湖泊科学动态

本期导读

- ***PNAS*:全球流域水储量的变化趋势被低估**
- ***Nature Geoscience*: 湿地有助于减少硝酸盐污染**
- CO_2 浓度升高对淡水关键物种产生不利影响
- 中办国办印发《关于在湖泊实施湖长制的指导意见》
- 我国湿地保护率达 49.03%

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热点文章

➢ Global models underestimate large decadal declining and rising water storage trends relative to GRACE satellite data

Bridget R. Scanlon; Zizhan Zhang; Himanshu Save; et al.

Assessing reliability of global models is critical because of increasing reliance on these models to address past and projected future climate and human stresses on global water resources. Here, we evaluate model reliability based on a comprehensive comparison of decadal trends (2002–2014) in land water storage from seven global models (WGHM, PCR-GLOBWB, GLDAS NOAH, MOSAIC, VIC, CLM, and CLSM) to trends from three Gravity Recovery and Climate Experiment (GRACE) satellite solutions in 186 river basins (~60% of global land area). Medians of modeled basin water storage trends greatly underestimate GRACE-derived large decreasing (⩽−0.5 km^3/y) and increasing (⩾0.5 km^3/y) trends. Decreasing trends from GRACE are mostly related to human use (irrigation) and climate variations, whereas increasing trends reflect climate variations. For example, in the Amazon, GRACE estimates a large increasing trend of ~43 km^3/y, whereas most models estimate decreasing trends (−71 to 11 km^3/y). Land water storage trends, summed over all basins, are positive for GRACE (~71–82 km^3/y) but negative for models (−450 to −12 km^3/y), contributing opposing trends to global mean sea level change. Impacts of climate forcing on decadal land water storage trends exceed those of modeled human intervention by about a factor of 2. The model-GRACE comparison highlights potential areas of future model development, particularly simulated water storage. The inability of models to capture large decadal water storage trends based on GRACE indicates that model projections of climate and human-induced water storage changes may be underestimated.

（来源：PNAS，2018，115(6)：E1080-E1089）

中文点评：

重力卫星观测数据显示全球流域水储量的变化趋势被低估

《美国科学院院报》（PNAS）近期刊登的一篇研究论文显示，传统的水文模型对全球流域水储量的预测并不可靠。研究者基于重力卫星观测数据，通过分析全球 180 多个流域的水量变化趋势发现：所有的水文模型与重力卫星观测数据相比，都低估了全球流域水储量的变化趋势。

该项研究由美国德克萨斯大学 Bridget R. Scanlon 教授领导，课题的研究目标是比较传统水文模型与重力恢复与气候试验（GRACE）卫星观测数据，评估人类活动对于全球流域水储量的影响，以及评估全球流域水储量变化趋势对于全球平均海平面变化的影响。

研究组人员首次将重力恢复与 GRACE 卫星监测到的数据作为主要参考源，对几种通用的水文模型模拟的水储量数据进行检验和甄别。结果发现，水文模型低估了人类活动和气候变化导致的流域水储量衰减，也低估了主要由气候变化导致的水量上升。因此在某些区域，传统的水文模型并不能真实地反映干旱对水储量的消耗情况，甚至会低估旱灾对水储量的影响。但使用 GRACE 重力卫星可以更加准确地反映陆地水储量的变化情况，用于灾害的监测预警，甚至评估全球海平面上升的情况。研究还发现，水文模型对全球流域水储量上升趋势

的低估程度比对下降趋势的低估更明显，多套水文模型甚至给出了反向的变化趋势，比如 2002 至 2014 年的十多年间，重力卫星观测的全球流域水储量上升约为 71 至 82 立方千米/年，而水文模型则给出了负 12 至负 450 立方千米/年的下降趋势。此外，重力卫星观测水总量呈显著下降的流域主要为位于北半球的人类灌溉活动频繁的流域，而显著上升的流域主要是湿润的非灌溉区；过去十几年间，气候变化对趋势变化的影响超过了人类活动。

（来源：根据相关资料编译）

➢ Contribution of wetlands to nitrate removal at the watershed scale

Amy T. Hansen; Christine L. Dolph; Efi Foufoula-Georgioun; et al.

Intensively managed row crop agriculture has fundamentally changed Earth surface processes within the Mississippi River basin through large-scale alterations of land cover, hydrology and reactive nitrogen availability. These changes have created leaky landscapes where excess agriculturally derived nitrate degrades riverine water quality at local, regional and continental scales. Individually, wetlands are known to remove nitrate but the conditions under which multiple wetlands meaningfully reduce riverine nitrate concentration have not been established. Only one region of the Mississippi River basin—the 44,000 km^2 Minnesota River basin—still contains enough wetland cover within its intensively agriculturally managed watersheds to empirically address this question. Here we combine high-resolution land cover data for the Minnesota River basin with spatially extensive repeat water sampling data. By clearly isolating the effect of wetlands from crop cover, we show that, under moderate–high streamflow, wetlands are five times more efficient per unit area at reducing riverine nitrate concentration than the most effective land-based nitrogen mitigation strategies, which include cover crops and land retirement. Our results suggest that wetland restorations that account for the effects of spatial position in stream networks could provide a much greater benefit to water quality then previously assumed.

（来源：Nature Geoscience, 2018,11: 127-132）

中文点评:

湿地有助于减少硝酸盐污染

近日，Nature geoscience期刊在线发表《流域尺度上湿地对硝酸盐清除的贡献》一文，来自美国明尼苏达大学的科研人员研究表明，湿地减少硝酸盐污染的效率是农田牧场的5倍，湿地是降低硝酸盐的最佳陆地方法。

众所周知，湿地是天然的净水器，在很大程度上减少河流中常见污染物的含量，这比一些清除N污染的黄金标准方法要有效得多。美国中西部的许多水道都充斥着被称为硝酸盐的有害化肥副产品。该研究小组在重养殖的明尼苏达河流域的200多个地点采集河水样品，并测量了该地区的作物和湿地的面积。将明尼苏达州河流域的高分辨率土地覆盖数据与空间重复的水样数据结合在一起。将湿地的影响从作物覆盖中分离开来，研究发现，在中等高度的河流中，湿地比最有效的陆地氮缓解方法在减少河流的硝酸盐浓度上的效率要高5倍。研究人员指出，湿地恢复对河流网络空间位置的影响，可能会对水质量改善带来更大的好处。

（来源：科学研究动态监测快报 2018-02-15，第4期总第321期）

摘要精选

The world's largest High Arctic lake responds rapidly to climate warming

Igor Lehnherr; Vincent L. St. Louis; Martin Sharp; et al.

Using a whole-watershed approach and a combination of historical, contemporary, modeled and paleolimnological datasets, we show that the High Arctic's largest lake by volume (Lake Hazen) has succumbed to climate warming with only a ~1 °C relative increase in summer air temperatures. This warming deepened the soil active layer and triggered large mass losses from the watershed's glaciers, resulting in a ~10 times increase in delivery of glacial meltwaters, sediment, organic carbon and legacy contaminants to Lake Hazen, a >70% decrease in lake water residence time, and near certainty of summer ice-free conditions. Concomitantly, the community assemblage of diatom primary producers in the lake shifted dramatically with declining ice cover, from shoreline benthic to open-water planktonic species, and the physiological condition of the only fish species in the lake, Arctic Char, declined significantly. Collectively, these changes place Lake Hazen in a biogeochemical, limnological and ecological regime unprecedented within the past ~300 years.

（来源：Nature Communications, 2018, doi:10.1038/s41467-018-03685-z）

Divergent trends of open-surface water body area in the contiguous United States from 1984 to 2016

Zhenhua Zou; Xiangming Xiao; Jinwei Dong; et al.

The contiguous United States (CONUS), especially the West, faces challenges of increasing water stress and uncertain impacts of climate change. The historical information of surface water body distribution, variation, and multidecadal trends documented in remote-sensing images can aid in water-resource planning and management, yet is not well explored. Here, we detected open-surface water bodies in all Landsat 5, 7, and 8 images (~370,000 images, >200 TB) of the CONUS and generated 30-meter annual water body frequency maps for 1984–2016. We analyzed the interannual variations and trends of year-long water body area, examined the impacts of climatic and anthropogenic drivers on water body area dynamics, and explored the relationships between water body area and land water storage (LWS). Generally, the western half of the United States is prone to water stress, with small water body area and large interannual variability. During 1984–2016, water-poor regions of the Southwest and Northwest had decreasing trends in water body area, while water-rich regions of the Southeast and far north Great Plains had increasing trends. These divergent trends, mainly driven by climate, enlarged water-resource gaps and are likely to continue according to climate projections. Water body area change is a good indicator of LWS dynamics in 58% of the CONUS. Following the 2012 prolonged drought, LWS in California and the southern Great Plains had a larger decrease than surface water body area, likely caused by massive groundwater withdrawals. Our findings provide valuable information for surface water-resource planning and management across the CONUS.

（来源：PNAS, 2018, https://doi.org/10.1073/pnas.1719275115）

Freshwater salinization syndrome on a continental scale

Sujay S. Kaushal; Gene E. Likens; Michael L. Pace; et al.

Salt pollution and human-accelerated weathering are shifting the chemical composition of major ions in fresh water and increasing salinization and alkalinization across North America. We propose a concept, the freshwater salinization syndrome, which links salinization and alkalinization processes. This syndrome manifests as concurrent trends in specific conductance, pH, alkalinity, and base cations. Although individual trends can vary in strength, changes in salinization and alkalinization have affected 37% and 90%, respectively, of the drainage area of the contiguous United States over the past century. Across 232 United States Geological Survey (USGS) monitoring sites, 66% of stream and river sites showed a statistical increase in pH, which often began decades before acid rain regulations. The syndrome is most prominent in the densely populated eastern and midwestern United States, where salinity and alkalinity have increased most rapidly. The syndrome is caused by salt pollution (e.g., road deicers, irrigation runoff, sewage, potash), accelerated weathering and soil cation exchange, mining and resource extraction, and the presence of easily weathered minerals used in agriculture (lime) and urbanization (concrete). Increasing salts with strong bases and carbonates elevate acid neutralizing capacity and pH, and increasing sodium from salt pollution eventually displaces base cations on soil exchange sites, which further increases pH and alkalinization. Symptoms of the syndrome can include: infrastructure corrosion, contaminant mobilization, and variations in coastal ocean acidification caused by increasingly alkaline river inputs. Unless regulated and managed, the freshwater salinization syndrome can have significant impacts on ecosystem services such as safe drinking water, contaminant retention, and biodiversity.

（来源：PNAS，2018,115(4)：E574-E583）

On the predictability of lake surface temperature using air temperature in a changing climate: A case study for Lake Tahoe (USA)

Piccolroaz, S.; Healey, N. C.; Lenters, J. D.; et al.

Can we predict long-term trends of lake surface temperature based on air temperature alone? We explore this question by analyzing the performance of a hybrid model (air2water) as a predictive tool for defining scenarios of lake surface temperature in the framework of climate change studies. Employing Lake Tahoe (U.S.A.) as a case study, we apply the model using different air temperature datasets (in situ measurements, gridded observations, and downscaled General Circulation Models). Through a data-driven calibration of the model parameters based on surface water temperature records, we show that air2water provides good performance (root mean square error similar to 0.5 degrees C, on a monthly scale) regardless of the input dataset. The model is able to accurately capture the historical long-term trend and interannual fluctuations over decades (from 1969 to present), using only 7 yr of monthly measurements of surface water temperature for calibration. Additionally, when used to predict future surface water temperature of the lake, air water produces the same projections irrespective of the air temperature dataset used to drive the model. This is certainly desirable, but not immediately expected when using a relatively simple model. Overall, the results suggest the high potential and robustness of air2water as a predictive tool for climate change assessment. Lake surface temperature warming of up to 1.1 degrees C (RCP 4.5) and 2.9 degrees C (RCP 8.5) was simulated at the end of the 21st century during summer months in Lake Tahoe. Such a scenario, if realized, would lead to serious consequences

on lake water chemistry, primary productivity, plankton community structure, and nutrient cycling.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2018, 63(1): 243-261）

Residents' concerns about lake uses and environments: a comparative study of Lakes Kasumigaura, Suwa, and Biwa in Japan

Kawamura, Shimako; Fukushima, Takehiko.

Lakes are a common water resource. This study analyzed residents' concerns regarding their lake environments to help solve lake environmental problems. The study area comprised three lakes in Japan-Kasumigaura, Suwa, and Biwa-which have different tendencies to change in water quality. A sample of 1200 respondents was evenly distributed among the three lake regions. A questionnaire survey asked about respondents' proximity to the lake, their concerns about the lakes' uses and environments, their evaluations of the lakes, and their opinions regarding environmental improvements. The number of options chosen in response to the multiple-answer questions was used to measure the extent of concern. The results found that knowledge of the water environment, general environmental concerns, the amount of travel time to the lake, and the visiting interval were significantly related to concerns about the lake environment. The results of logistic regression analysis found that high environmental concerns positively influenced attitudes toward lake use. Ways to increase concerns for lake environmental problems and the relationship between concerns and attitudes toward solving lake environmental problems are discussed.

（来源：LIMNOLOGY, 2018, 19(1): 101-113）

Lake Erie's ecological history reconstructed from the sedimentary record

Sgro, Gerald V.; Reavie, Euan D.

We evaluated the recent ecological history of Lake Erie from diatoms and geochemistry in sediment cores. Two major transition points in the ecology of the western basin (WB; 1985 and 2008) and central basin (CB; 1935 and 1982) were defined. Changes in abundance of diatom eutrophic indicators and geochemical markers were interpreted as a degradation in water quality after 1935 due to the effects of increased population, agriculture, and industrialization until abatement measures were enacted in the 1970s and 1980s. Diatom indicators suggested modest recovery from eutrophic conditions in Lake Erie, however diatom-inferred total phosphorus suggested that despite abatement efforts total phosphorus was not reduced below pre-impact levels. The effects on diatoms of increased temperature and dissolved silica also became apparent in the 1980s, and in the WB recent shifts were likely caused by increased pollution and recent climatic warming. Based on stratigraphic changes since 1985, the diatom trajectory suggests the phytoplankton of Lake Erie will likely remain in a state of flux for the near future due to a variety of countervailing impacts including unknown effects of mitigation efforts, legacy pollution, climate change, and changing upstream conditions.

（来源：JOURNAL OF GREAT LAKES RESEARCH, 2018, 44(1): 54-69）

Influence of industrial activity and pollution on the paleoclimate reconstruction from a eutrophic lake in lowland England, UK

Lang, B.; Medeiros, A. S.; Worsley, A.; et al.

Reliable estimates of Holocene temperatures are important for understanding past climate dynamics, the response of biota to climate change, and validating climate models. Chironomids in lake sediment cores are used widely to quantify past summer temperatures, for which high-latitude and/or high-altitude lakes, remote from human influence, are usually considered appropriate. Temperature inferences from lowland lakes are likely influenced by other variables, specifically eutrophication and industrial pollution, but their reliability has never been tested. We used a Norwegian chironomid-based transfer function (r (2) = 0.91; RMSEP = 1.01 A degrees C) to infer mean July air temperature over the last 200 years, using chironomid assemblages in a core collected from a polluted, nutrient-enriched lake at Speke Hall, Liverpool, England. The chironomid-inferred temperatures correlate significantly with the local instrumental temperature record and follow long-term national temperature trends. These results show that chironomids can be used to produce reliable estimates of past mean July air temperature, even when other variables have also influenced the composition of the chironomid community. These findings underline the value of chironomids as sensitive and reliable quantitative proxies for summer temperature.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2018, 59(4):397-410）

Adequacy of TRMM satellite rainfall data in driving the SWAT modeling of Tiaoxi catchment (Taihu lake basin, China)

Li, Dan; Christakos, George; Ding, Xinxin; et al.

Spatial rainfall data is an essential input to Distributed Hydrological Models (DHM), and a significant contributor to hydrological model uncertainty. Model uncertainty is higher when rain gauges are sparse, as is often the case in practice. Currently, satellite-based precipitation products increasingly provide an alternative means to ground-based rainfall estimates, in which case a rigorous product assessment is required before implementation. Accordingly, the twofold objective of this work paper was the real-world assessment of both (a) the Tropical Rainfall Measuring Mission (TRMM) rainfall product using gauge data, and (b) the TRMM product's role in forcing data for hydrologic simulations in the area of the Tiaoxi catchment (Taihu lake basin, China). The TRMM rainfall products used in this study are the Version-7 real-time 3B42RT and the post-real-time 3B42. It was found that the TRMM rainfall data showed a superior performance at the monthly and annual scales, fitting well with surface observation-based frequency rainfall distributions. The Nash-Sutcliffe Coefficient of Efficiency (NSCE) and the relative bias ratio (BIAS) were used to evaluate hydrologic model performance. The satisfactory performance of the monthly runoff simulations in the Tiaoxi study supports the view that the implementation of real-time 3B42RT allows considerable room for improvement. At the same time, post-real-time 3B42 can be a valuable tool of hydrologic modeling, water balance analysis, and basin water resource management, especially in developing countries or at remote locations in which rainfall gauges are scarce.

（来源：JOURNAL OF HYDROLOGY, 2018, 556:1139-1152）

A surrogate regression approach for computing continuous loads for the tributary nutrient and sediment monitoring program on the Great Lakes

Robertson, Dale M.; Hubbard, Laura E.; Lorenz, David L.; et al.

Water quality (WO) in many Great Lake tributaries has been degraded (increased nutrient and sediment concentrations) due to changes in their watersheds, resulting in downstream eutrophication. As part of the Great Lakes Water Quality Agreement, specific goals were established for loading of specific constituents (e.g., phosphorus). In 2010, the Great Lakes Restoration Initiative was launched to identify problem areas, accelerate restoration efforts, and track their progress. In 2011, the U.S. Geological Survey established a monitoring program on 30 tributaries to the lakes, representing-46% of the U.S. draining area and the spectrum of land uses. Discrete measurements of nutrients and suspended sediment, and continuous measurements of flow and WQ surrogates (turbidity, temperature, specific conductance, pH, and dissolved oxygen) are being collected in these tributaries to document their WQ and estimate continuous (5-min) loading. To estimate loadings, two regression models were developed for each constituent for each site: one using continuous flow and a seasonality factor; and one using flow, seasonality, and continuous surrogates. Variables included in the final models for each constituent were chosen from the explanatory variables that worked "best" for all sites. In computing loads, when continuous surrogate data were unavailable for short periods, loads were computed using the flow and seasonality models. Prediction intervals for all loads were calculated using results from both models. These results provide a better understanding of short-term variability and long-term changes in loading affecting the environmental health of the Great Lakes than traditional regression techniques that employ only flow and seasonality parameters.

（来源：JOURNAL OF GREAT LAKES RESEARCH, 2018, 44(1): 26-42）

Greenhouse gas emissions from diverse Arctic Alaskan lakes are dominated by young carbon

Clayton D. Elder; Xiaomei Xu; Jennifer Walker; et al.

Climate-sensitive Arctic lakes have been identified as conduits for ancient permafrost-carbon (C) emissions and as such accelerate warming. However, the environmental factors that control emission pathways and their sources are unclear; this complicates upscaling, forecasting and climate-impact-assessment efforts. Here we show that current whole-lake CH_4 and CO_2 emissions from widespread lakes in Arctic Alaska primarily originate from organic matter fixed within the past 3–4 millennia (modern to 3,300 ± 70 years before the present), and not from Pleistocene permafrost C. Furthermore, almost 100% of the annual diffusive C flux is emitted as CO_2. Although the lakes mostly processed younger C (89 ± 3% of total C emissions), minor contributions from ancient C sources were two times greater in fine-textured versus coarse-textured Pleistocene sediments, which emphasizes the importance of the underlying geological substrate in current and future emissions. This spatially extensive survey considered the environmental and temporal variability necessary to monitor and forecast the fate of ancient permafrost C as Arctic warming progresses.

（来源：Nature Climate Change, 2018, doi:10.1038/s41558-017-0066-9）

Anaerobic digestion of 30-100-year-old boreal lake sedimented fibre from the pulp industry: Extrapolating methane production potential to a practical scale

Kokko, Marika; Koskue, Veera; Rintala, Jukka

Since the 1980s, the pulp and paper industry in Finland has resulted in the accumulation of fibres in lake sediments. One such site in Lake Nasijarvi contains approximately 1.5 million m(3) sedimented fibres. In this study, the methane production potential of the sedimented fibres (on average 13% total solids (TS)) was determined in batch assays. Furthermore, the methane production from solid (on average 20% TS) and liquid fractions of sedimented fibres after solid -liquid separation was studied. The sedimented fibres resulted in fast methane production and high methane yields of 250 +/- 80 L CH_4/kg volatile solids (VS). The main part (ca. 90%) of the methane potential was obtained from the solid fraction of the sedimented fibres. In addition, the VS removal from the total and solid sedimented fibres was high, 61-65% and 63-78%, respectively. The liquid fraction also contained a large amount of organics (on average 8.8 g COD/L), treatment of which also has to be considered. The estimations of the methane production potentials in the case area showed potential up to 40 million m(3) of methane from sedimented fibres.

（来源：WATER RESEARCH, 2018,133: 218-226）

Modelling ROS formation in boreal lakes from interactions between dissolved organic matter and absorbed solar photon flux

Wolf, Raoul; Thrane, Jan-Erik; Hessen, Dag Olav; et al.

Concentrations of dissolved organic matter (DOM) are increasing in a large number of lakes across the Northern hemisphere. This browning serves a dual role for biota by protecting against harmful ultraviolet radiation, while also absorbing photosynthetically active radiation. The photochemical activation of DOM and subsequent formation of reactive oxygen species (ROS) is a potentially harmful side effect, but can be difficult to measure directly in situ. In this study, we combine a data set of physico-chemical properties from 71 Nordic lakes with in vitro ROS formation quantum yields to predict ROS formations across a representative boreal ecosystem gradient. For the upper centimeter of the water column, we calculate ROS formations in the range of 7.93-12.56 mu mol L-1 h(-1). In the first meter, they range between 1.69 and 6.69 mu mol L-1 h(-1) and in the remaining depth the range is 0.01-0.46 mu mol L-1 h(-1). These ROS formations are comparable with previously field-measured hydrogen peroxide formation rates and likely affect both phyto- and zooplankton, as well as lake chemistry. Interestingly, wavelengths of the visible spectrum (>400 nm) contribute more than half of the overall ROS formation in surface-near water layers. The association between DOM and ROS formation was found to be two-fold. While DOM promotes ROS formation in the first centimeters of the water column, the shading effect of light attenuation overpowers this with increasing depth. In the context of water browning, our results indicate the emergence of an underestimated oxidative stress environment for lake biota in the upper centimeters of the water column.

（来源：WATER RESEARCH, 2018, 132:331-339）

The potential of Earth Observation in modelling nutrient loading and water quality in lakes of southern Quebec, Canada

Politi, Eirini; Prairie, Yves T

Phosphorus and nitrogen are key nutrients that affect abundance and growth of aquatic primary producers but cannot be directly remotely sensed as their dissolved or organic forms do not interact with the remote sensing signal. In addition, other lake water quality variables such as chlorophyll a and Secchi disk depth, have been previously successfully estimated with remote sensing, but the retrieval algorithms are site-, season-, and/or scene-specific. Such algorithms do not take into account lake typological features, which can affect the sensitivity of lake to change, or catchment characteristics, for example, land cover that is a major driver of lake water quality change. Here we propose a novel approach that utilises remotely sensed land cover information in the catchment to estimate phosphorus, nitrogen and chlorophyll a concentrations in lake waters. We use land cover type-specific nutrient export coefficients and the NASA MODIS (Moderate Resolution Imaging Spectroradiometer) Land Cover Type product showing that nutrient loading based on remote sensing can explain up to 75% of variability in lake nutrient concentrations and 58% of variability in lake chlorophyll a concentrations. In addition, we show that land cover information, supplemented by satellite measurements and lake morphometry data are good predictors of chlorophyll a (R-2 = 0.77) and Secchi disk depth (R-2 = 0.87) in lakes with different trophic statuses and in different months and years.

（来源：AQUATIC SCIENCES, 2018, 80(1): UNSP8）

Optical properties and composition changes in chromophoric dissolved organic matter along trophic gradients: Implications for monitoring and assessing lake eutrophication

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

Chromophoric dissolved organic matter (CDOM) is an important optically active substance in aquatic environments and plays a key role in light attenuation and in the carbon, nitrogen and phosphorus biogeochemical cycles. Although the optical properties, abundance, sources, cycles, compositions and remote sensing estimations of CDOM have been widely reported in different aquatic environments, little is known about the optical properties and composition changes in CDOM along trophic gradients. Therefore, we collected 821 samples from 22 lakes along a trophic gradient (oligotrophic to eutrophic) in China from 2004 to 2015 and determined the CDOM spectral absorption and nutrient concentrations. The total nitrogen (TN), total phosphorus (TP), and chlorophyll a (Chla) concentrations and the Secchi disk depth (SDD) ranged from 0.02 to 24.75 mg/L, 0.002-3.471 mg/L, 0.03-882.66 mu g/L, and 0.05 -17.30 m, respectively. The trophic state index (TSI) ranged from 1.55 to 98.91 and covered different trophic states, from oligotrophic to hyper-eutrophic. The CDOM absorption coefficient at 254 nm (a(254)) ranged from 1.68 to 92.65 m(-1). Additionally, the CDOM sources and composition parameters, including the spectral slope and relative molecular size value, exhibited a substantial variability from the oligotrophic level to other trophic levels. The natural logarithm value of the CDOM absorption, lna(254), is highly linearly correlated with the TSI (r(2) = 0.92, p < .001, n = 821). Oligotrophic lakes are distinguished by a(254)<4 m(-1), and mesotrophic and eutrophic lakes are classified as 4 <= a(254)<= 10 and a(254) >10 m(-1), respectively. The results suggested that the CDOM absorption coefficient a(254) might be a more sensitive single indicator of the trophic state than TN, TP, Chla and SDD. Therefore, we

proposed a CDOM absorption coefficient and determined the threshold for defining the trophic state of a lake. Several advantages of measuring and estimating CDOM, including rapid experimental measurements, potential in situ optical sensor measurements and large-spatial-scale remote sensing estimations, make it superior to traditional TSI techniques for the rapid monitoring and assessment of lake trophic states.

（来源：WATER RESEARCH, 2018, 131: 255-263）

Simulation of photoreactive transients and of photochemical transformation of organic pollutants in sunlit boreal lakes across 14 degrees of latitude: A photochemical mapping of Sweden

Koehler, Birgit; Barsotti, Francesco; Minella, Marco; et al.

Lake water constituents, such as chromophoric dissolved organic matter (CDOM) and nitrate, absorb sunlight which induces an array of photochemical reactions. Although these reactions are a substantial driver of pollutant degradation in lakes they are insufficiently understood, in particular on large scales. Here, we provide for the first time comprehensive photochemical maps covering a large geographic region. Using photochemical kinetics modeling for 1048 lakes across Sweden we simulated the steady-state concentrations of four photoreactive transient species, which are continuously produced and consumed in sunlit lake waters. We then simulated the transient-induced photochemical transformation of organic pollutants, to gain insight into the relevance of the different photoreaction pathways. We found that boreal lakes were often unfavorable environments for photoreactions mediated by hydroxyl radicals (center dot OH) and carbonate radical anions (CO3-center dot), while photoreactions mediated by CDOM triplet states ((CDOM)-C-3*) and, to a lesser extent, singlet oxygen (O-1(2)) were the most prevalent. These conditions promote the photodegradation of phenols, which are used as plastic, medical drug and herbicide precursors. When CDOM concentrations increase, as is currently commonly the case in boreal areas such as Sweden, (CDOM)-C-3* will also increase, promoting its importance in photochemical pathways even more.

（来源：WATER RESEARCH, 2018, 129: 94-104）

Magnetite/Lanthanum hydroxide for phosphate sequestration and recovery from lake and the attenuation effects of sediment particles

Fang, Liping; Liu, Ru; Li, Ji; et al.

An effective approach for eutrophication control and phosphate recovery remains a longstanding challenge. Herein, we present a new technique for phosphate sequestration in lake and phosphate recovery using novel magnetically recoverable magnetite/lanthanum hydroxide [M-La(OH)(3)] hybrids that can be prepared using a simple one-pot synthesis method. Batch studies show that M-La(OH)(3) exhibits a strong sorption towards phosphate with sorption capacities of up to 52.7 mg-Pig at pH 7.0 in water. A simple model indicates that the efficiency of M-La(OH)(3) for phosphate sequestration in lake is significantly attenuated by 34-45% compared to that in water, due to interference from sediment particles. However, our results demonstrate that sediments suspensions mixed with a M-La(OH)(3) content of 1-3% exhibit a capability of up to 1.2 mg-Pig for sequestering external phosphate compared with that of 0.2 mg-Pig for pristine sediment at pH 7.3. M-La(OH)(3)-mixed sediment suspensions appear to effectively

sequester phosphate over an environmentally relevant pH range from 4 to 8.5. Phosphorus (P) fractionation experiments indicate that the enhanced phosphate sorption by M-La(OH)(3)-mixed sediment suspensions is mainly due to the increased fractions of NaOH-P and inorganic P. This work indicates that the M-La(OH)(3) has the potential for phosphate sequestration and recovery from lake.

（来源：WATER RESEARCH, 2018, 130: 243-254）

Coupled simulation of high-frequency dynamics of dissolved oxygen and chlorophyll widens the scope of lake metabolism studies

Istvanovics, Vera; Honti, Mark .

High frequency time series of dissolved oxygen (DO), delayed chlorophyll fluorescence (Chl) and relevant background variables were recorded on nearly 900 d during 7 yr in large, shallow, meso-eutrophic Lake Balaton (Hungary). Novel models were developed for coupled simulation of diel dynamics of DO and Chl using sequential learning and uncertainty assessment in a Bayesian framework. Despite the generally good model fit for both variables, the uncertainty of the metabolic estimates was high, due primarily to the identification problem of individual metabolic processes. Deviations between observed and simulated DO concentrations suggested that neglect of transient stratification might be responsible for the bulk of the systematic model errors. Net ecosystem production (NEP) was uncertain. Unless air-water oxygen exchange can be estimated from direct measurements, the free-water DO method cannot reliably estimate NEP. Gross primary production (GPP) could satisfactorily be hindcasted assuming non-linear multiplicative dependence on Chl, water temperature and light. Hindcast of community respiration (CR) was less successful, possibly due to the impact of local benthic respiration. Results suggested a major shift in lake metabolism at about 16 degrees C. Below and above this temperature, 70% and 90% of net primary production could be utilized by heterotrophs within a day, respectively. Indirect evidence suggested that biomass-specific net primary production was determined by phosphorus. The large difference between reproductive rates and net growth rates estimated from GPP and Chl and from daily change in Chl, respectively indicated that loss rates of phytoplankton were as important determinants of algal dynamics as reproductive rates.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2018, 63(1): 72-90）

Patterns and controls of mercury accumulation in sediments from three thermokarst lakes on the Arctic Coastal Plain of Alaska

Burke, S. M.; Zimmerman, C. E.; Branfireun, B. A.; et al.

The biogeochemical cycle of mercury will be influenced by climate change, particularly at higher latitudes. Investigations of historical mercury accumulation in lake sediments inform future predictions as to how climate change might affect mercury biogeochemistry; however, in regions with a paucity of data, such as the thermokarst-rich Arctic Coastal Plain of Alaska (ACP), the trajectory of mercury accumulation in lake sediments is particularly uncertain. Sediment cores from three thermokarst lakes on the ACP were analyzed to understand changes in, and drivers of, Hg accumulation over the past similar to 100 years. Mercury accumulation in two of the three lakes was variable and high over the past century (91.96 and 78.6 mu g/m(2)/year), and largely controlled by sedimentation rate. Mercury accumulation in the third lake was lower (14.2 mu g/m(2)/year), more temporally uniform, and was more strongly related to

sediment Hg concentration than sedimentation rate. Sediment mercury concentrations were quantitatively related to measures of sediment composition and VRS-inferred chlorophyll a, and sedimentation rates were related to various catchment characteristics. These results were compared to data from 37 previously studied Arctic and Alaskan lakes. Results from the meta-analysis indicate that thermokarst lakes have significantly higher and more variable Hg accumulation rates than non-thermokarst lakes, suggesting that certain properties (e.g., thermal erosion, thaw slumping, low hydraulic conductivity) likely make lakes prone to high and variable Hg accumulation rates. Differences and high variability in Hg accumulation among high latitude lakes highlight the complexity of predicting future climate-related change impacts on mercury cycling in these environments.

（来源：AQUATIC SCIENCES, 2018, 80(1):UNSP1）

Long-Term Phosphorus Loading and Springtime Temperatures Explain Interannual Variability of Hypoxia in a Large Temperate Lake

Del Giudice, Dario; Zhou, Yuntao; Sinha, Eva; et al.

Anthropogenic eutrophication has led to the increased occurrence of hypoxia in inland and coastal waters around the globe. While low dissolved oxygen conditions are known to be driven primarily by nutrient loading and water column stratification, the relative importance of these factors and their associated time scales are not well understood. Here, we explore these questions for Lake Erie, a large temperate lake that experiences widespread annual summertime hypoxia. We leverage a three-decade data set of summertime hypoxic extent (1985-2015) and examine the role of seasonal and long-term nutrient loading, as well as hydrometeorological conditions. We find that a linear combination of decadal total phosphorus loading from tributaries and springtime air temperatures explains a high proportion of the interannual variability in average summertime hypoxic extent (R-2 = 0.71). This result suggests that the lake responds primarily to long-term variations in phosphorus inputs, rather than springtime or annual loading as previously assumed, which is consistent with internal phosphorus loading from lake sediments likely being an important contributing mechanism. This result also demonstrates that springtime temperatures have a substantial impact on summertime hypoxia, likely by impacting the timing of onset of thermal stratification. These findings imply that management strategies based on reducing tributary phosphorus loading would take several years to reap full benefits, and that projected future increases in temperatures are likely to exacerbate hypoxia in Lake Erie and other temperate lakes.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2018, 52(4): 2046-2054）

Age-Corrected Trends and Toxic Equivalence of PCDD/F and CP-PCBs in Lake Trout and Walleye from the Great Lakes: 2004-2014

Pagano, James J.; Garner, Andrew J.; McGoldrick, Daryl J.; et al.

Our research reports polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and coplanar polychlorinated biphenyls (CP-PCBs) concentrations and age-corrected trends for lake trout and walleye in the Great Lakes over the 2004-2014 period. We determined that age-contaminant corrections are required to accurately report contaminant trends due to significant lake trout age structure changes. The age-trend model (ATM) described here uses a lake-specific age-contaminant regression to mitigate the effect of a fluctuating lake trout age structure to directly

improve the log-linear regression model. ATM results indicate that half-life (t(1/2)) and percent decreases for PCDD/Fs, CP-PCBs, and toxic equivalence (TEQ) (average -56 to 70%) were fairly uniform and consistent across the Great Lakes over the 2004-2014 period. The vast majority of TEQ associated with all Great Lakes lake trout and walleye samples is due to the nonortho CP-PCBs (average = 79%) as compared with PCDD/Fs (average = 21%). On average, CP-PCB_126 individually accounted for over 95% of the total CP-PCB TEQ. A retrospective analysis (1977-2014) of 2378-TCDF and 2378-TCDD raw concentrations in Lake Ontario lake trout revealed decreases of 94% and 96%, respectively. Tissue residue guidelines for wildlife protection based on lake trout and walleye total TEQ were uniformly exceeded in all the Great Lakes.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2018, 52(2): 712-721）

青藏高原中部纳木错流域孢粉多样性的时空变化及其对高寒植被恢复的启示

李泉

孢粉多样性可为植物多样性和植被变化历史的研究提供诸多线索。目前青藏高原地区尚未有现代孢粉多样性和过去植物多样性变化的研究。基于青藏高原中部纳木错流域的 37 个表土和 63 个湖泊表层沉积物孢粉组合，利用 Shannon-Wiener 指数(H)和孢粉丰富度指数(E(T600))定量构建了该地区现代孢粉多样性的空间分布格局。结果显示，不同植被类型孢粉多样性指数的差异反映了流域内植物多样性的空间变化。东南部高寒草原区域的孢粉多样性较高，在高寒草甸和沼泽草甸植被区域则较低。湖泊表层沉积物孢粉组合主要来自于流域内高寒草原植被和山地垂直植被带。因而纳木错沉积物记录的孢粉多样性可以有效的反映过去植物多样性的变化。通过纳木错 NMLC-1 孔化石孢粉组合，重建出过去 8400 年以来当地植物多样性经历了逐渐上升的长期变化，并发生过多期快速变化事件。这主要受控于气候持续变冷驱动下山地垂直植被带的向下迁移。青藏高原中部与纳木错流域面临着气候变暖与植被退化等环境问题的挑战，该地区高寒植被恢复工作应重视山地垂直植被带和地带性高寒草原植被，并从植物多样性的长期变化历史中寻找参照。

（来源：中国科学：地球科学 2018, 48(3): 315-330）

Natural and anthropogenic forcing of Holocene lake ecosystem development at Lake Uddelermeer (The Netherlands)

Engels, Stefan; van Oostrom, Rogier; Cherli, Chiara; et al.

Lake Uddelermeer (The Netherlands) is characterized by turbid conditions and annual blooms of toxic cyanobacteria, which are supposed to be the result of increased agricultural activity in the twentieth century AD. We applied a combination of classic palaeoecological proxies and novel geochemical proxies to the Holocene sediment record of Lake Uddelermeer (The Netherlands) in order to reconstruct the natural variability of the lake ecosystem and to identify the drivers of the change to the turbid

conditions that currently characterize this lake. We show that the lake ecosystem was characterized by a mix of aquatic macrophytes and abundant phytoplankton between 11,500 and 6000 cal year BP. A transition to a lake ecosystem with clear-water conditions and relatively high abundances of 'isoetids' coincides with the first signs of human impact on the landscape around Lake Uddelermeer during the Early Neolithic (ca. 6000 cal year BP). An abrupt and dramatic ecosystem shift can be seen at ca. 1030 cal year BP when increases in the abundance of algal microfossils and concentrations of sedimentary pigments indicate a transition to a turbid phytoplankton-dominated state. Finally, a strong increase in concentrations of plant and faecal biomarkers is observed around 1950 AD. Canonical Correspondence Analysis suggests that reconstructed lake ecosystem changes are best explained by environmental drivers that show long-term gradual changes (sediment age, water depth). These combined results document the long-term anthropogenic impact on the ecosystem of Lake Uddelermeer and provide evidence for pre-Industrial Era signs of eutrophication.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2018, 59(3): 329-347）

Context-dependent interactions and the regulation of species richness in freshwater fish

Andrew S. MacDougall; Eric Harvey; Jenny L. McCune; et al.

Species richness is regulated by a complex network of scale-dependent processes. This complexity can obscure the influence of limiting species interactions, making it difficult to determine if abiotic or biotic drivers are more predominant regulators of richness. Using integrative modeling of freshwater fish richness from 721 lakes along an 11° latitudinal gradient, we find negative interactions to be a relatively minor independent predictor of species richness in lakes despite the widespread presence of predators. Instead, interaction effects, when detectable among major functional groups and 231 species pairs, were strong, often positive, but contextually dependent on environment. These results are consistent with the idea that negative interactions internally structure lake communities but do not consistently ‘scale-up’ to regulate richness independently of the environment. The importance of environment for interaction outcomes and its role in the regulation of species richness highlights the potential sensitivity of fish communities to the environmental changes affecting lakes globally.

（来源：Nature Communications, 2018, doi:10.1038/s41467-018-03419-1）

Human-mediated and natural dispersal of an invasive fish in the eastern Great Lakes

Mattias L. Johansson; Bradley A. Dufour; Kyle W. Wellband; et al.

The globally invasive Round Goby (Neogobius melanostomus) was introduced to the Great Lakes around 1990, spreading widely and becoming the dominant benthic fish in many areas. The speed and scope of this invasion is remarkable and calls into question conventional secondary spread models and scenarios. We utilized nine microsatellites to identify large-scale genetic structure in Round Goby populations in the eastern Great Lakes, and assessed the role of colonization vs. secondary transport and dispersal in developing this structure. We identified three clusters, corresponding with Lake Huron, eastern Lake Erie, and western Lake Erie plus eastern Lake Ontario, along with three highly divergent populations. Bottleneck analysis identified founder effects in two divergent populations. Regression

analyses of isolation by distance and allelic richness vs. distance from the initial invasion site were consistent with limited migration. However, some populations in eastern Lake Erie and Lake Ontario showed anomalously low genetic distance from the original site of colonization, consistent with secondary transport of large numbers of individuals via ballast water. We conclude that genetic structure of Round Goby in the Great Lakes principally resulted from long-distance secondary transport via ballast water with additional movement of individual via bait buckets and natural dispersal. The success of Round Gobies represents an interesting model for colonization characterization; however, those same attributes present significant challenges for conservation and fisheries management. Current management likely prevents many new species from arriving in the Great Lakes, but fails to address the transport of species within the lakes after they arrive; this is an issue of clear and pressing importance.

（来源：Heredity, 2018, doi:10.1038/s41437-017-0038-x）

Pelagic zonation of water quality and phytoplankton in the Great Lakes

Cai, Meijun; Reavie, Euan D.

Analysis of aquatic ecosystem data collected from large water bodies must consider spatial variations. A suite of pelagic survey stations exists for the Laurentian Great Lakes, but little is known about their redundancy. We present a strategy to delineate the lakes into zones based on water quality and phytoplankton biovolume. Water samples were collected from 72 sites in two seasons (spring and summer) from 2007 to 2010 in all five lakes. Integrated samples were analyzed for phytoplankton biovolume and nine water quality parameters. We conducted cluster analysis, principal components analysis and non-metric multidimensional scaling methods for water quality and phytoplankton taxon-specific biovolume for the Great Lakes basin and for each lake separately. There were significant lake-to-lake differences, and based on lake-specific analyses, Lake Superior, Lake Michigan and Lake Erie were each divided into three zones; Lake Huron and Lake Ontario were each grouped into two zones. The zones identified by water quality and phytoplankton provide an understanding of spatial distributions for evaluating monitoring data.

（来源：LIMNOLOGY, 2018, 19(1): 127-140）

A mesocosm investigation of the effects of quagga mussels (Dreissena rostriformis bugensis) on Lake Michigan zooplankton assemblages

Whitten, Andrya L.; Jarrin, Jose R. Marin; McNaught, A. Scott

Dreissenid mussels are known to disrupt the base of the food web by filter feeding on phytoplankton; however, they may also directly ingest zooplankton thereby complicating their effects on plankton communities. The objective of this study was to quantify the effects of quagga mussel feeding on the composition and size structure of Lake Michigan zooplankton assemblages. Two mesocosm (six 946 L tanks) experiments were conducted in summer 2013, using quagga mussels and zooplankton collected near Beaver Island, MI, to examine the response of zooplankton communities to the presence and absence of mussels (experiment 1) and varying mussel density (experiment 2). Mesocosms were sampled daily and zooplankton taxa were enumerated and sized using microscopy and FlowCAM (R) imaging. In experiment 1, the presence of quagga mussels had a rapid negative effect on veliger and copepod nauplii abundance, and a delayed negative effect on rotifer abundance. In experiment 2, mussel

density had a negative effect on veliger, nauplii, and copepodite abundance within 24 h. Multivariate analyses revealed a change in zooplanlcton community composition with increasing mussel density. Ten zoo plankton taxa decreased in abundance and frequency as quagga mussel density increased: except for the rotifer Trichocerca sp., treatments with higher mussel densities (i.e., 1327,3585, and 5389 mussels/m(2)) had the greatest negative effect on small-bodied zooplankton (<= 128 mu m). This study confirms results from small-scale (<= 1 L) experiments and demonstrates that quagga mussels can alter zooplankton communities at mesoscales (similar to 1000 L), possibly through a combination of direct consumption and resource depletion.

（来源：JOURNAL OF GREAT LAKES RESEARCH, 2018, 44(1): 105-113）

From isolation to connectivity: the effect of floodplain lake restoration on sediments as habitats for macroinvertebrate communities

Obolewski, Krystian; Glinska-Lewczuk, Katarzyna; Bakowska, Martyna

The present study aimed to identify potential macrozoobenthic habitat indicators of the ecological success of restoration projects. As a part of the complex restoration project in the Slupia River floodplain (N Poland), the connectivity between three oxbow lakes and the river channel was re-established to improve biodiversity of the floodplain area, including bottom fauna. Following restoration, changes in the dynamics of flowing water and water levels induced the transformation of oxbows from plesiopotamal (lentic) to eupotamal (lotic) and subsequently to parapotamal (semi-lotic) habitats. The restored sites underwent a rapid depletion of benthic coarse particulate organic matter, with direct changes in most of the investigated parameters of bottom sediments, including conductivity, total organic carbon, soluble reactive phosphorus and total nitrogen. Redundancy analysis revealed that the changes in benthic fauna structure resulted from the increased connectivity with the river (flow rate) and changes in the chemical properties of sediments. The restored oxbow lakes were colonized by six new macroinvertebrate species whose density increased substantially. The assessment of the overall river-floodplain system restoration project indicated positive implications for improving the qualitative and quantitative structure of benthic fauna. However, to confirm ecologically successful restoration, it is necessary to evaluate appropriate sets of indicators based on a complex food web structure and more efficient or enhanced ecosystem functions. This study contributes to the discussion of sustainable management of floodplains to provide benefits to macroinvertebrates as indicators of aquatic ecosystem health under different restoration activities.

（来源：AQUATIC SCIENCES, 2018, 80(1): UNSP4）

Metabarcoding of lake benthic diatoms: from structure assemblages to ecological assessment

Rivera, S. F.; Vasselon, V.; Jacquet, S.; et al.

Benthic diatoms are relevant indicators of the ecological status of the littoral zone of lakes. Their use as bio-indicators is based on their morphological identification at species level using microscopy which is time consuming, requires taxonomic expertise, and is consequently expensive. To overcome these limitations, a molecular approach for diatom identification has been tested with success in rivers. DNA metabarcoding enables species identification from a standardized DNA barcode and high-throughput

sequencing (HTS), using DNA reference library. The suitability of the morphological and molecular approaches to assess the diatom community structure and the ecological status of the littoral zone of the largest deep lake in France (Lake Bourget) was compared. 66 sites were sampled in August 2015 along the shoreline, all around the lake. The composition of diatom assemblages was similar with both morphological and molecular approaches, and diatom assemblages were structured by the same environmental factors. However, the ecological status of Lake Bourget differed significantly among approaches since floristic inventories to species level also differed significantly. The main source of this difference was the incompleteness of the DNA reference library. Nevertheless, in a near future, when this constraint will be solved, the use of DNA metabarcoding for biomonitoring purposes seems promising.

（来源：HYDROBIOLOGIA, 2018, 807 (1): 37-51）

Cultivation and genomics of the first freshwater SAR11 (LD12) isolate

Michael W. Henson; V. Celeste Lanclos; Brant C. Faircloth; et al.

Evolutionary transitions between fresh and salt water happen infrequently among bacterioplankton. Within the ubiquitous and highly abundant heterotrophic Alphaproteobacteria order Pelagibacterales (SAR11), most members live in marine habitats, but the LD12 subclade has evolved as a unique freshwater lineage. LD12 cells occur as some of the most dominant freshwater bacterioplankton, yet this group has remained elusive to cultivation, hampering a more thorough understanding of its biology. Here, we report the first successful isolation of an LD12 representative, strain LSUCC0530, using high-throughput dilution-to-extinction cultivation methods, and its complete genome sequence. Growth experiments corroborate ecological data suggesting active populations of LD12 in brackish water up to salinities of ~5. LSUCC0530 has the smallest closed genome thus far reported for a SAR11 strain (1.16 Mbp). The genome affirms many previous metabolic predictions from cultivation-independent analyses, like a complete Embden–Meyerhof–Parnas glycolysis pathway, but also provides novel insights, such as the first isocitrate dehydrogenase in LD12, a likely homologous recombination of malate synthase from outside of the SAR11 clade, and analogous substitutions of ion transporters with others that occur throughout the rest of the SAR11 clade. Growth data support metagenomic recruitment results suggesting temperature-based ecotype diversification within LD12. Key gene losses for osmolyte uptake provide a succinct hypothesis for the evolutionary transition of LD12 from salt to freshwater. For strain LSUCC0530, we propose the provisional nomenclature Candidatus fonsibacter ubiquis.

（来源：The ISME Journal, 2018, doi:10.1038/s41396-018-0092-2）

Bacterial and Fungal Community Composition and Functional Activity Associated with Lake Wetland Water Level Gradients

Yantian Ma, Jinqian Li, Juan Wu, et al.

The water regime is often the primary force driving the evolution of freshwater lakes, but how soil microbes responded to this process is far from understood. This study sampled wetland soils from a shallow lake that experienced water regime changes, Poyang Lake of China, to explore the features of bacterial and fungal community in response to water level changes. The soil physicochemical properties, T-RFLP based community structures and soil activities (including basal respiration, microbial biomass and enzymes) were all determined. Soil microbial eco-function was captured by testing the carbon

metabolism with Biolog-Ecoplate. The results showed remarkable influence of the water level gradients on the soil physicochemical properties, microbial community structures and soil activities. However, the carbon utilization profile exhibited weak connections with the environmental variables and microbial community structures ($p > 0.05$). The microbial activities were significantly correlated with both bacterial and fungal community structures. Our results also emphasized the ascendant role of the deterministic process in the assemblages of microbial community structures and functions in wetland. In conclusion, this study revealed the discrepancy between community structures and eco-functions in response to water level gradients, and a relatively stable eco-function helped to maintain the ecosystem function of wetland from a long-term perspective.

（来源：Scientific Reports, 2018, doi:10.1038/s41598-018-19153-z）

Factors affecting annual occurrence, bioaccumulation, and biomagnification of polycyclic aromatic hydrocarbons in plankton food webs of subtropical eutrophic lakes

Tao, Yuqiang; Yu, Jing; Liu, Xingrong; et al.

The biological pump plays a critical role in the occurrence and fate of hydrophobic organic contaminants (HOCs) mostly in temperate and frigid oligotrophic waters. However, the factors for the long-term occurrence and fate of HOCs in subtropical eutrophic waters remain largely unknown. This study provides novel insights into biogeochemical and physical factors on the annual occurrence, bioaccumulation, and biomagnification of 16 polycyclic aromatic hydrocarbons (PAHs) in the plankton food webs of four Chinese subtropical eutrophic lakes by one-year simultaneous field observations for five compartments. The annual mean Sigma PAH(16) in the water columns ranged from 359.69 +/- 31.52 ng L-1 to 682.69 +/- 65.41 ng L-1, and increased with the annual mean trophic state index, and phytoplankton biomass of these lakes, but was independent on the proximity of the lakes to urban areas. Biodilution effect played an important role in the occurrence of the PAHs in both phytoplankton and zooplankton. In contrast to previous studies in oligotrophic waters, not only the biological pump but also the equilibrium partitioning and the indirect influence of eutrophication (high pH induced by phytoplankton, and phytoplankton life cycling) modulated the annual occurrence of the PAHs in the water columns of these eutrophic lakes. Biphasic correlations were found between the bioaccumulation factors of the PAHs by plankton and the temperature (n = 97-136, R-2 = 0.06-0.24, p <= .008), and were related to plankton phenology. Bioaccumulation factors by plankton were dependent on the hydrophobicity of the PAHs (n = 16, R-2 = 0.27-031, p <= .023), and decreased with plankton biomass (n = 94-103, R-2 = 0.09-0.27, p <= .010). Trophic transfer of the PAHs from phytoplankton to zooplankton increased with phytoplankton biomass (n = 26, R-2 = 0.27, p = .004), and the temperature (n = 102-135, R-2 = 0.06-0.13, p <= .004), but decreased with lake trophic state index. Biomagnification only occurred during phytoplankton bloom periods.

（来源：WATER RESEARCH, 2018, 132:1-11）

Spatial structure and beta-diversity of phytoplankton in Tibetan Plateau lakes: nestedness or replacement?

Yang, Yang; Hu, Ren; Lin, Qiuqi; et al.

Spatial patterns and beta-diversity of phytoplankton assemblages depend on the relative importance of species dispersal capacity and species-sorting. Variability in species composition, composed by differences in species richness (nestedness) and/or species replacement, may be caused by niche availability and environmental selection. A field survey was carried out in Tibetan plateau on 38 lakes. Tibetan plateau lakes, located at high elevation, are harsh ecosystems characterized by low temperatures, low available nutrients, high UV amount, and strong salinity gradients. Only well-adapted species can survive in these environments. We therefore hypothesized that environmental filtering was the main factor determining phytoplankton assemblage structure in these lakes, and that species nestedness largely contributed to beta-diversity. Spatial analysis showed that both environmental variables and broad-scale spatial variables accounted for the variation of phytoplankton assemblages. In particular, phytoplankton was mainly shaped by spatially structured environmental heterogeneity, which resulted in low alpha-diversity and high beta-diversity. In contrast to our assumption, species turnover contributed to the majority of beta-diversity of the studied assemblages. Local environments selected species with the corresponding stress-tolerant traits. Within the narrow range of available niches, environmental filtering of phytoplankton traits induced species' replacement along environmental gradients.

（来源：HYDROBIOLOGIA，2018，808(1)：301-314）

Macrophyte-induced thermal stratification in a shallow urban lake promotes conditions suitable for nitrogen-fixing cyanobacteria

Vilas, M. P.; Marti, C. L.; Oldham, C. E.; et al.

Densely vegetated shallow lakes often experience low water column nutrient levels and reduced phytoplankton growth, but in some cases a high phytoplankton biomass can co-exist with submerged macrophytes. The conditions that favour phytoplankton blooms within areas colonized by submerged macrophytes remain largely unexplored. We investigated changes in water quality variables and phytoplankton community composition data in relation to macrophyte-induced thermal stratification in a shallow urban lake. The results indicate that submerged macrophytes may favour internal loadings of phosphorus and low DIN:TP ratios, in periods when macrophyte-induced thermal stratification of the water column is common. Blooms of nitrogen-fixing cyanobacteria occurred under the strongly stratified conditions triggered by the high macrophyte biomass and elevated canopy, even though nitrogen limitation was apparent during the whole growing season. These findings suggest that submerged macrophytes can promote blooms of nitrogen-fixing cyanobacteria once they are sufficiently tall and dense to induce stable water column conditions.

（来源：HYDROBIOLOGIA，2018，806(1)：411-426）

Revealing biotic and abiotic controls of harmful algal blooms in a shallow subtropical lake through statistical machine learning

Nelson, Natalie Genevieve; Munoz-Carpena, Rafael; Phlips, Edward J; et al.

Harmful algal blooms are a growing human and environmental health hazard globally. Eco-physiological diversity of the cyanobacteria genera that make up these blooms creates challenges for water managers tasked with controlling the intensity and frequency of blooms, particularly of harmful taxa (e.g., toxin

producers, N_2 fixers). Compounding these challenges is the ongoing debate over the efficacy of nutrient management strategies (phosphorus-only versus nitrogen and phosphorus), which increases decision-making uncertainty. To help improve our understanding of how different cyanobacteria respond to nutrient levels and other biophysical factors, we analyzed a unique 17-year dataset comprising monthly observations of cyanobacteria genera and zooplankton abundances, water quality, and flow a bloom-impacted, subtropical, flow-through lake in Florida (USA). Using the Random Forests machine learning algorithm, an assumption-free ensemble modeling approach, we characterized and quantified relationships among environmental conditions and five cyanobacteria genera: Anabaena, Cylindrospermopsis, Planktolyngbya, Microcystis, and Oscillatoria. Results highlighted nonlinear relationships and critical thresholds between cyanobacteria genera and environmental covariates, the potential for hydrology and temperature to limit the efficacy of cyanobacteria bloom management actions, and the importance of a dual nutrient management strategy for reducing bloom risk in the long-term.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2018, 52(6): 3527-3535）

Aerosol Emissions from Great Lakes Harmful Algal Blooms

May, Nathaniel W.; Olson, Nicole E.; Panas, Mark; et al.

In freshwater lakes, harmful algal blooms (HABs) of Cyanobacteria (blue-green algae) produce toxins that impact human health. However, little is known about the lake spray aerosol (LSA) produced from wave-breaking in freshwater HABs. In this study, LSA were produced in the laboratory from freshwater samples collected from Lake Michigan and Lake Erie during HAB and nonbloom conditions. The incorporation of biological material within the individual HAB-influenced LSA particles was examined by single-particle mass spectrometry, scanning electron microscopy with energy-dispersive X-ray spectroscopy, and fluorescence microscopy. Freshwater with higher blue-green algae content produced higher number fractions of individual LSA particles that contained biological material) showing that organic molecules of biological origin are incorporated in LSA from HABs. The number fraction of individual LSA particles containing biological material also increased with particle diameter (greater than 0.5 mu m), a size dependence that is consistent with previous studies of sea spray aerosol impacted by phytoplankton blooms. Similar to sea spray aerosol, organic carbon markers were most frequently observed in individual LSA particles less than 0.5 mu m in diameter. Understanding the transfer of biological material from freshwater to the atmosphere via LSA is crucial for determining health and climate effects of HABs.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2018, 52(2):397-405）

科技热点

CO_2 浓度升高对淡水关键物种水蚤产生不利影响

2018 年 1 月 11 日，《当代生物学》（Current Biology）期刊发表题为《淡水生态系统二氧化碳分压升高负面影响水蚤对捕食者的防御能力》（Rising pCO_2 in Fresh Water Ecosystems Has the Potentialto Negatively Affect Predator-induced Defenses in Daphnia）的文章显示，德国淡水生态系统二氧化碳（CO_2）分压稳定升高，淡水生态系统已被酸化，并且已导致淡水关键物种水蚤丧失对捕食者的感知。

随着大气中 CO_2 浓度的升高，更多的 CO_2 被海水吸收，海洋酸化愈演愈烈，导致海洋生物多样性、食物网、生产力等受到了重大影响。但目前，受生物地球化学过程复杂性的影响，在 CO_2 对淡水生态系统的影响方面，人们还知之甚少。

水蚤是一种微小的甲壳类生物，是淡水中的关键物种，是其他水生动物的食物来源。来自德国鲁赫大学（Ruhr-University）和鲁尔河协会（Ruhrverband）的研究人员分析了 1981—2015 年德国 4 个淡水水库的变化。结果显示，4 个水库的 CO_2 分压稳定升高，平均 pH 值降低了 0.3，证实了淡水酸化的存在。升高的 CO_2 分压，而不是降低的 pH 值通过阻碍淡水生态系统中关键物种水蚤神经元启动子的工作，使水蚤丧失了对捕食者的感知，已导致水蚤无法保护自己。淡水生态系统中 CO_2 分压升高对水蚤产生的影响预计将对淡水生态系统的食物网产生深远的影响。

原文来源：http://www.sciencedirect.com/science/article/pii/S096098221731655X

（来源：科学研究动态监测快报 2018-02-01，第3期总第237期）

8 亿年前蓝藻既能输氧还能固氮

每到夏季，太湖等湖泊就会发生“水华”，黄海海域也会暴发“赤潮”，蓝藻成为养殖和旅游业避之不及的“环境杀手”。但近日，中国科学院南京地质古生物研究所在安徽寿县发现8亿年前的“大型安徽丝藻”，为地球早期生物固氮提供了最早化石证据。相关成果于2月2日在线发表在《细胞》出版集团《当代生物学》杂志上。

蓝藻是地球上最古老、生存时间最长的生物门类之一，通过光合作用释放氧气。蓝藻还有不少具备固氮能力的种类。生物通常不能直接利用空气中的氮气，而某些特殊类型的蓝藻可以将空气中的氮气转化为生物可吸收利用的化合态氮。

在现生蓝藻中，有一种能进行固氮作用的结构被称为异形胞。因此具异形胞蓝藻是早期生物固氮的直接证据，然而它们的化石记录非常稀少且争议很大。

中科院南京地质古生物所早期生命研究团队庞科博士等发现的大型安徽丝藻为单列的丝体化石，并由一层薄的胞外胶鞘包裹。既能单独保存为丝体化石，亦能与

其他丝状化石一起形成底栖的微生物席。丝藻由多个细胞组成，部分营养细胞成对地出现，为横向二分裂产生的子细胞。对比现生蓝藻的结构，研究认为大型安徽丝藻是一种具异形胞的蓝藻化石，很可能起源于新元古代早期。大型安徽丝藻的发现，将最早可靠的具异形胞的蓝藻化石记录由泥盆纪（约4.1亿年前）向前推进到新元古代早期（10亿—7.2亿年前），提供了早期生物固氮的最早化石证据。

蓝藻的异形胞是为了应对氧气浓度上升、保护其中对氧气敏感的固氮酶而产生，因此大型安徽丝藻从生物学方面也证实了新元古代早期地球氧化还原环境的转变。

（来源：科技日报，2018-02-02）

《湖泊沉积物调查规范》出版

近日，由中国科学院南京地理与湖泊研究所范成新研究员主编的《湖泊沉积物调查规范》一书日前由科学出版社出版，来自我国湖泊沉积环境相关专业的20位科研人员参与了专著编写，沈吉、吴丰昌、周易勇等22位国内知名专家学者审阅了专著原稿。沉积物(包括底质、底泥、泥沙) 是主要环境介质之一，湖泊沉积物是湖泊流域物质的汇，积累着包括污染物在内的绝大多数物质。沉积物调查是野外研究沉积物的一种基本方法，它以地理学理论为指导，利用科学的方法，有目的、系统地收集能够反映与沉积物有关的环境时空分布状况的信息。对湖底沉积物的调查，是所有有关沉积物底质专业性研究和工程施工的必不可少工作，调查成果可以作为国民经济规划和环境治理方案的基础性资料，具有重要的实用价值。 规范是明文规定或约定俗成的标准，该书参考和总结了国内外相关明文规定或约定俗成的标准和成熟方法，同时也介绍了近年来在沉积物调查领域已得到应用的新方法和新技术，是一部关于湖泊沉积物勘察、测量、测定和分析规范的工具性参考书。全书共分四篇22章，按沉积物采集与处理、沉积物物理性质测量、沉积物化学性质测定、沉积物生物分析等顺序进行了系统介绍。该书可供从事湖泊，以及河流、河口、海洋和湿地等调查研究的科研人员、大专院校师生、工程技术人员和环保工作者等参考。

（来源：湖泊科学， 2018年第1期）

新型便携装置两秒检测水质

以色列初创企业Lishtot研发出一种名为TestDrop的便携式水质检测装置，通过检测杯中水引起的电场变化，并采用特殊算法分析这些变化，两秒内就可检测到水中有无大肠杆菌、铅、砷、汞、铜和氯等污染物。

该装置外形如钥匙扣，操作方法非常简单：用户只需将TestDrop指向水杯，蓝灯亮起则意味着水是完全干净的；红灯亮起则表明水受到了污染。

TestDrop可以通过蓝牙连接相关应用软件，用户可在手机里追踪自己的测试历史和数据，按瓶装水、自来水和来自河流与小溪内的天然水进行分类，并将测试结果连同污染图片和污染源位置，发送到Lishtot公司正在创建的全球水质地图上。

（来源：科技日报，2018-02-08）

集中式饮用水源地环保专项行动将开展

环境保护部2月24日宣布，将开展全国集中式饮用水水源地环境保护专项行动。环保部表示，近年来我国饮用水水源地环保工作取得积极进展，但一些地区水源地环境安全隐患依然突出。通过专项行动打好污染防治攻坚战，督促地方政府落实责任，着力消除饮用水水源地环境安全隐患等。

据悉，本次专项行动还将督查做好县级及以上城市集中式饮用水水源保护区的划定、立标和保护区内环境违法问题的整治工作，对长江经济带地级及以上城市饮用水水源地整治情况开展“回头看”，切实杜绝问题死灰复燃等。

除《全国集中式饮用水水源地环境保护专项行动方案》外，环保部还审议并原则通过了《“绿盾2018”国家级自然保护区监督检查专项行动方案》《2018年黑臭水体整治和城镇、园区污水处理设施建设专项行动方案》。力争将自然保护区建设管理中长期存在的痼疾逐个清除，运用约谈和督察手段，压实地方政府对自然保护区的监督管理责任；开展2018年黑臭水体整治和城镇、园区污水处理设施建设专项行动，解决老百姓身边突出环境问题、全面改善水环境质量，从根本上解决黑臭水体问题等。

（来源：科技日报，2018-02-26）

英国 PML 主持 450 万美元水域观测研究项目

2017年12月13日，普利茅斯海洋实验室（PML）宣布将主持一个450万美元的研究项目，以提高从卫星观测得到的关于沿海和内陆水域的认知。这项工作有助于提高对水质问题的观察，这可能对粮食资源、淡水供应和健康产生重大影响。

地球观测（EO）技术越来越多地用于提供水质信息和处理水资源管理问题，特别是在沿海和内陆水域。尽管在EO平台和传感器开发方面已经取得了巨大的进展（包括通过哥白尼项目的运营潜力），但在降低沿海和内陆水体的EO产品的不确定性方面仍然存在一些挑战。在公共卫生、农业、水产养殖、能源和食品安全、饮用水、生态系统和生物多样性保护、导航和娱乐用水等领域，对准确可靠信息的需求不断增长。然而，内陆和沿海水域却呈现出惊人的光学和环境多样性。地面参考测量被用来确认卫星的读数和开发改进的卫星产品，因此对使用卫星图像进行日常决

策至关重要。

它只需要大约10%的大型战略水体，在地面上安装传感器，以支持每天的卫星观测并采用多尺度观测网络，用于对沿海水域、湖泊和河口（MONOCLE）项目进行光学监测，为其提供一个具有成本效益的测量框架。MONOCLE将使用现有和新开发的创新传感器技术用于低高端、完全自主和公民操作的平台，并提供所需的数据基础设施，以实现可持续发展。最终，它可用于大型河流、湖泊、水库、河口、海湾和其他沿海地区，并逐渐发展成为一种自给自足的现场服务，与EO水质服务一起。MONOCLE的一个主要目标将是开发7种新的光学传感器，用于在原地平台上安装，如浮标和船舶，以及无人机等公民科学平台，以提供更大、更节省成本的现场覆盖。

科研人员表示，利用卫星安装的传感器来进行地球观测，能够不断地扫描地球表面的大片地区，获得很好的光学观测量，但在这些具有光学复杂性的水域地区，例如近海岸和内陆地区，对看到的东西进行解读是一种挑战。MONOCLE项目的目标是在多个空间和时间尺度上观察，从低成本志愿者的观察到高频率的固定位置平台，以及无人驾驶飞行器。这一地区的知识将直接有助于提高水质，同时也将促进发展，以提高卫星观测系统的准确性。这种低成本的方法在数据贫困地区尤为重要，在那里，MONOCLE将为全球卫星观测能力提供培训和建设当地的能力，并为其提供帮助。

原文来源：http://www.pml.ac.uk/News_and_media/News/PML_to_lead_major_ European_ Commission _research_pro

（来源：科学研究动态监测快报 2018-01-05，第 2 期总第 319 期）

加拿大启动清洁渔业技术研究项目

2017 年 12 月 18 日，加拿大渔业与海洋部（Fisheries and Oceans Canada）正式启动清洁技术研究项目。该项目旨在加强渔业和水产养殖行业的海洋环境保护，在提高海洋产业竞争力的同时，为加拿大人创造更多的就业机会。

加拿大渔业与海洋部启动了这一新项目，并宣布在 4 年之内，为渔业与水产养殖行业投入 2000 万美元资金，帮助相关单位将现有的清洁技术运用到日常生活中。潜在的项目包括，用清洁燃料替代渔船的化石燃料，减少水产养殖场的能源使用等。清洁技术和创新是政府促进清洁经济发展的重要组成部分，有利于保护水生生态系统。作为加拿大经济发展的主要贡献者，渔业和水产养殖业为加拿大人提供了大量就业机会，同时为历代沿海和土著居民带来了不少收入。这一次，该项目将为相关中小型企业提供资金，帮助它们引进最新的清洁技术。有了资金支持，渔民可以使用更有效的工具和技术来生产和打捞海鲜，将海产品供应到国内外市场，从而促进

加拿大经济增长。

早在加拿大政府 2016 年的财政预算中就已批准渔业和水产养殖清洁技术。政府计划投资 10 亿美元，改进现有清洁技术，开发新技术，满足渔业和水产养殖行业的发展需要。旨在通过提供资金，鼓励加拿大渔业和水产养殖行业使用清洁技术，从而减少其活动对环境造成的潜在影响。支持积极参与海洋清洁相关活动的鱼类和海产品部门，如打捞部、养殖部、加工部等。企业、个体户（商业企业）及团体、协会、社区、行业或专业协会（当地组织）都可申请。该资金支持清洁生产、清洁技术、可持续性实践活动，如拟定草案和改进海产品打捞技术、野外捕捞、建设健全水产养殖设施及加工厂改善活动。

原文来源：https://www.canada.ca/en/fisheries-oceans/news/2017/12/canada_launches_cleantechnologyprogramforthefisheriesandaquacult.html

（来源：科学研究动态监测快报 2018-01-05，第 2 期总第 319 期）

俄高校设计出多种净水新方法

近日由世界水理事会举办的世界水资源论坛在巴西举办，各国争取解决水资源现实问题并提供各种形式的水资源节约方法。俄罗斯世界领先科学教育中心中竞争力提高规划（5-100 规划）的参与高校也提出多项创新性设想。其中，圣彼得堡彼得大帝理工大学专家研发了独特的综合性净水装置，可以代替加氯消毒的做法。该装置为电解设备，采用了铁酸钠作反应剂，可大大降低净水成本，且铁酸钠在净水过程中不产生毒性物质，可以把多种毒性物质分解成毒性很小的物质，并消灭微生物。

根据用铁酸钠进行的“红松树林”毒性工业垃圾场的雨水净化实验结果，铁酸钠可以消除成品油及其衍生物、含氮、含磷、含硫物质、氰化物、氨、重金属等工业排水与水池中的严重污染物。研究人员认为，该装置可用于现有排水系统与排水净化设施，也可用于饮用水与生活排水净化、正在发展排水系统与排水质量控制系统的地区。

另一家高校托木斯克理工大学专家研发了“Geyser TM-1.5”净水综合装置，用于净化地下水源。研发人员称，该技术可以将水有效净化到所需的程度，符合卫生保健要求，能消除颜色、浑浊度、臭味、高锰酸盐氧化性（有机物）、铁、锰等多种污染因素，还能灭菌。该装置无需反应剂，可以用公路、水路、铁路运送到居民点。

按照 2017 年俄罗斯“净水”规划框架，托木斯克州 69 个居民点已经建成了 70 座区域性净水设施，采用了由托木斯克理工大学专家研发的技术。专家认为，这种净水设施可以针对不同地区的水污染特点，也会受外国市场的欢迎。

（来源：科技日报 2018-03-27）

业界动态

中共中央办公厅国务院办公厅印发《生态环境损害赔偿制度改革方案》

近日，中共中央办公厅、国务院办公厅印发了《生态环境损害赔偿制度改革方案》，并发出通知，要求各地区各部门结合实际认真贯彻落实。

《生态环境损害赔偿制度改革方案》全文如下：

生态环境损害赔偿制度是生态文明制度体系的重要组成部分。党中央、国务院高度重视生态环境损害赔偿工作，党的十八届三中全会明确提出对造成生态环境损害的责任者严格实行赔偿制度。2015 年，中央办公厅、国务院办公厅印发《生态环境损害赔偿制度改革试点方案》（中办发〔2015〕57 号），在吉林等 7 个省市部署开展改革试点，取得明显成效。为进一步在全国范围内加快构建生态环境损害赔偿制度，在总结各地区改革试点实践经验基础上，制定本方案。

一、总体要求和目标

通过在全国范围内试行生态环境损害赔偿制度，进一步明确生态环境损害赔偿范围、责任主体、索赔主体、损害赔偿解决途径等，形成相应的鉴定评估管理和技术体系、资金保障和运行机制，逐步建立生态环境损害的修复和赔偿制度，加快推进生态文明建设。

自 2018 年 1 月 1 日起，在全国试行生态环境损害赔偿制度。到 2020 年，力争在全国范围内初步构建责任明确、途径畅通、技术规范、保障有力、赔偿到位、修复有效的生态环境损害赔偿制度。

二、工作原则

——依法推进，鼓励创新。按照相关法律法规规定，立足国情和地方实际，由易到难、稳妥有序开展生态环境损害赔偿制度改革工作。对法律未作规定的具体问题，根据需要提出政策和立法建议。

——环境有价，损害担责。体现环境资源生态功能价值，促使赔偿义务人对受损的生态环境进行修复。生态环境损害无法修复的，实施货币赔偿，用于替代修复。赔偿义务人因同一生态环境损害行为需承担行政责任或刑事责任的，不影响其依法承担生态环境损害赔偿责任。

——主动磋商，司法保障。生态环境损害发生后，赔偿权利人组织开展生态环境损害调查、鉴定评估、修复方案编制等工作，主动与赔偿义务人磋商。磋商未达成一致，赔偿权利人可依法提起诉讼。

——信息共享，公众监督。实施信息公开，推进政府及其职能部门共享生态环境损害赔偿信息。生态环境损害调查、鉴定评估、修复方案编制等工作中涉及公共利益的重大事项应当向社会公开，并邀请专家和利益相关的公民、法人、其他组织

参与。

三、适用范围

本方案所称生态环境损害，是指因污染环境、破坏生态造成大气、地表水、地下水、土壤、森林等环境要素和植物、动物、微生物等生物要素的不利改变，以及上述要素构成的生态系统功能退化。

（一）有下列情形之一的，按本方案要求依法追究生态环境损害赔偿责任：

1．发生较大及以上突发环境事件的；

2．在国家和省级主体功能区规划中划定的重点生态功能区、禁止开发区发生环境污染、生态破坏事件的；

3．发生其他严重影响生态环境后果的。各地区应根据实际情况，综合考虑造成的环境污染、生态破坏程度以及社会影响等因素，明确具体情形。

（二）以下情形不适用本方案：

1．涉及人身伤害、个人和集体财产损失要求赔偿的，适用侵权责任法等法律规定；

2．涉及海洋生态环境损害赔偿的，适用海洋环境保护法等法律及相关规定。

四、工作内容

（一）明确赔偿范围。生态环境损害赔偿范围包括清除污染费用、生态环境修复费用、生态环境修复期间服务功能的损失、生态环境功能永久性损害造成的损失以及生态环境损害赔偿调查、鉴定评估等合理费用。各地区可根据生态环境损害赔偿工作进展情况和需要，提出细化赔偿范围的建议。鼓励各地区开展环境健康损害赔偿探索性研究与实践。

（二）确定赔偿义务人。违反法律法规，造成生态环境损害的单位或个人，应当承担生态环境损害赔偿责任，做到应赔尽赔。现行民事法律和资源环境保护法律有相关免除或减轻生态环境损害赔偿责任规定的，按相应规定执行。各地区可根据需要扩大生态环境损害赔偿义务人范围，提出相关立法建议。

（三）明确赔偿权利人。国务院授权省级、市地级政府（包括直辖市所辖的区县级政府，下同）作为本行政区域内生态环境损害赔偿权利人。省域内跨市地的生态环境损害，由省级政府管辖；其他工作范围划分由省级政府根据本地区实际情况确定。省级、市地级政府可指定相关部门或机构负责生态环境损害赔偿具体工作。省级、市地级政府及其指定的部门或机构均有权提起诉讼。跨省域的生态环境损害，由生态环境损害地的相关省级政府协商开展生态环境损害赔偿工作。

在健全国家自然资源资产管理体制试点区，受委托的省级政府可指定统一行使全民所有自然资源资产所有者职责的部门负责生态环境损害赔偿具体工作；国务院直接行使全民所有自然资源资产所有权的，由受委托代行该所有权的部门作为赔偿权利人开展生态环境损害赔偿工作。

各省（自治区、直辖市）政府应当制定生态环境损害索赔启动条件、鉴定评估机构选定程序、信息公开等工作规定，明确国土资源、环境保护、住房城乡建设、水利、农业、林业等相关部门开展索赔工作的职责分工。建立对生态环境损害索赔行为的监督机制，赔偿权利人及其指定的相关部门或机构的负责人、工作人员在索赔工作中存在滥用职权、玩忽职守、徇私舞弊的，依纪依法追究责任；涉嫌犯罪的，移送司法机关。

对公民、法人和其他组织举报要求提起生态环境损害赔偿的，赔偿权利人及其指定的部门或机构应当及时研究处理和答复。

（四）开展赔偿磋商。经调查发现生态环境损害需要修复或赔偿的，赔偿权利人根据生态环境损害鉴定评估报告，就损害事实和程度、修复启动时间和期限、赔偿的责任承担方式和期限等具体问题与赔偿义务人进行磋商，统筹考虑修复方案技术可行性、成本效益最优化、赔偿义务人赔偿能力、第三方治理可行性等情况，达成赔偿协议。对经磋商达成的赔偿协议，可以依照民事诉讼法向人民法院申请司法确认。经司法确认的赔偿协议，赔偿义务人不履行或不完全履行的，赔偿权利人及其指定的部门或机构可向人民法院申请强制执行。磋商未达成一致的，赔偿权利人及其指定的部门或机构应当及时提起生态环境损害赔偿民事诉讼。

（五）完善赔偿诉讼规则。各地人民法院要按照有关法律规定、依托现有资源，由环境资源审判庭或指定专门法庭审理生态环境损害赔偿民事案件；根据赔偿义务人主观过错、经营状况等因素试行分期赔付，探索多样化责任承担方式。

各地人民法院要研究符合生态环境损害赔偿需要的诉前证据保全、先予执行、执行监督等制度；可根据试行情况，提出有关生态环境损害赔偿诉讼的立法和制定司法解释建议。鼓励法定的机关和符合条件的社会组织依法开展生态环境损害赔偿诉讼。

生态环境损害赔偿制度与环境公益诉讼之间衔接等问题，由最高人民法院商有关部门根据实际情况制定指导意见予以明确。

（六）加强生态环境修复与损害赔偿的执行和监督。赔偿权利人及其指定的部门或机构对磋商或诉讼后的生态环境修复效果进行评估，确保生态环境得到及时有效修复。生态环境损害赔偿款项使用情况、生态环境修复效果要向社会公开，接受公众监督。

（七）规范生态环境损害鉴定评估。各地区要加快推进生态环境损害鉴定评估专业力量建设，推动组建符合条件的专业评估队伍，尽快形成评估能力。研究制定鉴定评估管理制度和工作程序，保障独立开展生态环境损害鉴定评估，并做好与司法程序的衔接。为磋商提供鉴定意见的鉴定评估机构应当符合国家有关要求；为诉讼提供鉴定意见的鉴定评估机构应当遵守司法行政机关等的相关规定规范。

（八）加强生态环境损害赔偿资金管理。经磋商或诉讼确定赔偿义务人的，赔

偿义务人应当根据磋商或判决要求，组织开展生态环境损害的修复。赔偿义务人无能力开展修复工作的，可以委托具备修复能力的社会第三方机构进行修复。修复资金由赔偿义务人向委托的社会第三方机构支付。赔偿义务人自行修复或委托修复的，赔偿权利人前期开展生态环境损害调查、鉴定评估、修复效果后评估等费用由赔偿义务人承担。

赔偿义务人造成的生态环境损害无法修复的，其赔偿资金作为政府非税收入，全额上缴同级国库，纳入预算管理。赔偿权利人及其指定的部门或机构根据磋商或判决要求，结合本区域生态环境损害情况开展替代修复。

五、保障措施

（一）落实改革责任。各省（自治区、直辖市）、市（地、州、盟）党委和政府要加强对生态环境损害赔偿制度改革的统一领导，及时制定本地区实施方案，明确改革任务和时限要求，大胆探索，扎实推进，确保各项改革措施落到实处。省（自治区、直辖市）政府成立生态环境损害赔偿制度改革工作领导小组。省级、市地级政府指定的部门或机构，要明确有关人员专门负责生态环境损害赔偿工作。国家自然资源资产管理体制试点部门要明确任务、细化责任。

吉林、江苏、山东、湖南、重庆、贵州、云南 7 个试点省市试点期间的实施方案可以结合试点情况和本方案要求进行调整完善。

各省（自治区、直辖市）在改革试行过程中，要及时总结经验，完善相关制度。自 2019 年起，每年 3 月底前将上年度本行政区域生态环境损害赔偿制度改革工作情况送环境保护部汇总后报告党中央、国务院。

（二）加强业务指导。环境保护部会同相关部门负责指导有关生态环境损害调查、鉴定评估、修复方案编制、修复效果后评估等业务工作。最高人民法院负责指导有关生态环境损害赔偿的审判工作。最高人民检察院负责指导有关生态环境损害赔偿的检察工作。司法部负责指导有关生态环境损害司法鉴定管理工作。财政部负责指导有关生态环境损害赔偿资金管理工作。国家卫生计生委、环境保护部对各地区环境健康问题开展调查研究或指导地方开展调查研究，加强环境与健康综合监测与风险评估。

（三）加快技术体系建设。国家建立健全统一的生态环境损害鉴定评估技术标准体系。环境保护部负责制定完善生态环境损害鉴定评估技术标准体系框架和技术总纲；会同相关部门出台或修订生态环境损害鉴定评估的专项技术规范；会同相关部门建立服务于生态环境损害鉴定评估的数据平台。相关部门针对基线确定、因果关系判定、损害数额量化等损害鉴定关键环节，组织加强关键技术与标准研究。

（四）做好经费保障。生态环境损害赔偿制度改革工作所需经费由同级财政予以安排。

（五）鼓励公众参与。不断创新公众参与方式，邀请专家和利益相关的公民、

法人、其他组织参加生态环境修复或赔偿磋商工作。依法公开生态环境损害调查、鉴定评估、赔偿、诉讼裁判文书、生态环境修复效果报告等信息，保障公众知情权。

六、其他事项

2015 年印发的《生态环境损害赔偿制度改革试点方案》自 2018 年 1 月 1 日起废止。

（来源：http://www.gov.cn 2017-12-17）

中办国办印发《关于在湖泊实施湖长制的指导意见》

近日，中共中央办公厅、国务院办公厅印发了《关于在湖泊实施湖长制的指导意见》，并发出通知，要求各地区各部门结合实际认真贯彻落实。

《关于在湖泊实施湖长制的指导意见》全文如下：

为深入贯彻党的十九大精神，全面落实《中共中央办公厅、国务院办公厅印发〈关于全面推行河长制的意见〉的通知》要求，进一步加强湖泊管理保护工作，现就在湖泊实施湖长制提出如下意见。

一、充分认识在湖泊实施湖长制的重要意义及特殊性

党的十九大强调，生态文明建设功在当代、利在千秋，要推动形成人与自然和谐发展现代化建设新格局。湖泊是江河水系的重要组成部分，是蓄洪储水的重要空间，在防洪、供水、航运、生态等方面具有不可替代的作用。长期以来，一些地方围垦湖泊、侵占水域、超标排污、违法养殖、非法采砂，造成湖泊面积萎缩、水域空间减少、水质恶化、生物栖息地破坏等问题突出，湖泊功能严重退化。在湖泊实施湖长制是贯彻党的十九大精神、加强生态文明建设的具体举措，是关于全面推行河长制的意见提出的明确要求，是加强湖泊管理保护、改善湖泊生态环境、维护湖泊健康生命、实现湖泊功能永续利用的重要制度保障。

同时，在湖泊实施湖长制具有特殊性：一是湖泊一般有多条河流汇入，河湖关系复杂，湖泊管理保护需要与入湖河流通盘考虑、统筹推进；二是湖泊水体连通，边界监测断面不易确定，准确界定沿湖行政区域管理保护责任较为困难；三是湖泊水域岸线及周边普遍存在种植养殖、旅游开发等活动，管理保护不当极易导致无序开发；四是湖泊水体流动相对缓慢，水体交换更新周期长，营养物质及污染物易富集，遭受污染后治理修复难度大；五是湖泊在维护区域生态平衡、调节气候、维护生物多样性等方面功能明显，遭受破坏对生态环境影响较大，管理保护必须更加严格。在湖泊实施湖长制，必须坚持问题导向，明确各方责任，细化实化措施，严格考核问责，确保取得实效。

二、建立健全湖长体系

各省（自治区、直辖市）要将本行政区域内所有湖泊纳入全面推行湖长制工作范围，到 2018 年年底前在湖泊全面建立湖长制，建立健全以党政领导负责制为核心的责任体系，落实属地管理责任。

全面建立省、市、县、乡四级湖长体系。各省（自治区、直辖市）行政区域内主要湖泊，跨省级行政区域且在本辖区地位和作用重要的湖泊，由省级负责同志担任湖长；跨市地级行政区域的湖泊，原则上由省级负责同志担任湖长；跨县级行政区域的湖泊，原则上由市地级负责同志担任湖长。同时，湖泊所在市、县、乡要按照行政区域分级分区设立湖长，实行网格化管理，确保湖区所有水域都有明确的责任主体。

三、明确界定湖长职责

湖泊最高层级的湖长是第一责任人，对湖泊的管理保护负总责，要统筹协调湖泊与入湖河流的管理保护工作，确定湖泊管理保护目标任务，组织制定“一湖一策”方案，明确各级湖长职责，协调解决湖泊管理保护中的重大问题，依法组织整治围垦湖泊、侵占水域、超标排污、违法养殖、非法采砂等突出问题。其他各级湖长对湖泊在本辖区内的管理保护负直接责任，按职责分工组织实施湖泊管理保护工作。

流域管理机构要充分发挥协调、指导和监督等作用。对跨省级行政区域的湖泊，流域管理机构要按照水功能区监督管理要求，组织划定入河排污口禁止设置和限制设置区域，督促各省（自治区、直辖市）落实入湖排污总量管控责任。要与各省（自治区、直辖市）建立沟通协商机制，强化流域规划约束，切实加强对湖长制工作的综合协调、监督检查和监测评估。

四、全面落实主要任务

（一）严格湖泊水域空间管控。各地区各有关部门要依法划定湖泊管理范围，严格控制开发利用行为，将湖泊及其生态缓冲带划为优先保护区，依法落实相关管控措施。严禁以任何形式围垦湖泊、违法占用湖泊水域。严格控制跨湖、穿湖、临湖建筑物和设施建设，确需建设的重大项目和民生工程，要优化工程建设方案，采取科学合理的恢复和补救措施，最大限度减少对湖泊的不利影响。严格管控湖区围网养殖、采砂等活动。流域、区域涉及湖泊开发利用的相关规划应依法开展规划环评，湖泊管理范围内的建设项目和活动，必须符合相关规划并科学论证，严格执行工程建设方案审查、环境影响评价等制度。

（二）强化湖泊岸线管理保护。实行湖泊岸线分区管理，依据土地利用总体规划等，合理划分保护区、保留区、控制利用区、可开发利用区，明确分区管理保护要求，强化岸线用途管制和节约集约利用，严格控制开发利用强度，最大程度保持湖泊岸线自然形态。沿湖土地开发利用和产业布局，应与岸线分区要求相衔接，并为经济社会可持续发展预留空间。

（三）加强湖泊水资源保护和水污染防治。落实最严格水资源管理制度，强化

湖泊水资源保护。坚持节水优先，建立健全集约节约用水机制。严格湖泊取水、用水和排水全过程管理，控制取水总量，维持湖泊生态用水和合理水位。落实污染物达标排放要求，严格按照限制排污总量控制入湖污染物总量、设置并监管入湖排污口。入湖污染物总量超过水功能区限制排污总量的湖泊，应排查入湖污染源，制定实施限期整治方案，明确年度入湖污染物削减量，逐步改善湖泊水质；水质达标的湖泊，应采取措施确保水质不退化。严格落实排污许可证制度，将治理任务落实到湖泊汇水范围内各排污单位，加强对湖区周边及入湖河流工矿企业污染、城镇生活污染、畜禽养殖污染、农业面源污染、内源污染等综合防治。加大湖泊汇水范围内城市管网建设和初期雨水收集处理设施建设，提高污水收集处理能力。依法取缔非法设置的入湖排污口，严厉打击废污水直接入湖和垃圾倾倒等违法行为。

（四）加大湖泊水环境综合整治力度。按照水功能区区划确定各类水体水质保护目标，强化湖泊水环境整治，限期完成存在黑臭水体的湖泊和入湖河流整治。在作为饮用水水源地的湖泊，开展饮用水水源地安全保障达标和规范化建设，确保饮用水安全。加强湖区周边污染治理，开展清洁小流域建设。加大湖区综合整治力度，有条件的地区，在采取生物净化、生态清淤等措施的同时，可结合防洪、供用水保障等需要，因地制宜加大湖泊引水排水能力，增强湖泊水体的流动性，改善湖泊水环境。

（五）开展湖泊生态治理与修复。实施湖泊健康评估。加大对生态环境良好湖泊的严格保护，加强湖泊水资源调控，进一步提升湖泊生态功能和健康水平。积极有序推进生态恶化湖泊的治理与修复，加快实施退田还湖还湿、退渔还湖，逐步恢复河湖水系的自然连通。加强湖泊水生生物保护，科学开展增殖放流，提高水生生物多样性。因地制宜推进湖泊生态岸线建设、滨湖绿化带建设、沿湖湿地公园和水生生物保护区建设。

（六）健全湖泊执法监管机制。建立健全湖泊、入湖河流所在行政区域的多部门联合执法机制，完善行政执法与刑事司法衔接机制，严厉打击涉湖违法违规行为。坚决清理整治围垦湖泊、侵占水域以及非法排污、养殖、采砂、设障、捕捞、取用水等活动。集中整治湖泊岸线乱占滥用、多占少用、占而不用等突出问题。建立日常监管巡查制度，实行湖泊动态监管。

五、切实强化保障措施

（一）加强组织领导。各级党委和政府要以习近平新时代中国特色社会主义思想为指导，把在湖泊实施湖长制作为全面贯彻党的十九大精神、推进生态文明建设的重要举措，切实加强组织领导，明确工作进展安排，确保各项要求落到实处。要逐个湖泊明确各级湖长，进一步细化实化湖长职责，层层建立责任制。要落实湖泊管理单位，强化部门联动，确保湖泊管理保护工作取得实效。水利部要会同全面推行河长制工作部际联席会议各成员单位加强督促检查，指导各地区推动在湖泊实施

湖长制工作。

（二）夯实工作基础。各地区各有关部门要抓紧摸清湖泊基本情况，组织制定湖泊名录，建立“一湖一档”。抓紧划定湖泊管理范围，实行严格管控。对堤防由流域管理机构直接管理的湖泊，有关地方要积极开展管理范围划定工作。

（三）强化分类指导。各地区各有关部门要针对高原湖泊、内陆湖泊、平原湖泊、城市湖泊等不同类型湖泊的自然特性、功能属性和存在的突出问题，因湖施策，科学制定“一湖一策”方案，进一步强化对湖泊管理保护的分类指导。

（四）完善监测监控。各地区要科学布设入湖河流以及湖泊水质、水量、水生态等监测站点，建设信息和数据共享平台，不断完善监测体系和分析评估体系。要积极利用卫星遥感、无人机、视频监控等技术，加强对湖泊变化情况的动态监测。跨行政区域的湖泊，上一级有关部门要加强监测。

（五）严格考核问责。各地区要建立健全考核问责机制，县级及以上湖长负责组织对相应湖泊下一级湖长进行考核，考核结果作为地方党政领导干部综合考核评价的重要依据。实行湖泊生态环境损害责任终身追究制，对造成湖泊面积萎缩、水体恶化、生态功能退化等生态环境损害的，严格按照有关规定追究相关单位和人员的责任。要通过湖长公告、湖长公示牌、湖长 APP、微信公众号、社会监督员等多种方式加强社会监督。

（来源：新华社 2018-01-04）

生态环境部：围绕四种水体加快四项整治

3 月 22 日是“世界水日”，为加强节水宣传，社会各界及生态环境部开展了多种节水、净水活动。生态环境部部长李干杰近日表示，要通过抓生态系统的保护和修复，增强生态系统服务功能，使水体有更大接纳和净化能力，从而实现水环境质量的改善。

据监测数据显示，与 2012 年相比，2017 年我国地表水中，好于三类水质所占比例提高了 6.3 个百分点，劣五类水质比例下降了 4.1 个百分点。“大气的问题难，水的问题要解决起来更难。”李干杰说，需在打赢蓝天保卫战的同时，也打好碧水保卫战。

李干杰说，将围绕突出的“四种水体”加快四项整治。“四种水体”指集中饮用水水源地的水体、黑臭水体、劣五类水体和入江河湖海不达标的排污口水体，“倒逼相关的污染治理工作和生态保护工作”。四项整治，是指工业园区中的“散乱污”企业清理整治好，对重点行业企业进一步提高排放标准；生活源方面，主要加快建设城乡污染处理设施进度；农村面源的污染防治和整治方面，是把种植业农药化肥减下来等；生态系统的保护和修复方面，湿地要进一步加强保护和修复，保障河流

的生态基本流量。

（来源：科技日报 2018-03-22）

水利部：2018 年年底前我国将全面建立河长制、湖长制

水利部1月5日表示，2018年年底前我国将全面建立河长制、湖长制，对所有河流、湖泊入河排污口进行摸底。

中办、国办日前印发《关于在湖泊实施湖长制的指导意见》，要求各地在2018年年底前，全面建立省、市、县、乡四级湖长体系。此前，河长制已全面推行一年多，河畅、水清、岸绿、景美的水生态、水环境开始显现。水利部副部长周学文介绍，河长制的指导意见已经要求在全国江河湖泊推行河长制，现在针对湖泊专门出台指导意见，是对制度的补充。

周学文说："与河流相比，湖泊的管理保护有它的特殊性。河湖的关系复杂；湖泊的水体是连通的，边界的监测断面不容易确定；湖泊的水域岸线及周边都存在种植养殖、旅游开发等活动，容易导致无序开发；湖泊的水体流动相对比较缓慢，遭受污染后治理修复的难度很大。在湖泊实施湖长制的指导意见，实际是对河长制的一种深化和具体化，是专门为湖泊量身定制的。"

根据要求，在湖长制实施过程中，各地区各有关部门要建立"一湖一档"，加强分类指导，完善监测监控，严格考核问责，实施湖泊生态环境损害责任终身追究制。周学文表示，今年，针对河湖管理和保护，水利部将组织对所有河流、湖泊入河排污口进行摸底，"每个地方的河湖治理保护要坚持问题导向，针对河湖存在的突出问题，制定一河一策、一湖一策。2018年，水利部将做好全国摸底调查，把所有河流、湖泊的入河排污口摸清楚，提出相应的治理措施。"。

（来源：中国广播网 2018-01-05）

九三学社建议加强内陆湖泊湿地保护

分布在我国内蒙古、宁夏、贵州、云南等12个省（区、市）的内陆湖泊湿地总面积为2575.9万公顷，占全国湿地总面积的48.22%。但是，由于当前西部内陆地区经济社会迅速发展，湿地特别是湖泊湿地保护与治理面临着巨大压力。

九三学社建议，应加强西部内陆湖泊湿地保护治理，保护和维护湿地生态系统调节气候、调蓄水量、保护生物多样性等重要功能。

一是加快推进湿地管护中的生态补偿试点和制度建设。开展湿地生态服务价值评估和生态损失评价，建立科学合理的生态补偿标准。

二是严守湿地保护红线，完善湿地保护管理体系。对列入国家重要湿地名录以

及各级湿地自然保护区、湿地公园的湿地保育区和恢复重建区，一律纳入红线范围，已经被占用的责令采取补救措施，尽快还湖修复。

三是多头入手，加大对重要湿地和关键部位的恢复力度。对云南滇池等曾经或已经出现严重生态环境问题的湖库加大治理力度。重视生态环境良好的湖泊管护，避免其遭受破坏。对于中等状况的湖库要通过河湖长制度的执行和一定的奖惩政策、生态补偿制度等，推进水环境治理和生态环境恢复。

四是开展湿地监测和科研，加强风险防范和预警预测。积极开展湿地功能、价值、生物多样性、湿地修复技术、湿地合理利用模式等方面的科学研究，制定湿地资源调查和监测的技术规程与标准，建立湿地生物多样性数据库等。

（来源：中国环境报 2018-03-05）

应对水资源挑战重在顺应联合国呼吁更好利用基于自然的解决方案

联合国近日发布的《2018 年世界水资源开发报告》显示， 由于人口增长、经济发展和消费方式转变等因素，全球水资源的需求正在以每年 1%的速度增长，而这一速度在未来 20 年还将大幅加快。各国必须实现从对抗自然到顺应自然的转变，更好地利用基于自然的解决方案来应对水资源挑战。

报告称，未来工业用水和生活用水需求量将远大于农业需水量。对水资源需求的增长最主要来自发展中国家和新兴经济体。与此同时，气候变化正在加速全球水循环，造成湿润地区更加多雨，干旱地区更加干旱。未来数十年，水质还将进一步恶化，对人类健康、环境和可持续发展的威胁将只增不减。

面临洪水风险的人口数量预计将从目前的 12 亿增长到 2050 年的大约 16 亿，受到土地退化、沙漠化以及干旱影响的人口数量大约为 18 亿，从死亡人数和人均 GDP 社会经济影响角度来看，这是最严重的一类“自然灾害”。

生态系统退化是水资源管理不断面临挑战的一个主要原因。自 1900 年起，全球大约有 64%—71%的自然湿地面积因人类活动因素消失殆尽。报告强调，生态系统恶化在历史上造成了诸多古代文明的消亡。现在要避免重蹈古人覆辙，必须实现从对抗自然到顺应自然的转变，更好地利用基于自然的解决方案。

基于自然的解决方案取灵感于自然，着眼于管理水的可获得性、水质和涉水风险，通过利用或模仿自然过程，致力于改善水资源的管理。

近年来，基于自然的解决方案引起了广泛关注，主要体现在将这种思路纳入政策制定的主流之中，包括水资源、粮食安全、农业、生物多样性、环境、降低灾害风险、城市居住地以及气候变化等领域。

（来源：科技日报 2018-03-22）

WWC 提出全球水资源安全的政策建议

2018年2月19日，针对世界水理事会（WWC）和中国水利部出版的《全球水资源安全的经验教训及长期影响》（Global Water Security: Lessons Learnt and Long-Term Implications）一书中有关全球水安全的一些观点、挑战和机遇，WWC提出全球水安全政策建议层面的8个行动，并遴选重点国家和地区水安全相关的案例经验进行介绍。

1 建议开展的8个全球水安全行动

WWC认为全球水安全的行动主要为：①健全相关机构和立法。水安全不取决于一个地区有多少水，而是由健全的机构、适当的法律和监管框架、政策工具、有效的执法和社会资源来决定。②找出不同的公共政策是否在没有协调的情况下对水产生影响。有很多不同的水用户，他们有自己的需求、计划和规则，要努力使他们团结在一起。③投资供水系统。缩小世界各地的基础设施缺口，并加以管理基础设施，为每个人提供水服务，需要有更大的投资。④相信当地居民应对水安全的方法，并就水安全问题与当地居民开展对话。这些都是解决水不确定性和不平衡问题的有力解决方案的必要组成部分。⑤在极端事件中总结经验。一些极端事件的发生，往往根源在于水资源管理和治理。干旱和洪涝灾害应在水资源安全战略中发挥核心作用。⑥研究水安全对能源、食品和环境安全的影响。通过社会、经济和政治行动，水的稀缺和差异性的影响可以得到缓解。⑦花时间采纳新的管理方式和创新政策解决方案，并致力于长期的建设。避免快速采用和不去执行的恶性循环，这种循环经常出现在依赖外部社会和制度支持的国家。⑧使用水安全作为实现可持续发展目标的途径。水对大多数目标至关重要，如果不回答水需求上升、不平等获取、稀缺、污染和气候变化等问题，就无法实现这些目标。

2 一些国家和地区“水安全”相关的经验

水的安全从根本上取决于当地的环境，这意味着常规的处理方法不一定通用。然而，政策制定者可以从另一个方面了解到在类似情况下所起的作用：正式和非正式的机构、政策、法律框架和管理策略，这些都加强了水的安全性。将不同的用户聚集在一起，围绕地理区域的特殊需求，而不是试图在单一方法的保护伞下尝试各种不同的本地环境。这就是为什么水安全在任何地方都是不同的。

在摩洛哥，它意味着最大限度地利用地表水灌溉、饮用水、工业和能源。最近，这种努力已经从大量的基础设施投资转向了更为复杂和困难的任务，即确保其能高效率的分配给不同的用户群体。

在巴西，严重干旱对大都市地区的影响，使得水资源治理在政治议程上的影响非常严重。干旱管理计划、大量供水管理的创新以及供应系统之间的相互联系，都得到相关者积极的响应和支持，这些人积极参与保护项目。与此同时，在中亚地区，

每个国家的水安全都依赖于一个广泛的跨界河网，而共享河流流域管理方法代表着一项重要的改革，以改善共同倡议。尽管新加坡的规模很小，但它的目标是利用前瞻性的战略，从考虑社会行为到尝试高纯度的回收水和海水淡化，以确保未来的水资源。法国通过更广泛的生态安全措施解决了水资源管理、洪水风险和污染问题，将生态系统和生物多样性放在了水安全的中心。

在澳大利亚这个极端的大陆上，水安全方面重点关注的是风险。几十年来，在政策和政治议程中，水的风险一直是突出的，但近年来，人们的关注焦点已经迅速缩小。政策和规划已经将范围从管理危机转变为长期的水安全挑战。许多大型城市供水服务提供商都在增加水的投资组合，目的是改善水安全，减少长期风险。然而，在地区和偏远地区，人类继续面临着不确定的水量和质量。在这个国家，最独特的是，在国家和国家层面均采取了政策措施，缓解经济增长与环境需求之间的紧张关系。

在中国，水资源在人口众多的情况下分布得很稀疏，分布不均。这一事实，加上污染、农村基础设施不足、复杂的河流系统以及频繁的洪水和干旱，使水安全成为国家的头等大事。具体政策的应对措施包括：实施水资源保护措施、加强治理、同时实施政府和市场机制。其中一个最重要的政策是“三条红线”：控制总用水量，提高用水效率，朝着水污染控制方向努力，所有这些都是由新的管理和绩效评估系统为指导。中国也在用非传统的资源进行多样化的水资源投资组合，并把重点放在了水生态文明的理念上。

在南非国家采取不同的方式来解决水安全问题，这反映了它们的具体情况，但它们面临着两大挑战。第一个是建立安全可靠的供水系统，特别是在农村地区；第二种是建立对干旱和其他气候变化表现的适应能力。在所有情况下，要克服的主要障碍是经济和制度上的障碍。在区域范围内，有很大的机会缓解干旱和洪水的影响，并且正在进行政治努力以实施合作的方法。另一项议程是，为许多国家所依赖的外部支持提供更好的地方适应，希望能减缓短期管理范式的快速循环，有利于持久的机构。

在美国加利福尼亚州，由一个具有挑战性的规章制度、水权、合同和激励机制来协调。由此产生的制度和物理系统总是与干旱和多变的气候相争，并被长期的人口增长和国家经济和社会目标的变化所拉长。然而，体制的政治分权，加上政治动机，带来了稳定的地方创新。通过极端事件带来的周期性的关注，更大的区域和全州范围内的创新也在发生。其水治理是一种具有远见的渐进主义，由持续的问题驱动，并为大多数国家提供了不同程度的水安全。

原文来源：http://www.worldwatercouncil.org/sites/default/files/Thematics/WaterSecurity_policiy_recommandations.PDF

（来源：科学研究动态监测快报 2018-03-15，第6期总第323期）

欧盟通过立法提高饮用水安全

2018年2月1日，欧盟（EU）在线发布新闻称，欧盟委员会提出修订欧洲立法，提高饮用水的质量并为公民提供更好的水信息。

EU希望根据最新的科学建议，继续确保提供高质量的饮用水，并帮助消费者获得安全饮用水，并找到有关其供应的可靠信息。安全饮用水对公众健康和福祉至关重要，水污染或短缺可能会造成严重的社会和经济代价。

欧盟委员会通过一项立法支持所有欧洲人获得安全饮用水，这也是对欧洲公民倡议“权利2-水（Right2water）”做出的回应。新立法规定将要求会员国改善所有人获取安全饮用水的途径，尤其是对那些目前难以获得饮用水的弱势群体和边缘群体。在实践中，这意味着为公共场所的饮用水提供设备，开展宣传活动，向市民宣传其水的质量，并鼓励政府建设公共建筑提供饮用水。

这项立法的另一个重要变化是将使公众更容易获取和使用关于生活区饮用水质量和供应的信息，提高人们对自来水水质的信心。据估计，这些新措施将减少与饮用水相关的潜在健康风险，从4%降至1%以下。同时，饮用水质量改善可以降低瓶装水消费，帮助欧洲家庭每年节省6亿多美元。随着人们对自来水质量改善信心的增强，市民也可以减少瓶装水使用，从而降低因此带来的塑料垃圾，包括海洋塑料垃圾等，可以更好地管理欧盟成员国的饮用水，避免不必要的水资源损失，并有助于降低二氧化碳的排放量。

原文来源：https://ec.europa.eu/commission/news/safer-drinking-water-all-europeans-2018-feb-01_en

（来源：科学研究动态监测快报 2018-02-15，第4期总第321期）

我国湿地保护率达 49.03%

2月2日是第22个“世界湿地日”，2018年世界湿地日中国主场宣传活动在广东广州海珠国家湿地公园举办。在活动中，国家林业局为河北永年洼等84处国家湿地公园授牌。

据国家林业局副局长李春良介绍，目前我国拥有国际重要湿地57个，建成湿地自然保护区602个、国家湿地公园试点898个；5年间，实施湿地保护修复工程和湿地补助项目1500多个；湿地保护率5年间增加5.52个百分点，已达49.03%。

国际湿地公约秘书长玛莎·罗杰斯·乌瑞格对中国政府在湿地保护方面做出的努力给予充分肯定。玛莎·罗杰斯·乌瑞格说：“我特别赞赏中国，尤其是中国国家林业局制定的《全国湿地保护“十三五”实施规划》。这个将致力于保护中国所有湿地的规划非常棒，也展现了中国政府对湿地保护的长期承诺。”

“今年10月，湿地公约第13次缔约方大会将认可第一批获得国际湿地公约认证的国际湿地城市。中国提名了6个候选城市参与国际湿地城市认证。希望这些先锋城市能成为催化剂，激励我们采取更加有准备的行动，让我们走上可持续城镇化之路。”她说。

（来源：科技日报，2018-02-05）

云南省财政厅全力推进九大高原湖泊保护

九大高原湖泊是云南省生态体系的重要组成部分，保护治理好九大高原湖泊，对争当生态文明建设排头兵、筑牢西南生态安全屏障意义重大。近年来，云南省财政厅紧紧围绕中央和云南省委、省政府决策部署，多措并举，全力支持九大高原湖泊保护治理。2015-2017年，云南省财政厅共计筹措54.6亿元，用于支持九大高原湖泊保护治理工作。目前，各大湖泊水质总体保持稳定，重点污染湖泊水质得到有效改善。需要积极筹资，持续加大投入力度、抢抓机遇争取中央支持力度、统筹兼顾积极推进改革创新、突出重点抓好湖泊保护治理。九大高原湖泊各自拥有不同的水环境情况，针对各湖泊污染现状和治理需求。下一步，云南省财政厅将继续秉承绿色发展理念，在云南省委、省政府的正确领导下，积极履职尽责，全力支持九大高原湖泊的保护治理工作。

（来源：给水排水 2018,44(1):121）

湖长制：“千湖之省碧水长流”的体制保障

2017年12月26日，中共中央办公厅、国务院办公厅印发《关于在湖泊实施湖长制的指导意见》（以下简称《意见》）。这是贯彻落实党的十九大精神、统筹山水林田湖草系统治理、维护湖泊健康生命的重大制度创新。这对于“千湖之省”的湖北更是机遇难得、意义非凡， 必将有力促进我省湖泊治理保护， 促进湖泊自然、生态功能恢复，促进湖区经济社会可持续发展， 促进人与湖泊环境和谐共生。

作为“千湖之省”，2012 年湖北省就在武汉市开始探索试行湖长制，2014 年在全省全面推行，2017 年全面深化。通过湖长制改革，全省湖泊水域岸线基本稳定、生态系统逐步恢复，环境质量不断改善，受到人民群众好评。湖北虽然探索湖长制先行几年，但对照中央湖长制《意见》精神，还有很大差距。我们将进一步把思想和行动统一到中央决策部署和《意见》要求上来，打造具有湖北特色的湖长制模式，为“千湖之省碧水长流”提供体制保障。致力构建安全湖泊。稳步推进湖泊外排能

力、湖堤加固、涉湖闸站改造，补齐湖泊工程短板，消除湖泊防洪安全隐患的同时，实施河湖水系连通工程，构建“布局合理、生态良好，引排得当、循环通畅，蓄泄兼筹、丰枯调剂，多源互补、调控自如”的江河湖库水系连通体系。致力实施健康湖泊。实行最严格的生态环境保护制度，突出湖泊生态功能建设，加快推进退渔还湖、退田还湖、控源截污、生态修复等综合治理措施，实现湖泊保面（容）积、保水质、保功能、保生态、保可持续利用的“五保”目标。致力推行智能湖泊。开展划界确权、水域岸线登记，落实湖泊保护区范围。探索湖泊网格化管理，运用好湖泊卫星遥感监测系统，提高湖泊监督执法的信息化水平。建立统一管理和综合执法模式，实行湖泊动态监管，打击涉湖违法行为，为打造具有湖北特色的湖长制提供强有力执法保障。致力打造灵秀湖泊。引导社会各界更加关心湖泊保护，营造浓厚的爱湖护湖文化氛围，培育护湖为荣、损湖为耻的社会风尚。坚持“一湖一策”，实施“一湖一景”“一湖一品”建设，把每个湖泊建设成为水清岸绿、生物多样的水生态景点，水系连通、旱涝无忧的水安全景点，传承文明、人水和谐的水文化景点。

（来源：中国水利 2018年01期）

贵州：109 亿元抢救威宁草海

在草海生态濒临崩溃之际，经中国科协大力支持，贵州省科协及时组织孙鸿烈等20位院士专家赴威宁县“抢救”草海，并推动草海综合治理上升为国家战略。29日，记者从贵州省科协获悉，随着威宁草海生态环境保护和综合治理规划获得国家批复，109亿元的总投资让这颗“高原明珠”重新焕发出生机，威宁草海再现碧波荡漾。

作为与青海湖、滇池齐名的全国三大高原淡水湖之一，上个世纪50年代，草海生态一度濒临崩溃。之后，当地虽积极开展草海治理工作，但由于草海紧邻县城，随着经济社会迅速发展，草海再度面临水质恶化、生态破坏、湿地面积缩小等严重威胁。为此，在中国科协的大力支持下，贵州省科协组织多位院士赴威宁草海调研，并发出警告：“如不及时治理，预计37年后，草海将从地球上消失！”最终，20位院士和专家共同形成的《采取抢救性措施保护草海生态系统的建议》上报国务院，积极推动草海综合治理上升为国家战略。此后，《贵州草海高原喀斯特湖泊生态环境保护和综合治理规划》获国家发改委批复，总投资109亿元，涉及43个项目。如今，威宁草海通过退耕还湿、退城还湿和治理净湿等一系列措施，生态环境不断修复。

来自威宁草海保护区管委会的数据显示，每年约有230种、10万余只候鸟在此栖息繁殖及越冬。

（来源：科技日报 2018-03-30）

青海：三江源多个湖泊面积呈扩容态势

据青海省气象科学研究所最新监测数据显示，我国重要的生态屏障和水源涵养地——三江源地区的多个湖泊面积近年来普遍呈“扩容”态势，这将有利于三江源地区生态恢复。

科研人员选取了三江源区域的9个大型湖泊，利用2017年9月卫星遥感监测到的湖泊面积与近五年的湖泊面积平均值对比发现：9个湖泊中，6个湖泊的面积增大，其中黄河源头之一的扎陵湖，以20.92平方公里的增幅位居首位，湖泊面积达564.56平方公里，达到15年来的最大值。其余5个湖泊增幅为5.41至17.27平方公里。

青海省气象科学研究所高级工程师 刘宝康：我们分析了（2017年）3月以来的降水情况发现，秋季三江源地区降水增加，是它（湖泊）面积扩大的主要原因。

三江源地区地处青藏高原腹地，是长江、黄河、澜沧江三大江河的发源地，具有巨大的生态功能。2017年三江源区域湖泊的普遍“扩容”，将有助于该地区牧草返青和生态恢复。

（来源：http://www.xinhuanet.com/ 2018-01-26）

环青海湖地区普氏原羚种群数量创历史新高

3月20日至25日，青海湖国家级自然保护区管理局完成普氏原羚春季专项调查。观测结果显示，在环湖地区13个普氏原羚观测样区，共观测记录到普氏原羚个体数量2057只，较此前2017年8月记录到的2010只增加47只，普氏原羚种群数量再创新高。

保护区管理局相关负责人介绍，监测人员在13个样区设置观测样点43个，采用分区直数法和直接记数法，共观测记录普氏原羚个体2057只，其中雄羚357只、雌羚875只、幼羚4只，受距离和光线及观察角度的影响有781只未能分辨雌雄，这是开展普氏原羚观测以来的最高值，也是历史最高峰值。2057只普氏原羚分布于青海湖流域4个县域内的13个区域。

普氏原羚作为青海湖的旗舰物种和濒危物种,与上世纪80年代至本世纪初相比较，种群数量增加近4倍,保护成效明显。

实地调查发现，在普氏原羚分布区域尤其是在普氏原羚集中分布区域和普氏原羚保护项目实施区域，大多数草场的围栏都在1.5米左右，同时去除了刺丝这一措施有效减少了对普氏原羚的威胁。在青海省野生动物保护主管部门、青海湖国家级自然保护区管理局和当地政府社区协同保护，普氏原羚栖息地生境得到有效改善，普氏原羚种群实现了持续的增长。

（来源：科技日报 2018-03-30）

白洋淀开展“跑道养鱼”

河北白洋淀国家农业科技园区内龙头企业绿之梦开发有限公司的负责人赵振杰，见证了首个跨区域星创天地“北京-雄安白洋淀星创天地”的诞生和成长。

2017年4月，中共中央、国务院印发通知，决定设立河北雄安新区，重点打造北京非首都功能疏解集中承载地。在京津冀协同发展和雄安新区建设大背景下，北京市科委农村中心（简称：农村中心）以星创天地建设为抓手，筹划将首都优质科技资源及星创天地建设经验对接到雄安新区，支持当地产业升级和整体规划发展。

“安新是雄安新区里面积最大的县，白洋淀的主体也在这，我们园区以‘治水、保水、节水、净水、增水’为主线，发展‘生态循环农业、健康食品产业、休闲体验农业’三大产业。”赵振杰告诉笔者。

“我们请专家对白洋淀星创天地进行了整体规划设计，梳理出智慧园区、星创学院、星创孵化、生态示范、文化科技和创客电商六大业务板块内容。”农村中心有关负责人介绍。北京团队开展了一系列工作：对白洋淀星创天地办公环境进行了整体提升；选派18名科技特派员到白洋淀国家园区开展创新创业服务；建立规模化淡水鱼健康智能化调控技术装备研发与示范基地，开展基于物联网的智能养鱼模式示范，在综合演示指挥调度大厅能够实现远程视频监控、远程操控系统和实时环境监控。目前，已有26家企业入驻白洋淀星创天地。

这些措施让雄安新区的产业迈上新台阶。以养鱼为例，“以前我们试过网箱养鱼，但因对水体污染严重被政府取缔，之后就是最原始的放养了。”赵振杰说，养的是容易成活却卖不上价的“四大家鱼”，一亩塘能有500元收益就不错了。

但现在，在农村中心牵线搭桥下，赵振杰搞起了“跑道养鱼”。笔者在他的养鱼场看到，长20多米、宽5米、深3米的铁箱子一字排开，气泵将铁箱子里的水不停地朝同一方向推动，天性逆流而上的鱼儿便“跑”了起来。

“这样养出的鱼品质好，而且用2亩地就能达到原来100亩地的产值。”技术员仉志平告诉笔者，作为物联网智能养鱼模式示范基地，北京的科研人员在这里安装了三个智能监测终端，以往要靠人工监测的各种水质参数现在通过机器就能读出来。

农村中心有关负责人介绍，接下来，将进一步打造白洋淀智慧园区，推动科技成果集成转化，共建孵化中心，培育高新技术企业，实现企业发展和农民增收双赢。

（来源：中国渔业报，2018-01-23）

东北地下水超采严重 专家呼吁勿蹈华北覆辙

3 月 22 日，又到“世界水日”。该纪念日旨在呼吁世界各国关注水资源，唤起公众的水忧患意识。

“世界水日”来临前夕，中国水利水电科学研究院水资源所所长王建华在接受科技日报记者采访时坦言，近年来我国东北地区水稻种植面积迅速增加，导致用水需求激增，局部地区供需矛盾突出。“地下水超采的问题在东北已经初见端倪，且发展迅速，应当引起高度重视。”

事实上，2017 年 6 月，农业部、水利部等六部委联合印发的《东北黑土地保护规划纲要（2017—2030 年）》也指出，近些年东北地区水稻面积逐年扩大，地下水超采严重。

东北地区旱作农业大部分为雨养，正常年份灌溉量较少，干旱年份才需补充灌溉。但水稻每年都需要灌溉，且灌溉定额较高，逐年扩大的水稻种植面积带来灌溉用水需求量不断增加。

据统计，松花江—辽河流域 2016 年供水量为 698 亿立方米，其中地下水供水量 318.7 亿立方米，占总供水量的 45.7%。平原区浅层地下水开采量 234.6 亿立方米，超过全区地下水补给量的 60%，部分地区地下水开采量已经超过补给量，出现了明显的超采趋势。王建华举例，其中，松嫩平原和辽河平原浅层地下水超采最为严重，地下水位降落漏斗总面积达到 480 平方公里，漏斗中心地下水位下降 30 米—60 米。

地下水是河湖湿地生态系统重要的涵养水源，也是陆域非地带性植被基础性支撑条件，一旦地下水超采致地下水位下降，必然会导致区域湖沼湿地系统退化和非地带性植被演替，由此带来的生态系统风险难以估量。“因此，在东北地区地下水的问题上一定要防微杜渐、未雨绸缪，千万不能重蹈华北地区的覆辙，以免对区域生态系统造成难以逆转的损害。”王建华指出。

在王建华看来，华北平原地下水超采无疑是前车之鉴。华北平原从上世纪 70 年代开始大规模打井抗旱，随后地下水开采逐步常态化，愈演愈烈。目前，华北平原每年超采地下水约 100 亿立方米，超过全国平原区地下水超采量的 60%；其中河北省地下水超采最为严重，每年超采约 60 亿立方米。

为避免在地下水开采上出现“第二个华北”情况，王建华建议，首先要严格用水总量控制与定额管理。坚持以水定地，地下超采区要适当退减灌溉面积，或是降低灌溉定额；坚持以水定产，地下水灌区严控水稻生产；坚持以水定额，地下水灌区要采用同类地区先进定额。同时，推广先进适用的节水灌溉技术，加大灌区续建配套与节水改造力度，大力推广寒地水稻节水控制灌溉技术。

对此，中国水利水电科学研究院水利研究所教授级高级工程师管孝艳博士也表达了相近的观点。他指出，在以地下水作为水源实施节水增粮行动的区域，尤其是在旱田发展灌溉，要以高效利用和有效保护地下水资源、严格控制地下水开采总量不超其承载能力为根本前提，做好水资源论证，合理开发利用地下水资源，科学合理地确定灌溉发展布局与规模，避免造成地下水超采及相应的生态环境问题。

（来源：科技日报 2018-03-21）