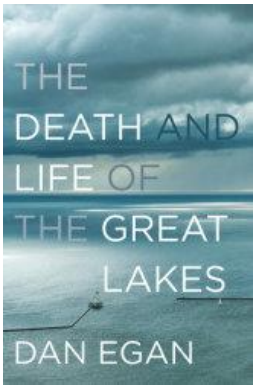
此时，几万吨废水中还剩下几百吨高盐水需要处理。团队采用了机械再压缩蒸发结晶技术，实现了有效结晶。前来洽购的精细化工厂都不敢相信，这白花花的工业盐居然出自制浆废水。

最后残余的干泥，含有钙、镁等成份，用在修建工程中，实惠又平安。

3 个月完成设计，6 个月完成建设与装置，一年实现试运营。看似“天方夜谭”的世界级难题，攻克了!。

（来源:《科技日报》2017-01-17）

《The Death and Life of the Great Lakes》一书出版



2017年3月1日，《The Death and Life of the Great Lakes》（五大湖的生与死）一书由美国W. W. Norton & Company（诺顿出版社）出版。

五大湖——伊利湖、休伦湖、密歇根湖、安大略湖和苏必利尔湖，它们拥有全世界20%的地表淡水资源，为全美国千百万人提供食物、工作以及娱乐资源，然而目前它们遭受着前所未有的威胁。《五大湖的生与死》是由获奖记者Dan Egan所著，该书将五大湖发生的生态灾难刻画的历历在目，并结合这些湖泊的历史故事与现今它们面临的威胁，呼吁为了人类子孙后代对它们应采取的修复和保护。

该书被列入Nature杂志推荐书单。

原文来源：http://www.booksontape.com/book/553345/the-death-and-life-of-the-great-lakes/

（来源：Nature, 2017, 543: 488-489 根据相关资料编译）

10 项技术改善太湖地区饮用水质

2月5日同济大学教授于水利接受科技日报记者采访时说，国家水专项“江苏太湖水源饮用水安全保障技术集成与综合示范”项目通过攻关，开发了10项关键技术与工艺，改善了太湖地区饮用水质，并具示范作用。

随着太湖流域人口急剧增长，用水量攀升，水量性缺少问题严重，还存在饮用水源污染、供水设施逐年老化等问题。为此江苏省建设厅牵头，由同济大学负责开展了上述项目。

于水利说，课题组以保证龙头水达标为目标，通过联合攻关，开发了适合太湖地区饮用水处理的10项关键技术与工艺，其中7项技术在示范工程中得到了应用。如复合重污染备用水源预臭氧和生物预处理耦合处理工艺，该工艺用于宜兴氿滨水厂示范工程，对有机物去除率提高10%，制水成本增加不超过10%；预处理、长距离输水反应器和深度处理综合净水关键技术，该技术用于中桥深度处理水厂示范工程，出水水质指标达到《生活饮用水卫生标准》（GB5749-2006），耗氧量小于2毫克/升，制水成本增加不超过30%；构建高速通道优化调度运行管理平台，使千吨水电耗降低1%以上；基于紫外线等消毒技术的管网二次供水水质保障技术，建设监控平台，使龙头水质达标率超过95%。

课题组还制定江苏太湖地区多水源切换调度指南等导则、操作规程、指南共6部；获发明专利21项；建设了苏州、无锡、吴江和宜兴四个示范区，示范区中200万人口住宅中的龙头水质达到国家生活饮用水卫生标准。

（来源：科技日报 2017-02-06）

水质监测用上太阳能物联网浮标

近日，从扬州大学获悉，该校杨小令团队成功研发出一款新型太阳能物联网水质监测浮标。该监测浮标以太阳能为动力源，能够长时间监测水质变化，同时采用物联网技术和大数据处理，可以实现远距离、实时监测水质。

水质监测被称为水资源保护的“眼睛”。国内水质自动监测站大多采用太阳能浮标形式，但结构复杂、成本很高，难以推广，且只能监测水温、溶解氧、pH值、电导率、浊度5种水质参数，不具有生物毒性监测功能，漏报率很高。

据介绍，该项技术采用紧凑的浸入式结构，直接把浮标投放于被监测水域。通过采用太阳能供电，可以保证晴天和阴雨天都正常工作。同时，数据采集和设备控制精度更高、更加节能。而GPRS的数据通讯方式可保证不掉线，几乎覆盖全国城乡各地，无需建造通讯铁塔。在实际操作中，浮标采集到的水质数据，采用物联网技术发送到阿里云服务器，用大数据、云计算软件对8种水质数据进行融合。监测人员可以通过APP客户端浏览实时数据，与以往的监测数据比对，给出水质评价结果，大大降低了监测人员的劳动强度和风险。

（来源：科技日报 2017-01-18）

太湖将率先全面建成河长制

3 月 16 日从水利部获悉，太湖流域片明确了全面建立河长制的时间表、路线图和阶段性目标，提出在 2017 年年底前，在全国率先全面建成省、市、县、乡四级河长制，有条件的地方，特别是平原河网地区积极探索河长向村（社区）拓展，力争建成五级河长制。

水利部太湖流域管理局局长吴文庆介绍，太湖流域片各省（市）均已明确省级河长办设置，并按照长期实体运作的目标进行组建，部分省份在人员编制、流动机制上积极创新，通过增编、内部调剂等方式充实河长办人员，设立支撑单位，为河长制各项工作任务的推进创造了条件。

“太湖流域管理局将帮助协调解决流域片各地推进河长制的重点难点问题，同时，做好省际边界水体和主要入太湖河道控制断面的水质监测，为河长制监督考核提供基础依据。”吴文庆表示。

据悉，太湖流域片地处我国东南沿海，包括太湖流域、钱塘江流域和东南诸河，涉及江苏、浙江、上海、福建、安徽五省（市），流域片总面积 24.5 万平方公里。

（来源：科技日报 2017-03-20）

我国最大深水型淡水湖泊抚仙湖 4 月 1 日进入封湖禁渔期

据央广网3月29日消息，从玉溪市抚仙湖—星云湖生态建设与旅游改革发展综合试验区管理委员会获悉，从4月1日中午12点开始，我国最大的深水型淡水湖泊抚仙湖将进入今年的封湖禁渔期，历时五个月，至9月1号中午12点止。期间禁止所有捕捞活动，所有捕捞渔船必须按属地管理原则归港上岸集中管理，禁止收购、加工、晾晒抚仙湖鱼类，禁止任何形式的破坏渔业资源和渔业生态环境的活动。

近年来，抚仙湖沿湖三县和抚管部门全面贯彻落实珠江流域禁渔期制度和《云南省抚仙湖保护条例》等法律法规，严格执行封湖禁渔制度，通过长期坚持不懈的

努力，有效保护和恢复了抚仙湖渔业资源，维护了湖泊生物多样性和正常渔业生产秩序，保护了抚仙湖Ⅰ类水质，促进了抚仙湖渔业生产的可持续发展。

（来源：央广网　2017-03-29）