湖泊科学动态

本期导读

- Science：降水增加影响水质富营养化
- 第三极河湖源科考将填补多项湖泊河流资料空白
- 升温导致世界最大湖泊水位连年下降
- WRI 剖析全球水危机产生原因
- 三峡库区水质总体稳定或优于蓄水前

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热点文章

➢ Eutrophication will increase during the 21st century as a result of precipitation changes

E Sinha, AM Michalak, V Balaji

Eutrophication, or excessive nutrient enrichment, threatens water resources across the globe. We show that climate change–induced precipitation changes alone will substantially increase (19 ± 14%) riverine total nitrogen loading within the continental United States by the end of the century for the "business-as-usual" scenario. The impacts, driven by projected increases in both total and extreme precipitation, will be especially strong for the Northeast and the corn belt of the United States. Offsetting this increase would require a 33 ± 24% reduction in nitrogen inputs, representing a massive management challenge. Globally, changes in precipitation are especially likely to also exacerbate eutrophication in India, China, and Southeast Asia. It is therefore imperative that water quality management strategies account for the impact of projected future changes in precipitation on nitrogen loading.

（来源：SCIENCE，2017，doi:10.1126/science.aan2409）

中文点评：

降水增加影响水质富营养化

气候变化导致的降水增多将使过量的氮进入河道污染水质，增加海岸带水污染的可能性。降雨和其他降水将农业和化石燃料等人类活动产生的营养物质冲刷到河流和湖泊中。当这些营养物质超过水域的承载力时，将会发生水域富营养化，导致危险的后果。产生毒素的有害藻类水华能够将一块水域变成危险的低氧死亡区。研究发现，河水富营养化在美国中西部和东北地区的影响特别严重。在过去的几年中，包括墨西哥湾、切萨皮克湾和佛罗里达州等美国沿海地区，藻类大量繁殖并形成了诸多的死亡区。研究人员指出，在 20 世纪 70 年代，人类造成的富营养化被首次发现，同时相关部门采取了一些措施来扭转其发展趋势。研究结论指出看似轻微的气候变化能够导致富营养化现象的回归，为了进一步限制其发展，保持水质平衡，就需要更多的研究和制定更好的管理策略。研究人员利用 21 个不同的模型进行预测，并研究了三种可能的未来情景。预测了未来由气候变化引起的降水变化将如何影响氮的径流以及对美国水质破坏增加的风险。研究发现，如果温室气体排放趋势得不到遏制，气候变化将改变美国乃至全球的降水模式，预计到本世纪末营养物污染将增加 1/5，在玉米生产带和美国东北部地区的影响尤为显著。控制越来越多的氮被冲刷进河道将是一项巨大的任务，至少需要减少如化肥等总氮的使用量的 1/3 以上才能初现成效。该研究目前只针对美国国内，然而研究人员已将印度、中国和东南亚确定为降水增加导致氮污染大幅度增加的高风险地区。这是世界上一半以上人口居住的地区，严重的水质破坏将产生严重的后果。

（来源：科学研究动态监测快报 2017-09-01，第 17 期总第 301 期）

摘要精选

Warmer climate squeezes aquatic predators out of their preferred habitat

Daniel E. Schindler

Ecosystems are mosaics of different habitats, each of which provides its own opportunities and risks to the organisms that inhabit it. The profitability of any habitat depends on a variety of biotic and abiotic variables including the abundance of prey, vulnerability to predators, and physical features such as temperature that modify physiology and behavior. Because biological and physical conditions are continuously varying, and it is rare that any single habitat satisfies all requirements for successfully completing life cycles, organisms must navigate across habitat landscapes to fulfill their resource needs. Human modifications to habitats are presenting new challenges to many organisms. One underappreciated effect humans are having on the profitability of landscapes is via climate warming, where we are changing the rules of the game controlling how consumers can move among habitats. In PNAS, Guzzo et al. show that warmer water temperatures in lakes restrict the daily movements of a top predator between habitats that are profitable for feeding and those that provide cold water for maintaining physiological functions. Intensified thermal barriers to movement under warmer climate conditions reduce feeding rates in productive habitats, thereby slowing growth of the predator. Surprising stories such as this continue to emerge from field ecology and serve as a sharp reminder that human perturbations to the Earth's climate system have many untold consequences for the biosphere.

（来源：PNAS, 2017, 114(37): 9764–9765）

Development and application of a sustainability index for a lake ecosystem

Gal, Gideon; Zohary, Tamar; et al.

We modify an existing water quality index of Lake Kinneret to better match the objective of sustaining the ecosystem over time. The Kinneret Sustainability Index (KSI) provides a quantitative indication of how similar the current ecosystem is in relation to a reference state that managers are striving to achieve and sustain once accomplished. As Lake Kinneret is the only freshwater lake in Israel, it is vital to sustain the lake ecosystem over time. The KSI provides lake managers with a means for assessing the state of the lake. The KSI is based on nine ecosystem variables and provides information on each variable and the combined index. We present examples of application of the KSI to lake management and conduct a sensitivity analysis of the underlying assumptions demonstrating its robustness to the assumptions. While the index presented here is specific to Lake Kinneret, it is a general approach that can be readily applied to lakes worldwide and can assist, for example, in achievement of the required good status for European lakes.

（来源：HYDROBIOLOGIA, 2017, 800(1): 207-223）

An "EAR" on Environmental Surveillance and Monitoring: A Case Study on the Use of Exposure Activity Ratios (EARs) to Prioritize Sites, Chemicals, and Bioactivities of Concern in Great Lakes Waters

Blackwell, Brett R.; Ankley, Gerald T.; Corsi, Steven R.; et al.

Current environmental monitoring approaches focus primarily on chemical occurrence. However, based on concentration alone, it can be difficult to identify which compounds may be of toxicological concern and should be prioritized for further monitoring, in-depth testing, or management. This can be problematic because toxicological characterization is lacking for many emerging contaminants. New sources of high-throughput screening (HTS) data, such as the ToxCast database, which contains information for over 9000 compounds screened through up to 1100 bioassays, are now available. Integrated analysis of chemical occurrence data with HTS data offers new opportunities to prioritize chemicals, sites, or biological effects for further investigation based on concentrations detected in the environment linked to relative potencies in pathway-based bioassays. As a case study, chemical occurrence data from a 2012 study in the Great Lakes Basin along with the ToxCast effects database were used to calculate exposure-activity ratios (EARs) as a prioritization tool. Technical considerations of data processing and use of the ToxCast database are presented and discussed. EAR prioritization identified multiple sites, biological pathways, and chemicals that warrant further investigation. Prioritized bioactivities from the EAR analysis were linked to discrete adverse outcome pathways to identify potential adverse outcomes and biomarkers for use in subsequent monitoring efforts.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(15): 8713-8724）

A comprehensive data set of lake surface water temperature over the Tibetan Plateau derived from MODIS LST products 2001–2015

Wei Wan, Huan Li, Hongjie Xie; et al.

Lake surface water temperature (LSWT) is sensitive to long-term changes in thermal structure of lakes and regional air temperature. In the context of global climate change, recent studies showed a significant warming trend of LSWT based on investigating 291 lakes (71% are large lakes, ≥50 km^2 each) globally. However, further efforts are needed to examine variation in LSWT at finer regional spatial and temporal scales. The Tibetan Plateau (TP), known as ‘the Roof of the World’ and ‘Asia’s water towers’, exerts large influences on and is sensitive to regional and even global climates. Aiming to examine detailed changing patterns and potential driven mechanisms for temperature variations of lakes across the TP region, this paper presents the first comprehensive data set of 15-year (2001–2015) nighttime and daytime LSWT for 374 lakes (≥10 km^2 each), using MODIS (Moderate Resolution Imaging Spectroradiometer) Land Surface Temperature (LST) products as well as four lake boundary shapefiles (i.e., 2002, 2005, 2009, and 2014) derived from Landsat/CBERS/GaoFen-1 satellite images. The data set itself reveals significant information on LSWT and its changes over the TP and is an indispensable variable for numerous applications related to climate change, water budget analysis (particularly lake evaporation), water storage changes, glacier melting and permafrost degradation, etc.

（来源：Sci Data, 2017, 4: 170095）

MODIS observations of cyanobacterial risks in a eutrophic lake: Implications for long-term safety evaluation in drinking-water source

Duan, Hongtao; Tao, Min; Loiselle, Steven Arthur; et al.

The occurrence and related risks from cyanobacterial blooms have increased world-wide over the past 40 years. Information on the abundance and distribution of cyanobacteria is fundamental to support risk assessment and management activities. In the present study, an approach based on Empirical Orthogonal Function (EOF) analysis was used to estimate the concentrations of chlorophyll a (Chla) and the cyanobacterial biomarker pigment phycocyanin (PC) using data from the MODerate resolution Imaging Spectroradiometer (MODIS) in Lake Chaohu (China's fifth largest freshwater lake). The approach was developed and tested using fourteen years (2000-2014) of MODIS images, which showed significant spatial and temporal variability of the PC:Chla ratio, an indicator of cyanobacterial dominance. The results had unbiased RMS uncertainties of <60% for Chla ranging between 10 and 300 mu g/L, and unbiased RMS uncertainties of <65% for PC between 10 and 500 mu g/L. Further analysis showed the importance of nutrient and climate conditions for this dominance. Low TN:TP ratios (<29:1) and elevated temperatures were found to influence the seasonal shift of phytoplankton community. The resultant MODIS Chla and PC products were then used for cyanobacterial risk mapping with a decision tree classification model. The resulting Water Quality Decision Matrix (WQDM) was designed to assist authorities in the identification of possible intake areas, as well as specific months when higher frequency monitoring and more intense water treatment would be required if the location of the present intake area remained the same. Remote sensing cyanobacterial risk mapping provides a new tool for reservoir and lake management programs.

（来源：WATER RESEARCH, 2017, 122: 455-470）

Spatiotemporal dynamics of bacterial community composition in large shallow eutrophic Lake Taihu: High overlap between free-living and particle-attached assemblages

Tang, Xiangming; Chao, Jianying; Gong, Yi; et al.

In eutrophic lakes, heterotrophic bacteria are closely associated with algal detritus and play a crucial role in nutrient cycling. However, the seasonal and spatial dynamics of free-living (FL) and particle-attached (PA) bacteria and the environmental factors shaping this relationship remain poorly understood. To address this issue, we explored the spatiotemporal patterns of bacterial community composition (BCC) in Lake Taihu, China, using terminal restriction fragment length polymorphism (T-RFLP) and 454-tag pyrosequencing of 16S rRNA gene. We generated a total of 218,027 high quality non-cyanobacterial sequence reads that resulted in 4940 OTUs (97% cutoff), with Actinobacteria, beta- and alpha-proteobacteria being the predominant taxa. Although PA communities contained significantly higher alpha-diversity than FL ones, we found that 59% of OTUs, that accounted for 96% of the total reads, were shared by both communities. The high degree of overlap between FL and PA communities indicates a high rate of dispersal potential, highlighting an underestimated connectivity and potentially similar ecological role for these two components. Distinct seasonal trends were recorded in both FL and PA communities, while spatial differences in BCC were small. In addition, both FL and PA bacterial communities exhibited similar patterns and synchrony, correlated to water temperature, nitrate and total suspended solids (TSS). Accordingly, the effects of eutrophication and hydrodynamics on the

phylogenetic overlap and diversity between FL and PA communities were discussed.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1366-1382）

Predicting blooms of toxic cyanobacteria in eutrophic lakes with diverse cyanobacterial communities

Aleksandra Bukowska, Tomasz Kaliński, Michał Koper; et al.

We investigated possibility of predicting whether blooms, if they occur, would be formed of microcystin-producing cyanobacteria. DGGE analysis of 16S-ITS and mcyA genes revealed that only Planktothrix and Microcystis possessed mcy-genes and Planktothrix was the main microcystin producer. qPCR analysis revealed that the proportion of cells with mcy-genes in Planktothrix populations was almost 100%. Microcystin concentration correlated with the number of potentially toxic and total Planktothrix cells and the proportion of Planktothrix within all cyanobacteria, but not with the proportion of cells with mcy-genes in total Planktothrix. The share of Microcystis cells with mcy-genes was low and variable in time. Neither the number of mcy-possessing cells, nor the proportion of these cells in total Microcystis, correlated with the concentration of microcystins. This suggests that it is possible to predict whether the bloom in the Masurian Lakes will be toxic based on Planktothrix occurrence. Two species of toxin producing Planktothrix, P. agardhii and P. rubescens, were identified by phylogenetic analysis of 16S-ITS. Based on morphological and ecological features, the toxic Planktothrix was identified as P. agardhii. However, the very high proportion of cells with mcy-genes suggests P. rubescens. Our study reveals the need of universal primers for mcyA genes from environment.

（来源： Scientific Reports, 2017, doi:10.1038/s41598-017-08701-8）

Community Biological Ammonium Demand: A Conceptual Model for Cyanobacteria Blooms in Eutrophic Lakes

Gardner, Wayne S.; Newell, Silvia E.; McCarthy, Mark J.; et al.

Cyanobacterial harmful algal blooms (Cyano-HABs) ate enhanced by anthropogenic pressures, including excessive nutrient (nitrogen, N, and.hosphoms, P) inputs and a warming climate. Severe eutrophication in aquatic systems is often manifested as non-N-2-fixing CyanoHABs (e.g., Microcystis spp.), but the biogeochemical relationship between N inputs/dynamics and CyanoHABs needs definition. Community biological ammonium (NH_4^+) demand (CBAD) relates N dynamics to total microbial productivity and NH4+ deprivation in aquatic systems. A mechanistic conceptual model was constructed by combining nutrient cycling and CBAD observations from a spectrum of lakes to assess N cycling interactions with CyanoHABs. Model predictions were supported with CBAD data from a Microcystis bloom in Maumee Bay, Lake Erie, during summer 2015. Nitrogen compounds are transformed to reduced, more bioavailable forms (e.g., NH_4^+ and urea) favored by CyanoHABs. During blooms, algal biomass increases faster than internal NH4+ regeneration rates, causing high CBAD values. High turnover rates from cell death and remineralization of labile organic matter consume oxygen and enhance denitrification. These processes drive eutrophic systems to NH_4^+ limitation or colimitation under warm, shallow conditions and support the need for dual nutrient (N and P) control.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(14): 7785-7793）

Ecophysiological Examination of the Lake Erie Microcystis Bloom in 2014: Linkages between Biology and the Water Supply Shutdown of Toledo, OH

Steffen, Morgan M.; Davis, Timothy W.; McKay, R. Michael L.; et al.

Annual cyanobacterial blooms dominated by Microcystis have occurred in western Lake Erie (U.S./Canada) during summer months since 1995. The production of toxins by bloom-forming cyanobacteria can lead to drinking water crises, such as the one experienced by the city of Toledo in August of 2014, when the city was rendered without drinking water for >2 days. It is important to understand the conditions and environmental cues that were driving this specific bloom to provide a scientific framework for management of future bloom events. To this end, samples were collected and metatranscriptomes generated coincident with the collection of environmental metrics for eight sites located in the western basin of Lake Erie, including a station proximal to the water intake for the city of Toledo. These data were used to generate a basin-wide ecophysiological fingerprint of Lake Erie Microcystis populations in August 2014 for comparison to previous bloom communities. Our observations and analyses indicate that, at the time of sample collection, Microcystis populations were under dual nitrogen (N) and phosphorus (P) stress, as genes involved in scavenging of these nutrients were being actively transcribed. Targeted analysis of urea transport and hydrolysis suggests a potentially important role for exogenous urea as a nitrogen source during the 2014 event. Finally, simulation data suggest a wind event caused microcystin-rich water from Maumee Bay to be transported east along the southern shoreline past the Toledo water intake. Coupled with a significant cyanophage infection, these results reveal that a combination of biological and environmental factors led to the disruption of the Toledo water supply. This scenario was not atypical of reoccurring Lake Erie blooms and thus may reoccur in the future.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(12): 6745-6755）

Removal of cyanobacteria and cyanotoxins from lake water by composites of bentonite with micelles of the cation octadecyltrimethyl ammonium (ODTMA)

Sukenik, Assaf; Viner-Mozzini, Yehudit; Tavassi, Mordechay; et al.

Cyanobacteria and their toxins present potential hazard to consumers of water from lakes, reservoirs and rivers, thus their removal via water treatment is essential. The capacity of nano-composites of Octadecyltrimethyl-ammonium (ODTMA) complexed with clay to remove cyanobacterial and their toxins from laboratory cultures and from lake water, was evaluated. Column filters packed with micelles of ODTMA complexed with bentonite and granulated were shown to significantly reduce the number of cyanobacteria cells or filaments and their corresponding toxins from laboratory cultures. Fluorescence measurements demonstrated that cyanobacteria cells lost their metabolic activity (photosynthesis) upon exposure to the micelle (ODTMA)-bentonite complex, or ODTMA monomers. The complex efficiently removed cyanobacteria toxins with an exceptional high removal rate of microcystins. The effectiveness of the complex in elimination of cyanobacteria was further demonstrated with lake water containing cyanobacteria and other phytoplankton species. These results and model calculations suggest that filters packed with granulated composites can secure the safety of drinking water in case of a temporary bloom event of toxic cyanobacteria.

（来源：WATER RESEARCH, 2017, 120: 165-173）

Toolset for assessment of natural recovery from legacy contaminated sediment: Case study of Pallanza Bay, Lake Maggiore, Italy

Lin, Diana; Cho, Yeo-Myoung; Oen, Amy; et al.

The aim of this study was to develop a toolset that can be used by site managers to assess and monitor natural attenuation processes in sediments contaminated with legacy hydrophobic organic contaminants. The toolset is composed of sediment traps to measure quality and deposition rate of incoming sediment under different hydrodynamic conditions, sediment cores to show trends in sediment bed concentrations over time, and passive samplers attached to a porewater probe frame to assess the mobility of buried contaminants and possible contaminant flux from sediment. These three tools were used together for the first time to assess the mobility of dichlorodiphenyltrichloroethane (DDT) contaminants in sediment in Pallanza Bay, Lake Maggiore, Italy. Depositing sediment and sediment cores were consistent in showing that DDT-contaminated sediment is undergoing burial by cleaner sediment. Elevated DDT concentrations from historical contamination seemed to be effectively buried and immobilized by ongoing deposition by cleaner sediment, because the positive flux from the elevated DDT concentration in the sediment porewater should not advance towards the sediment surface. The monitoring toolset introduced in this study enabled us to more effectively assess ongoing natural attenuation processes and provide more risk relevant data than traditional methods used in monitored natural recovery projects, such as bulk sediment concentrations from sediment cores. Our field assessment results suggest that incoming sediment from the Toce River have reduced DDT concentrations in the sediment compared to historic levels, and will continue to do so in locations where higher DDT concentrations are found within the bioactive layer.

（来源：WATER RESEARCH, 2017, 121: 109-119）

Winter weather and lake-watershed physical configuration drive phosphorus, iron, and manganese dynamics in water and sediment of ice-covered lakes

Joung, DongJoo; Leduc, Meagan; Ramcharitar, Benjamin; et al.

While decreasing occurrence and duration of lake ice cover is well-documented, biogeochemical dynamics in frozen lakes remain poorly understood. Here, we interpret winter physical and biogeochemical time series from eutrophic Missisquoi Bay (MB) and hyper-eutrophic Shelburne Pond (SP) to describe variable drivers of under ice biogeochemistry in systems of fundamentally different lake-watershed physical configurations (lake area, lake:watershed area). The continuous cold of the 2015 winter drove the MB sediment-water interface to the most severe and persistent suboxic state ever documented at this site, promoting the depletion of redox-sensitive phases in sediments, and an expanding zone of bottom water enriched in reactive species of Mn, Fe, and P. In this context, lake sediment and water column inventories of reactive chemical species were sensitive to the severity and persistence of subfreezing temperatures. During thaws, event provenance and severity impact lake thermal structure and mixing, water column enrichment in P and Fe, and thaw capability to suppress redox front position and internal chemical loading. Nearly identical winter weather manifest differently in

nearby SP, where the small surface and watershed areas promoted a warmer, less stratified water column and active phytoplankton populations, impacting biogeochemical dynamics. In SP, Fe and P behavior under ice were decoupled due to active biological cycling, and thaw impacts were different in distribution and composition due to SP's physical structure and related antecedent conditions. We find that under ice biogeochemistry is highly dynamic in both time and space and sensitive to a variety of drivers impacted by climate change.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1620-1635）

Sediment resuspension mechanisms and their contributions to high-turbidity events in a large lake

Valipour, Reza; Boegman, Leon; Bouffard, Damien; et al.

High-resolution field data, collected during April to October of 2008-2009, were analyzed to investigate the quantitative contribution of sediment resuspension to high-turbidity events in central Lake Erie. Resuspension events were distinguished within high-turbidity events according to turbidity, fluorescence and acoustic backscatter timeseries, as well as satellite images. We observed 16 high-turbidity events, causing a total duration of similar to 20 d (out of 344 d) with elevated nearbed turbidity (> 10 NTU). Of these events, 64% were correlated with algal biomass, with the remaining 18%, 5%, and 4% being attributed to sediment resuspension by surface waves, storm-generated currents and enhanced nearbed turbulence induced by high-frequency internal waves, respectively. This is the first time that resuspension by enhanced nearbed turbulence from high-frequency linear internal wave degeneration has been observed in a large lake. Resuspension was parameterized as a function of the instantaneous critical bottom velocity, bottom shear stress and the Shields parameter. From the in situ measurements, we suggest an extended Shields diagram for silty bed material that can be used to predict resuspension in other aquatic systems with similar sediment composition (similar to 20% cohesive sediment).

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1045-1065）

喀纳斯湖植物残体碳同位素记录的温度波动

王玉慧, 黄小忠, 彭卫, 等.

喀纳斯湖位于阿尔泰山脉南坡，区域森林植被茂盛，气候相对湿润。目前，阿尔泰山脉南坡的古温度记录主要来自于树轮宽度及短时间序列的树轮同位素，从结果来看，最近 100 多年来似乎没有表现出明显的增温趋势.在全球大部分地区 (尤其是北半球中高纬度地区) 普遍增温的情况下，是否这一区域因为某些特殊原因对全球气候变暖没有响应，抑或是该区域的树轮对长期趋势表现不明显?本文基于喀纳斯湖湖滨 29 m 水深处获得的 81 cm 岩芯，在陆生植物残体 AMS ^{14}C 定年的基础上，利用陆生 C3 植物残体 $\delta^{13}C$ 序列经过大气 CO_2 浓度校正，探讨过去近 600 年区域温度对全球气候变化的响应.本文 $\delta^{13}C$ 序列很好地记录了阿尔泰山脉南坡对气候变暖的响应。19 世纪前期以来温度在冷暖波动中持续上升；20 世纪是近 600 年来最暖的一个世纪.这种温度变化特征与俄罗斯阿尔泰地区的冰芯、湖泊沉积物和树轮重建的温度

记录以及周边地区的温度记录表现出比较一致的趋势，与北半球中高纬度地区多代用指标集成重建温度也表现出很好的一致性。此外，岩芯顶部的 $\delta^{13}C$ 序列表现出降温的趋势，这与近十几年来北半球许多地区出现的增温停滞现象以及喀纳斯湖邻近气象站的器测资料中表现明显的降温趋势相互印证。

（来源：科学通报，2017，24(62),2829-2839）

Development of large shallow Lake Peipsi (North-Eastern Europe) over the Holocene based on the stratigraphy of phosphorus fractions

Kisand, Anu; Kirsi, Anna-Liisa; Ehapalu, Kristiina; et al.

We studied high-resolution stratigraphy of phosphorus (P) forms in the Holocene sediments of large shallow Lake Peipsi (Estonia/Russia) in order to evaluate the lake ecosystem response to environmental changes and track the lake's eutrophication history. We distinguished four main periods in the history of Lake Peipsi, each having likely different factors responsible for the distribution pattern of P fractions in the sediment record. We suggest that in the oldest period, from ca. 10.4 up to 7.3 cal ka BP, the sediment composition was mainly determined by rising water level, the second period dated 7.3-2.3 cal ka BP was governed mainly by stable hydrology and P loading, while the third period between 2.3 and 0 cal ka BP was primarily influenced by emerging anthropogenic impact. The sediments from the last period since 1950 are subject of ongoing diagenetic processes but still reflect rapid eutrophication of the lake. Comparison of the results with periods derived from other sediment proxies proved the usability of P fractions stratigraphy in reconstruction of the development of lakes.

（来源：JOURNAL OF PALEOLIMNOLOGY，2017，58(1)：43-56）

Evidence for the Importance of Atmospheric Nitrogen Deposition to Eutrophic Lake Dianchi, China

Zhan, Xiaoying; Zhou, Feng; Liu, Xuejun; et al.

Elevated atmospheric nitrogen (N) depcisition has significantly influenced aquatic ecosystems, especially with regard to their N budgets and phytoplankton growth potentials. Compared to a considerable number of studies on oligotrophic lakes and oceanic waters, little evidence for the importance of N deposition has been generated for eutrophic lakes, even though emphasis has been placed on reducing external N inputs to control eutrophication in these lakes. Our high-resolution observations of atmospheric depositions and riverine inputs of biologically reactive N species into eutrophic Lake Dianchi (the sixth largest freshwater lake in China) shed new light onto the contribution of N deposition to total N loads. Annual N deposition accounted for 15.7% to 16.6% of total N loads under variable precipitation conditions, 2-fold higher than previous estimates (7.6%) for the Lake Dianchi. The proportion of N deposition to total N loads further increased to 27-48% in May and June when toxic blooms of the ubiquitous non-N-2 fixing cyanobacteria Microcystis spp. are initiated and proliferate. Our observations reveal that reduced N (59%) contributes a greater amount than oxidized N to total N deposition, reaching 56-83% from late spring to summer. Progress toward mitigating eutrophication in Lake Dianchi and other bloom-impacted eutrophic lakes will be difficult without reductions in ammonia emissions and subsequent N deposition.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017,51(12): 6699-6708）

Evaluation of CDOM sources and their links with water quality in the lakes of Northeast China using fluorescence spectroscopy

Zhao, Ying; Song, Kaishan; Wen, Zhidan; et al.

The spatial distributions of the fluorescence intensities F-max), for chromophoric dissolved organic matter (CDOM) components, the fluorescence indices (FI370 and FI310) and their correlations with water quality of 19 lakes in the Songhua River Basin (SHRB) across semiarid regions of Northeast China were examined with the data collected in September 2012 and 2015. The 19 lakes were divided into two groups according to EC (threshold value = 800 mu S cm(-1)): fresh water (N=13) and brackish water lakes (N=6). The fluorescent characteristics of CDOM in the 19 lakes were investigated using excitation-emission matrix fluorescence spectroscopy (EEM) coupled with parallel factor (PARAFAC) and multivariate analysis. Two humic-like components (C1 and C3), one tryptophan-like component (C2), and one tyrosine-like component (C4) were identified by PARAFAC. The component C4 was not included in subsequent analyses due to the strong scatter in some colloidal water samples from brackish water lakes. The correlations between F-max for the three EEM-PARAFAC extracted CDOM components C1-C3, the fluorescence indices (FI370 and FI310) and the water quality parameters (i.e., TN, TP, Chl-a, pH, EC, turbidity (Turb) and dissolved organic carbon (DOC)) were determined by redundancy analysis (RDA). The results of RDA analysis showed that spatial variation in land cover, pollution sources, and salinity/EC gradients in water quality affected F-max for the fluorescent components C1-C3 and the fluorescence indices (FI370 and FI310). Further examination indicated that the CDOM fluorescent components and the fluorescence indices (FI370 and F1310) did not significantly differ (t-test, $p > 0.05$) in fresh water (N=13) and brackish water lakes (N=6). There was a difference in the distribution of the average F-max for the CDOM fluorescent components between Cl to C3 from agricultural sources and urban wastewater sources in hypereutrophic brackish water lakes. The F-max for humic-like components Cl and C3 spatially varied with land cover among the 19 lakes. Our results indicated that the spatial distributions of F-max for CDOM fluorescent components and their correlations with water quality can be evaluated by EEM-PARAFAC and multivariate analysis among the 19 lakes across semiarid regions of Northeast China, which has potential implication for lakes with similar genesis.

（来源：JOURNAL OF HYDROLOGY, 2017, 550: 80-91）

Long-term chloride concentrations in North American and European freshwater lakes

Dugan HA, Summers JC, Skaff NK; et al.

Anthropogenic sources of chloride in a lake catchment, including road salt, fertilizer, and wastewater, can elevate the chloride concentration in freshwater lakes above background levels. Rising chloride concentrations can impact lake ecology and ecosystem services such as fisheries and the use of lakes as drinking water sources. To analyze the spatial extent and magnitude of increasing chloride concentrations in freshwater lakes, we amassed a database of 529 lakes in Europe and North America that had greater than or equal to ten years of chloride data. For each lake, we calculated climate statistics of mean annual total precipitation and mean monthly air temperatures from gridded global datasets. We also quantified land cover metrics, including road density and impervious surface, in buffer zones of 100

to 1,500 m surrounding the perimeter of each lake. This database represents the largest global collection of lake chloride data. We hope that long-term water quality measurements in areas outside Europe and North America can be added to the database as they become available in the future.

（来源：Scientific Data, 2017, 4: 170101）

The Chaoborus pump: Migrating phantom midge larvae sustain hypolimnetic oxygen deficiency and nutrient internal loading in lakes

Tang, Kam W.; Flury, Sabine; Grossart, Hans-Peter; et al

Hypolimnetic oxygen demand in lakes is often assumed to be driven mainly by sediment microbial processes, while the role of Chaoborus larvae, which are prevalent in eutrophic lakes with hypoxic to anoxic bottoms, has been overlooked. We experimentally measured the respiration rates of C flavicans at different temperatures yielding a Q(10) of 1.44-1.71 and a respiratory quotient of 0.84-0.98. Applying the experimental data in a system analytical approach, we showed that migrating Chaoborus larvae can significantly add to the water column and sediment oxygen demand, and contribute to the observed linear relationship between water column respiration and depth. The estimated phosphorus excretion by Chaoborus in sediment is comparable in magnitude to the required phosphorus loading for eutrophication. Migrating Chaoborus larvae thereby essentially trap nutrients between the water column and the sediment, and this continuous internal loading of nutrients would delay lake remediation even when external inputs are stopped.

（来源：WATER RESEARCH, 2017, 122: 36-41）

Behavioral responses to annual temperature variation alter the dominant energy pathway, growth, and condition of a cold-water predator

Matthew M. Guzzo; Paul J. Blanchfield; Michael D. Rennie

There is a pressing need to understand how ecosystems will respond to climate change. To date, no long-term empirical studies have confirmed that fish populations exhibit adaptive foraging behavior in response to temperature variation and the potential implications this has on fitness. Here, we use an unparalleled 11-y acoustic telemetry, stable isotope, and mark–recapture dataset to test if a population of lake trout (Salvelinus namaycush), a cold-water stenotherm, adjusted its use of habitat and energy sources in response to annual variations in lake temperatures during the open-water season and how these changes translated to the growth and condition of individual fish. We found that climate influenced access to littoral regions in spring (data from telemetry), which in turn influenced energy acquisition (data from isotopes), and growth (mark–recapture data). In more stressful years, those with shorter springs and longer summers, lake trout had reduced access to littoral habitat and assimilated less littoral energy, resulting in reduced growth and condition. Annual variation in prey abundance influenced lake trout foraging tactics (i.e., the balance of the number and duration of forays) but not the overall time spent in littoral regions. Lake trout greatly reduced their use of littoral habitat and occupied deep pelagic waters during the summer. Together, our results provide clear evidence that climate-mediated behavior can influence the dominant energy pathways of top predators, with implications ranging from individual fitness to food web stability.

（来源：Chinese Science Bulletin, 2017, 114(37): 9912–9917）

Ecological speciation in a generalist consumer expands the trophic niche of a dominant predator

Stephen M. Thomas, Chris Harrod, Brian Hayden; et al.

Ecological speciation – whereby an ancestral founder species diversifies to fill vacant niches – is a phenomenon characteristic of newly formed ecosystems. Despite such ubiquity, ecosystem-level effects of such divergence remain poorly understood. Here, we compared the trophic niche of European whitefish (Coregonus lavaretus) and their predators in a series of contrasting subarctic lakes where this species had either diversified into four ecomorphologically distinct morphs or instead formed monomorphic populations. We found that the trophic niche of whitefish was almost three times larger in the polymorphic than in the monomorphic lakes, due to an increase in intraspecific specialisation. This trophic niche expansion was mirrored in brown trout (Salmo trutta), a major predator of whitefish. This represents amongst the first evidence for ecological speciation directly altering the trophic niche of a predator. We suggest such mechanisms may be a common and important – though presently overlooked – factor regulating trophic interactions in diverse ecosystems globally.

（来源：Scientific Reports, 2017, doi:10.1038/s41598-017-08263-9）

Winds and the distribution of nearshore phytoplankton in a stratified lake

Cyr, Helenel.

The distribution of phytoplankton in lakes is notoriously patchy and dynamic, but wind-driven currents and algal buoyancy motility are thought to determine where algae accumulate. In this study, nearshore phytoplankton were sampled from different parts of a lake basin twice a day for 4-5 consecutive days, in the spring and in late summer, to test whether short-term changes in phytoplankton biomass and community composition can be predicted from wind-driven currents. On windy days, phytoplankton biomass was higher at downwind than at upwind nearshore sites, and the magnitude of this difference increased linearly with increasing wind speed. However, contrary to the generally assumed downwind phytoplankton aggregations, these differences were mostly due to upwelling activity and the dilution of phytoplankton at upwind nearshore sites. The distribution of individual taxa was also related to wind speed, but only during late stratification (except for cryptophytes), and these relationships were consistent with the buoyancy and motility of each group. On windy days, large diatoms and cyanobacteria concentrated upwind, neutrally buoyant taxa (green algae, small diatoms) were homogeneously distributed, and motile taxa (cryptophytes, chrysophytes, dinoflagellates) concentrated downwind. Predictable differences in the biomass and composition of phytoplankton communities could affect the efficiency of trophic transfers in nearshore areas.

（来源：WATER RESEARCH, 2017,122: 114-127）

Under-ice availability of phytoplankton lipids is key to freshwater zooplankton winter survival

Guillaume Grosbois, Heather Mariash,Tobias Schneider; et al.

Shortening winter ice-cover duration in lakes highlights an urgent need for research focused on under-ice ecosystem dynamics and their contributions to whole-ecosystem processes. Low temperature, reduced light and consequent changes in autotrophic and heterotrophic resources alter the diet for long-lived consumers, with consequences on their metabolism in winter. We show in a survival experiment that the copepod Leptodiaptomus minutus in a boreal lake does not survive five months under the ice without food. We then report seasonal changes in phytoplankton, terrestrial and bacterial fatty acid (FA) biomarkers in seston and in four zooplankton species for an entire year. Phytoplankton FA were highly available in seston (2.6 μg L^{-1}) throughout the first month under the ice. Copepods accumulated them in high quantities (44.8 μg mg dry weight−1), building lipid reserves that comprised up to 76% of body mass. Terrestrial and bacterial FA were accumulated only in low quantities (<2.5 μg mg dry weight−1). The results highlight the importance of algal FA reserve accumulation for winter survival as a key ecological process in the annual life cycle of the freshwater plankton community with likely consequences to the overall annual production of aquatic FA for higher trophic levels and ultimately for human consumption.

（来源：Scientific Reports, 2017, doi:10.1038/s41598-017-10956-0）

Reconciling the opposing effects of warming on phytoplankton biomass in 188 large lakes

BM Kraemer, T Mehner, R Adrian.

Lake ecosystems are deeply integrated into local and regional economies through recreation, tourism, and as sources of food and drinking water. Shifts in lake phytoplankton biomass, which are mediated by climate warming will alter these benefits with potential cascading effects on human well-being. The metabolic theory of ecology suggests that warming reduces lake phytoplankton biomass as basal metabolic costs increase, but this hypothesis has not been tested at the global scale. We use satellite-based estimates of lake surface temperature (LST) and lake surface chlorophyll-a concentration (chl-a; as a proxy for phytoplankton biomass) in 188 of the world's largest lakes from 2002-2016 to test for interannual associations between chl-a and LST. In contrast to predictions from metabolic ecology, we found that LST and chl-a were positively correlated in 46% of lakes ($p < 0.05$). The associations between LST and chl-a depended on lake trophic state; warming tended to increase chl-a in phytoplankton-rich lakes and decrease chl-a in phytoplankton-poor lakes. We attribute the opposing responses of chl-a to LST to the effects of temperature on trophic interactions, and the availability of resources to phytoplankton. These patterns provide insights into how climate warming alters lake ecosystems on which millions of people depend for their livelihoods.

（来源：Scientific Reports, 2017, doi:10.1038/s41598-017-11167-3）

A High-Throughput DNA-Sequencing Approach for Determining Sources of Fecal Bacteria in a LakeSuperior Estuary

Brown, Clairessa M.; Staley, Christopher; Wang, Ping; et al.

Current microbial source-tracking (MST) methods, employed to determine sources of fecal contamination

in waterways, use molecular markers targeting host associated bacteria in animal or human feces. However, there is a lack of knowledge about fecal microbiome composition in several animals and imperfect marker specificity and sensitivity. To overcome these issues, a community-based MST method has been developed. Here, we describe a study done in the Lake Superior Saint Louis River estuary using SourceTracker, a program that calculates the source contribution to an environment. High-throughput DNA sequencing of micro biota from a diverse collection of fecal samples obtained from 11 types of animals (wild, agricultural, and domesticated) and treated effluent (n = 233) was used to generate a fecal library to perform community-based MST. Analysis of 319 fecal and environmental samples revealed that the community compositions in water and fecal samples were significantly different, allowing for the determination of the presence of fecal inputs and identification of specific sources. SourceTracker results indicated that fecal bacterial inputs into the Lake Superior estuary were primarily attributed to wastewater effluent and, to a lesser extent, geese and gull wastes. These results suggest that a community-based MST method may be another useful tool for determining sources of aquatic fecal bacteria.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(15): 8263-8271）

Nitrogen and phosphorus colimitation of phytoplankton in Lake Baikal: Insights from a spatial survey and nutrient enrichment experiments

O'Donnell, Daniel R.; Wilburn, Paul; Silow, Eugene A.; et al.

Lake Baikal, Siberia, is the most biodiverse freshwater lake on Earth. However, despite decades of painstaking limnological research on Baikal, broad spatial data on nutrient (nitrogen (N), phosphorus (P), silica (Si)) concentrations and temperature are sparse, as is our understanding of the bottom-up factors that limit phytoplankton in the lake. Earlier studies have suggested both N and P as limiting nutrients in Baikal, but the evidence, mostly based on elemental ratios, is limited and somewhat conflicting. We present experimental evidence that N and P co-limit phytoplankton productivity in some areas of Baikal during summer, along with the results of a comprehensive spatial survey of surface temperature, nutrients and chlorophyll a (Chl a) in Lake Baikal that support the experimental finding of colimitation. Surface water incubations from two trophically contrasting locations revealed co-limitation by N and P, as well as a positive effect of temperature (fluorescence after 5 d was similar to 10% higher at 15 degrees C than at 10 degrees C). In a linear model of the survey data (26 sampling locations), N, P, and their interaction (N x P) were all significant predictors of Chl a concentration, indicating that either N or P (or both) may limit summer phytoplankton, depending on location. In contrast to the incubation experiments, temperature was not a significant predictor of Chl a concentration across the 26 sites we sampled. Lake Baikal is undergoing rapid warming and increased nutrient loading, which may boost phytoplankton productivity in the lake; however, the magnitude of this response will depend on ratios of soluble N and P inputs.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1383-1392）

Toward Quantitative Understanding of the Bioavailability of Dissolved Organic Matter in FreshwaterLake during Cyanobacteria Blooming

Bai, Leilei; Cao, Chicheng; Wang, Changhui; et al.

Occurrence of cyanobacterial harmful algal blooms (CyanoHAB) can induce considerable patchiness in the concentration and bioavailability of dissolved organic matter (DOM), which could influence biogeochemical processes and fuel microbial metabolism. In the present study, a laboratory 4-stage plug-flow bioreactor was used to successfully separate the CyanoHAB-derived DOM isolated from the eutrophic Lake Taihu (China) into continuum classes of bioavailable compounds. A combination of new state-of-the-art tools borrowed from analytical chemistry and microbial ecology were used to characterize quantitatively the temporary evolution of DOM and to get deeper insights into its bioavailability. The results showed a total 79% dissolved organic carbon loss over time accompanied by depletion of protein-like fluorescent components, especially the relatively hydrophilic ones. However, hydrophilic humic-like fluorescent components exhibited bioresistant behavior. Consistently, ultrahigh resolution mass spectrometry (FTICR-MS) revealed that smaller, less aromatic, more oxygenated, and nitrogen-rich molecules were preferentially consumed by microorganisms with the production of lipid-like species, whereas recalcitrant molecules were primarily composed of carboxylic-rich alicyclic compounds. Moreover, the bioavailability of DOM was negatively correlated with microbial community diversity in the bioreactor. Results from this study provide deeper insights into the fate of DOM and relevant biogeochemical processes in eutrophic lakes.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(11): 6018-6026）

Effects of episodic sediment resuspension on phytoplankton in Lake Taihu: focusing on photosynthesis, biomass and community composition

Ding, Yanqing; Qin, Boqiang; Deng, Jianming; et al.

Sediment resuspension is an important characteristic of large shallow lakes. To further understand the influence of sediment resuspension on the nutrients release, the algal photosynthetic activity, algal biomass and algal community composition, a 2 x 5 factorial (2 water types and 5 turbulence intensities) bioassay experiment was carried out for 2 weeks. 2 water types: one type water was filtered through GF/F filter to remove all indigenous algae (Filtered group) and the other type was source water without filtering through GF/F filter (Non-filtered group). 5 turbulence intensities in the experiment simulated the different intensity of the field wind-induced turbulence in Lake Taihu, with different turbidities (0, 30, 70, 150, 250 NTUs). Results showed that sediment resuspension had significant effects on the nutrients release that could be absorbed to support algae growing. Different turbulence intensities had no significant effects on the photosynthetic activities. The time variation of photosynthetic parameters in the Filtered and Non-filtered groups indicated that algae could moderate themselves to adapt to different intensities turbulence environment to be more in favor of photosynthesis. In addition, sediment resuspension also brought sediment-associated algae back into the water body increasing the algal biomass. The community composition in the Filtered group and Non-filtered group showed that the new phytoplankton community formed from the resuspended algae was similar to the original community. So, the research highlights the importance of sediment resuspension in long-term management goals and restoration efforts for these types of ecosystems.

（来源：AQUATIC SCIENCES, 2017, 79(3): 617-629）

Pelagic food web response to whole lake N fertilization

Deininger, A.; Faithfull, C. L.; Karlsson, J.;.et al.

Anthropogenic activities are increasing inorganic nitrogen (N) loadings to unproductive boreal lakes. In many of these lakes phytoplankton are N limited, consequently N fertilization may affect ecosystem productivity and consumer resource use. Here, we conducted whole lake inorganic N fertilization experiments with six small N limited unproductive boreal lakes (three control and three N enriched) in an area receiving low N deposition with one reference and two impact years. Our aim was to assess the effects of N fertilization on pelagic biomass production and consumer resource use. We found that phytoplankton primary production (PP) and biomass, and the PP: bacterioplankton production ratio increased after fertilization. As expected, the relative contribution of phytoplankton derived resources (autochthony) that supported the crustacean zooplankton community increased. Yet, the response in the consumer community was modest with autochthony only increasing in one of the three major zooplankton groups and with no effect on zooplankton biomass. In conclusion, our findings imply that newly available phytoplankton energy derived from N fertilization was not efficiently transferred up to zooplankton, indicating a mismatch between producer energy supply and consumer energy use with potential accumulation of phytoplankton biomass as the result.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1498-1511）

The effects of experimental whole-lake mixing on horizontal spatial patterns of fish and Zooplankton

Emily, Heald; Hrabik, Thomas R.; Li, Yang; et al.

We examined horizontal spatial patterns of fish densities and zooplankton biomass at a fine spatial scale of 50 m across seasons before, during, and after an experimental lake destratification to determine how interacting trophic levels may respond to alteration of thermal stratification. We used semivariogram analysis to calculate maximum distances of autocorrelation for fish and zooplankton separately, and cross variograms to determine whether relationships between fish and zooplankton are positive or negative. Fish became more dispersed during the manipulation, likely due to a flight response with the loss of preferred cold water habitat. There were no changes in zooplankton horizontal distributions with mixing, but we detected seasonal trends in distribution and biomass. We detected positive relationships between fish densities and zooplankton biomass for portions of the year, but did not detect any negative relationships. There was no effect of lake mixing on spatial interactions between fish and zooplankton. Our results indicate that external factors, such as seasonal wind patterns, may drive whole-lake zooplankton distributions, and that fish respond horizontally to change in vertically structured processes, especially when reliant on depth-dependent variables such as cold water.

（来源：AQUATIC SCIENCES, 2017, 79(3): 543-556）

Contrasting patterns of diversity of abundant and rare bacterioplankton in freshwater lakes along an elevation gradient

Li, Huabing; Zeng, Jin; Ren, Lijuan; et al.

Bacterial communities comprise large numbers of species and normally include a few abundant taxa and

many rare taxa. These two subcommunities may have fundamentally different ecological roles, and it is not clear whether their diversity patterns along elevation gradients vary. In this study, we investigated the diversity of bacterioplankton and their subcommunities, i.e., abundant and rare bacterioplankton, in lakes across gradual elevations from 525 m to 4652 m at Siguniang Mountain in western China via the high-throughput sequencing of bacterial 16S rRNA genes. Elevation showed strong influence on bacterioplankton community composition (BCC) and that the dissimilarity of BCC increased with increasing differences in elevation. However, the elevational distance-decay rate of abundant bacterioplankton was higher than that of rare bacterioplankton. Abundant bacterioplankton were more sensitive to changes of environmental factors than rare bacterioplankton. We observed a marginal increase in alpha diversity, estimated as operational taxonomic unit richness and phylogenetic diversity, of overall bacterioplankton with increasing elevation. The alpha diversity of abundant bacterioplankton decreased monotonically with elevation; in contrast, the alpha diversity of rare bacterioplankton increased monotonically with elevation. Null model tests indicated that environmental filtering played a dominant role in overall bacterioplankton community assembly along the elevation gradient, while there was decreased contribution of environmental selection to rare bacterioplankton in smaller lakes at higher elevation. Our results revealed that abundant bacterioplankton followed the general elevation diversity theory commonly found for plants and animals in freshwater lakes, whereas rare bacterioplankton did not follow this tenet.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(4): 1570-1585）

Ubiquity and quantitative significance of bacterioplankton lineages inhabiting the oxygenated hypolimnion of deep freshwater lakes

Yusuke Okazaki, Shohei Fujinaga, Atsushi Tanaka; et al.

The oxygenated hypolimnion accounts for a volumetrically significant part of the global freshwater systems. Previous studies have proposed the presence of hypolimnion-specific bacterioplankton lineages that are distinct from those inhabiting the epilimnion. To date, however, no consensus exists regarding their ubiquity and abundance, which is necessary to evaluate their ecological importance. The present study investigated the bacterioplankton community in the oxygenated hypolimnia of 10 deep freshwater lakes. Despite the broad geochemical characteristics of the lakes, 16S rRNA gene sequencing demonstrated that the communities in the oxygenated hypolimnia were distinct from those in the epilimnia and identified several predominant lineages inhabiting multiple lakes. Catalyzed reporter deposition fluorescence in situ hybridization revealed that abundant hypolimnion-specific lineages, CL500-11 (Chloroflexi), CL500-3, CL500-37, CL500-15 (Planctomycetes) and Marine Group I (Thaumarchaeota), together accounted for 1.5–32.9% of all bacterioplankton in the hypolimnion of the lakes. Furthermore, an analysis of single-nucleotide variation in the partial 16S rRNA gene sequence (oligotyping) suggested the presence of different sub-populations between lakes and water layers among the lineages occurring in the entire water layer (for example, acI-B1 and acI-A7). Collectively, these results provide the first comprehensive overview of the bacterioplankton community in the oxygenated hypolimnion of deep freshwater lakes.

（来源：The ISME Journal, 2017, 11: 2279-2293）

Are diatoms recovering to pre-acidification assemblages in a warming world? Revisiting Killarney Provincial Park lakes (Ontario, Canada)

Sivarajah, Branaavan; Ruhland, Kathleen M.; Smol, John R.

Previous paleolimnological assessments have shown that many poorly buffered Canadian Shield lakes in the Sudbury (Ontario) region, including George and Lumsden lakes in Killarney Provincial Park (similar to 60 km southwest of Sudbury), acidified as a result of metal mining and smelting activities since the 1880s. In this paper, we revisit George and Lumsden lakes to conduct a paleolimnological re-assessment of these sites 25 years after the original sediment cores were collected. This updated study represents a period of chemical recovery from acidification, as well as the acceleration of regional climate warming. In agreement with the earlier paleolimnological study, our results also show that diatoms responded to acidification beginning 1920/30s, characterized by an increase in the relative abundance of acidobiontic Asterionella ralfsii. Although the most recent diatom assemblages (past 30 years) suggest that pH has likely returned to pre-acidification levels, the arrival and increases in diatom taxa absent in earlier sedimentary intervals (such as Asterionella formosa, Eunotia exigua, Frustulia magaliesmontana, and Kobayasiella subtilissima) signify the onset of new environmental conditions. The marked difference in composition between recent and pre-acidification diatom assemblages suggests a response to multiple environmental stressors, particularly regional warming, that has likely affected the trajectory of biological recovery. In these oli-gotrophic lakes, the recent increase in the relative abundance of Asterionella formosa, a rise in whole lake primary production, and a higher chrysophyte scale : diatom valve index suggest that regional warming has influenced the observed algal re-organization. Our paleolimnological investigation shows that, much like what had been reported for the Cladocera, the algal communities of these lakes have crossed climate-related limnological thresholds and are not returning to pre-acidification assemblages.

（来源：FUNDAMENTAL AND APPLIED LIMNOLOGY, 2017, 190(1): 13-28）

Depth distribution of the native freshwater mussel (Echyridella menziesii) in warm monomictic lakes: Towards a general model for mussels in lakes

Cyr, Helene; Phillips, Ngaire; Butterworth, Joseph.

Freshwater mussels are large, long-lived and can be important contributors to benthic biomass and processes. They are currently one of the most endangered groups of organisms and it is urgent to develop tools to predict their distribution and the potential effect of their decline or disappearance on these ecosystems. Cyr () showed that the distribution of Elliptio complanata (Unionidae) in Canadian Shield lakes is constrained by physical forces. Here we test Cyr's model in a very different group of mussels (Hyriidae), in different types of lakes (warm monomictic lakes) that cover a wider range of sizes and morphologies. We use data on the depth distribution of Echyridella menziesii along 38 depth transects in 11 warm monomictic lakes located in New Zealand to test three hypotheses: (1) wave-mixed depth and bottom slope are good predictors of the depth of maximum mussel density, (2) thermocline depth does not limit the distribution of mussels in warm monomictic lakes, and (3) the lower boundary of mussel distribution is determined by the mud deposition boundary. Mussels in New Zealand lakes reach their maximum density within the epilimnion, at increasing depths with increasing lake size and increasing site exposure. The only exceptions were found in large lakes or parts of large lakes with

shallow bathymetric slopes, where high mussel densities were found in relatively shallow waters. Mussel density peaks are found much deeper in the volcanic New Zealand lakes than in (glacial) Canadian Shield lakes, a discrepancy we hypothesise could be due to lower sediment stability along the steep slopes of volcanic lakes. Mussels appear to have a very broad range of depth distribution in these warm monomictic lakes. The deepest samples collected in deep oligotrophic lakes (down to 12-30m) all contained mussels, often in substantial numbers (up to 2-186 mussels/m(2)), and can only offer a minimal estimate of the lower boundary of their distribution. However, the distribution of mussels in highly productive lakes is limited by hypolimnetic anoxia, and therefore by position of the thermocline.Echyridella menziesii are found in a wide range of substrates. Mussels were found below the mud deposition boundary in many lakes, suggesting that the presence of fine flocculent organic sediments does not prevent them from living in deep areas. The distribution of E.menziesii in warm monomictic lakes appears to be governed by relatively simple physical processes. This supports findings for a very different group of mussels in Canadian Shield lakes and suggests that general models could be developed to predict the distribution of mussels in lakes.

（来源：FRESHWATER BIOLOGY, 2017, 62(8): 1487-1498）

Feeding and nutrient excretion of the New Zealand freshwater mussel Echyridella menziesii (Hyriidae, Unionida): implications for nearshore nutrient budgets in lakes and reservoirs

Cyr, Helene; Collier, Kevin J.; Clearwater, Susan J.; et al.

Native freshwater mussels (Bivalvia: Unionoida) can represent a large portion of benthic biomass, but their functional role is still poorly understood. We sampled Echyridella menziesii (Hyriidae) in six lakes from two regions of the North Island of New Zealand to develop general allometric relationships for predicting filtration, excretion and biodeposition rates. Experimental containers were set up in the field (no-flow conditions) to measure filtration and biodeposition using natural phytoplankton communities, and excretion in filtered lake water. Filtration rates were 0.02-1.3 L mussel(-1) h(-1) and increased with increasing mussel size (R-2 = 0.13, P = 0.023). Stable isotope analysis suggests that mussels also assimilate food from non-planktonic origins. Nitrogen excretion rates were 4-50 mu g N mussel(-1) h(-1) and increased with mussel size (R-2 = 0.70, P < 0.0001), with no difference between regions (ANCOVA, P > 0.3). In contrast, phosphorus excretion rates did not vary with mussel size, and were much lower in Rotorua than Waikato lakes (2 vs 5 mu g P mussel(-1) h(-1)). The reason for this regional difference is unclear, but suggests that mussels could contribute different N: P ratios to nearshore nutrient budgets in different types of lakes. Biodeposits represented 50-70% of the N, and 25-70% of the P recycled. Echyridella filters and excretes nutrients at rates similar to those measured in North American and European mussels (Unionidae, Margaritiferidae). Mussels could be important contributors of nutrients in areas where they are abundant, and their inclusion into nutrient budget models could improve the predictions of nearshore nutrient fluxes in lakes and reservoirs.

（来源：AQUATIC SCIENCES, 2017, 79(3): 557-571）

Delving deeper: Metabolic processes in the metalimnion of stratified lakes

Giling, Darren P.; Staehr, Peter A.; Grossart, Hans Peter; et al.

Many lakes exhibit seasonal stratification, during which they develop strong thermal and chemical gradients. An expansion of depth-integrated monitoring programs has provided insight into the importance of organic carbon processing that occurs below the upper mixed layer. However, the chemical and physical drivers of metabolism and metabolic coupling remain unresolved, especially in the metalimnion. In this depth zone, sharp gradients in key resources such as light and temperature co-occur with dynamic physical conditions that influence metabolic processes directly and simultaneously hamper the accurate tracing of biological activity. We evaluated the drivers of metalimnetic metabolism and its associated uncertainty across 10 stratified lakes in Europe and North America. We hypothesized that the metalimnion would contribute highly to whole-lake functioning in clear oligotrophic lakes, and that metabolic rates would be highly variable in unstable polymictic lakes. Depth-integrated rates of gross primary production (GPP) and ecosystem respiration (ER) were modelled from diel dissolved oxygen curves using a Bayesian approach. Metabolic estimates were more uncertain below the epilimnion, but uncertainty was not consistently related to lake morphology or mixing regime. Metalimnetic rates exhibited high day-to-day variability in all trophic states, with the metalimnetic contribution to daily whole-lake GPP and ER ranging from 0% to 87% and < 1% to 92%, respectively. Nonetheless, the metalimnion of low-nutrient lakes contributed strongly to whole-lake metabolism on average, driven by a collinear combination of highlight, low surface-water phosphorous concentration and high metalimnetic volume. Consequently, a single-sensor approach does not necessarily reflect whole-ecosystem carbon dynamics in stratified lakes.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(3): 1288-1306）

From dimictic to monomictic: Empirical evidence of thermal regime transitions in three deep alpine lakes in Austria induced by climate change

Ficker, Harald; Luger, Martin; Gassner, Hubert

Duration and timing of thermal stratification and the period of vertical mixing are crucial for internal chemical and biological processes of deep temperate lakes. Climatic changes induced a prolongation of thermal stratification in many lakes over the last decades. This study provides a comparative assessment of observed climate-induced changes in thermal and limnological properties of three originally dimictic temperate lakes. We analysed 41 years of vertical sampling data of Lake Irrsee (IR), Mondsee (MO) and Hallstatter See (HA) located in the Salzkammergut lake district of Austria. We examined temperatures in surface and bottom waters, quantified changes in thermal regimes and investigated the development of hypoxia,anoxia and phosphorus concentrations of the three lakes from 1975 to 2015. Mean annual surface-water temperatures increased substantially, whereas bottom-water temperatures showed insignificant trends in IR and MO and a slight rising trend in HA. Resulting higher vertical temperature gradients caused stronger thermal stabilities of the lakes. Based on calculations of daily thermal stability, all three lakes showed a significant prolongation of the stratification period with +31days (7days) in IR, +37days (7days) in MO and +28 (+/- 8days) in HA. We observed greater changes in the timing of onset of stratification compared to the changes in the timing of stratification termination (IR onset -19days versus

termination +11days, MO onset -21days versus termination +16days, HA onset -16days versus termination +12days). We found that expanding seasonal hypoxia and anoxia were correlated to prolonged seasonal stratifications and to increasing phosphorus concentrations inbottom-water layers. However, higher phosphorus concentrations in bottomwaters did not raise the lakes volume-weighted total phosphorus concentrations. Under ongoing climate change, alterations in the thermal characteristics will inevitably lead to a transition of mixing regimes from a dimictic to a monomictic mixing pattern in originally ice-covered temperate lakes. Our investigation revealed that this transition will be earlier in larger and deeper lakes.

（来源：FRESHWATER BIOLOGY, 2017, 62(8): 1335-1345）

Increased sediment oxygen flux in lakes and reservoirs: The impact of hypolimnetic oxygenation

Bierlein, Kevin A.; Rezvani, Maryam; Socolofsky, Scott A.; et al.

Hypolimnetic oxygenation is an increasingly common lake management strategy for mitigating hypoxia/anoxia and associated deleterious effects on water quality. A common effect of oxygenation is increased oxygen consumption in the hypolimnion and predicting the magnitude of this increase is the crux of effective oxygenation system design. Simultaneous measurements of sediment oxygen flux ($J(O_2)$) and turbulence in the bottom boundary layer of two oxygenated lakes were used to investigate the impact of oxygenation on $J(O_2)$. Oxygenation increased $J(O_2)$ in both lakes by increasing the bulk oxygen concentration, which in turn steepens the diffusive gradient across the diffusive boundary layer. At high flow rates, the diffusive boundary layer thickness decreased as well. A transect along one of the lakes showed $J(O_2)$ to be spatially quite variable, with near-field and far-field $J(O_2)$ differing by a factor of 4. Using these in situ measurements, physical models of interfacial flux were compared to microprofile-derived $J(O_2)$ to determine which models adequately predict $J(O_2)$ in oxygenated lakes. Models based on friction velocity, turbulence dissipation rate, and the integral scale of turbulence agreed with microprofile-derived $J(O_2)$ in both lakes. These models could potentially be used to predict oxygenation-induced oxygen flux and improve oxygenation system design methods for a broad range of reservoir systems.

（来源：WATER RESOURCES RESEARCH, 2017, 53(6): 4876-4890）

鄱阳湖及五河尾闾演变特征

唐洪武，袁赛瑜，肖洋，等.

自然、气候变化和人类活动引起的江-湖-河关系的变化导致了鄱阳湖湖区及五河尾闾的演变加剧，给鄱阳湖湖区及五河尾闾地区的水文、环境、生态以及社会经济发展等造成了极大的响应性影响。本文对近年来鄱阳湖湖区和五河尾闾演变，鄱阳湖、长江和“五河”的江-湖-河关系尤其是水沙关系的变化及其驱动机制，以及相应的调控对策进行了综述。对江-湖-河关系及调控研究的研究方向提出了展望。

（来源：中国科学：技术科学，2017，47(8)：805-813）

Little impact of the Three Gorges Dam on recent decadal lake decline across China's Yangtze Plain

Wang, Jida; Sheng, Yongwei; Wada, Yoshihide.

The ubiquitous lakes across China's Yangtze Plain (YP) are indispensable freshwater resources sustaining ecosystems and socioeconomics for nearly half a billion people. Our recent survey revealed a widespread net decline in the total YP lake inundation area during 2000-2011 (a cumulative decrease of approximate to 10%), yet its mechanism remained contentious. Here we uncover the impacts of climate variability and anthropogenic activities including (i) Yangtze flow and sediment alterations by the Three Gorges Dam (TGD) and (ii) human water consumption in agricultural, industrial, and domestic sectors throughout the downstream Yangtze Basin. Results suggest that climate variability is the dominant driver of this decadal lake decline, whereas studied human activities, despite varying seasonal impacts that peak in fall, contribute marginal fraction (approximate to 10-20% or less) to the interannual lake area decrease. Given that the TGD impacts on the total YP lake area and its seasonal variation are both under approximate to 5%, we also dismiss the speculation that the TGD might be responsible for evident downstream climate change by altering lake surface extent and thus open water evaporation. Nevertheless, anthropogenic impacts exhibited a strengthening trend during the past decade. Although the TGD has reached its full-capacity water regulation, the negative impacts of human water consumption and TGD-induced net channel erosion, which are already comparable to that of TGD's flow regulation, may continue to grow as crucial anthropogenic factors to future YP lake conservation.

（来源：WATER RESOURCES RESEARCH, 2017, 53(5): 3854-3877）

Physical effects of thermal pollution in lakes

Vinna, Love Raman; Wuest, Alfred; Bouffard, Damien.

Anthropogenic heat emissions into inland waters influence water temperature and affect stratification, heat and nutrient fluxes, deep water renewal, and biota. Given the increased thermal stress on these systems by growing cooling demands of riparian/coastal infrastructures in combination with climate warming, the question arises on how to best monitor and manage these systems. In this study, we investigate local and system-wide physical effects on the medium-sized perialpine Lake Biel (Switzerland), influenced by point-source cooling water emission from an upstream nuclear power plant (heat emission approximate to 700 MW, approximate to 18 W m(-2) lake wide). We use one-dimensional (SIMSTRAT) and three-dimensional (Delft3D-Flow) hydrodynamic numerical simulations and provide model resolution guidelines for future studies of thermal pollution. The effects on Lake Biel by the emitted excess heat are summarized as: (i) clear seasonal trend in temperature increase, locally up to 3.4 degrees C and system-wide volume mean approximate to 0.3 degrees C, which corresponds to one decade of regional surface water climate warming; (ii) the majority of supplied thermal pollution (approximate to 60%) leaves this short residence time (approximate to 58 days) system via the main outlet, whereas the remaining heat exits to the atmosphere; (iii) increased length of stratified period due to the stabilizing effects of additional heat; (iv) system-wide effects such as warmer temperature, prolonged stratified period, and river-caused epilimnion flushing are resolved by both models whereas local raised temperature and river short circuiting was only identifiable with the three-dimensional model approach. This model-based method provides an ideal tool to assess man-made impacts on lakes and their downstream outflows.

（来源：WATER RESOURCES RESEARCH, 2017, 53(5): 3968-3987）

A modeling approach to identify the effective forcing exerted by wind on a prealpine lake surrounded by a complex topography

Valerio, G.; Cantelli, A.; Monti, P.; et al.

The representation of spatial wind distribution is recognized as a serious difficulty when modeling the hydrodynamics of lakes surrounded by a complex topography. To address this issue, we propose to force a 3-D lake model with the wind field simulated by a high-resolution atmospheric model, considering as a case study a 61 km(2) prealpine lake surrounded by mountain ranges that reach 1800 m above the lake's surface, where a comprehensive data set was available in the stratified season. The improved distributed description of the wind stress over the lake surface led to a significant enhancement in the representation of the main basin-scale internal wave motions, and hence provided a reference solution to test the use of simplified approaches. Moreover, the analysis of the power exerted by the computed wind field enabled us to identify measuring stations that provide suitable wind data to be applied uniformly on the lake surface in long-term simulations. Accordingly, the proposed methodology can contribute to reducing the uncertainties associated with the definition of wind forcing for modeling purposes and can provide a rational criterion for installing representative measurement locations in prealpine lakes.

（来源：WATER RESOURCES RESEARCH, 2017, 53(5): 4036-4052）

Lake and wetland ecosystem services measuring water storage and local climate regulation

Wong, Christina P.; Jiang, Bo; Bohn, Theodore J.; et al.

Developing interdisciplinary methods to measure ecosystem services is a scientific priority, however, progress remains slow in part because we lack ecological production functions (EPFs) to quantitatively link ecohydrological processes to human benefits. In this study, we tested a new approach, combining a process-based model with regression models, to create EPFs to evaluate water storage and local climate regulation from a green infrastructure project on the Yongding River in Beijing, China. Seven artificial lakes and wetlands were established to improve local water storage and human comfort; evapotranspiration (ET) regulates both services. Managers want to minimize the trade-off between water losses and cooling to sustain water supplies while lowering the heat index (HI) to improve human comfort. We selected human benefit indicators using water storage targets and Beijing's HI, and the Variable Infiltration Capacity model to determine the change in ET from the new ecosystems. We created EPFs to quantify the ecosystem services as marginal values [Delta final ecosystem service/Delta ecohydrological process]: (1) Delta water loss (lake evaporation/volume)/Delta depth and (2) Delta summer HI/Delta ET. We estimate the new ecosystems increased local ET by 0.7 mm/d (20.3 W/m(2)) on the Yongding River. However, ET rates are causing water storage shortfalls while producing no improvements in human comfort. The shallow lakes/wetlands are vulnerable to drying when inflow rates fluctuate, low depths lead to higher evaporative losses, causing water storage shortfalls with minimal cooling effects. We recommend managers make the lakes deeper to increase water storage, and plant shade trees to improve human comfort in the parks.

（来源：WATER RESOURCES RESEARCH, 2017, 53(4): 3197-3223）

Multiple mining impacts induce widespread changes in ecosystem dynamics in a boreal lake

Jaakko Johannes Leppänen,Jan Weckström, Atte Korhola

In order to satisfy the needs of constant economic growth, the pressure to exploit natural resources has increased. Since accessible mineral resources are becoming scarce, the mining industry is constantly looking for novel techniques to allow commercial exploitation of lower-grade deposits. However, mining can have considerable impacts on freshwater ecosystems. Here, we present the ecological damage inflicted by mine water originating from the massive Terrafame Talvivaara polymetal mine (central Finland), where bioheap leaching is being applied to high-sulphur low-grade ore. We found that saline mine water has turned the lake meromictic, and sediment is heavily contaminated. As a result, important zooplankton and phytoplankton groups have been significantly altered. As the exploitation of poor-grade deposits is the future of the mining industry globally, water management should be taken to a higher level in order to proceed towards a sustainable mining sector.

（来源：Scientific Reports, 2017, doi:10.1038/s41598-017-11421-8）

Measuring water level in rivers and lakes from lightweight Unmanned Aerial Vehicles

Bandini, Filippo; Jakobsen, Jakob; Olesen, Daniel; et al.

The assessment of hydrologic dynamics in rivers, lakes, reservoirs and wetlands requires measurements of water level, its temporal and spatial derivatives, and the extent and dynamics of open water surfaces. Motivated by the declining number of ground-based measurement stations, research efforts have been devoted to the retrieval of these hydraulic properties from spaceborne platforms in the past few decades. However, due to coarse spatial and temporal resolutions, spaceborne missions have several limitations when assessing the water level of terrestrial surface water bodies and determining complex water dynamics. Unmanned Aerial Vehicles (UAVs) can fill the gap between spaceborne and ground-based observations, and provide high spatial resolution and dense temporal coverage data, in quick turnaround time, using flexible payload design. This study focused on categorizing and testing sensors, which comply with the weight constraint of small UAVs (around 1.5 kg), capable of measuring the range to water surface. Subtracting the measured range from the vertical position retrieved by the onboard Global Navigation Satellite System (GNSS) receiver, we can determine the water level (orthometric height). Three different ranging payloads, which consisted of a radar, a sonar and an in-house developed camera-based laser distance sensor (CLDS), have been evaluated in terms of accuracy, precision, maximum ranging distance and beam divergence. After numerous flights, the relative accuracy of the overall system was estimated. A ranging accuracy better than 0.5% of the range and a maximum ranging distance of 60 m were achieved with the radar. The CLDS showed the lowest beam divergence, which is required to avoid contamination of the signal from interfering surroundings for narrow fields of view. With the GNSS system delivering a relative vertical accuracy better than 3-5 cm, water level can be retrieved with an overall accuracy better than 5-7 cm.

（来源：JOURNAL OF HYDROLOGY, 2017, 548: 237-250）

The impact of lake and reservoir parameterization on global streamflow simulation

Zajac, Zuzanna; Revilla-Romero, Beatriz; Salamon, Peter; et al.

Lakes and reservoirs affect the timing and magnitude of streamflow, and are therefore essential hydrological model components, especially in the context of global flood forecasting. However, the parameterization of lake and reservoir routines on a global scale is subject to considerable uncertainty due to lack of information on lake hydrographic characteristics and reservoir operating rules. In this study we estimated the effect of lakes and reservoirs on global daily streamflow simulations of a spatially distributed LISFLOOD hydrological model. We applied state-of-the-art global sensitivity and uncertainty analyses for selected catchments to examine the effect of uncertain lake and reservoir parameterization on model performance. Streamflow observations from 390 catchments around the globe and multiple performance measures were used to assess model performance.

Results indicate a considerable geographical variability in the lake and reservoir effects on the stream flow simulation. Nash -Sutcliffe Efficiency (NSE) and Kling -Gupta Efficiency (KGE) metrics improved for 65% and.38% of catchments respectively, with median skill score values of 0.16 and 0.2 while scores deteriorated for 28% and 52% of the catchments, with median values -0.09 and -0.16, respectively. The effect of reservoirs on extreme high flows was substantial and widespread in the global domain, while the effect of lakes was spatially limited to a few catchments. As indicated by global sensitivity analysis, parameter uncertainty substantially affected uncertainty of model performance. Reservoir parameters often contributed to this uncertainty, although the effect varied widely among catchments. The effect of reservoir parameters on model performance diminished with distance downstream of reservoirs in favor of other parameters, notably groundwater-related parameters and channel Manning's roughness coefficient. This study underscores the importance of accounting for lakes and, especially, reservoirs and using appropriate parameterization in large-scale hydrological simulations.

（来源：JOURNAL OF HYDROLOGY, 2017, 548: 552-568）

Climatic implications of hydrologic changes in two lake catchments on the central Tibetan Plateau since the last glacial

Hou, Juzhi; Tian, Qian; Liang, Jie; et al.

The numerous and widespread lakes of the Tibetan Plateau (TP) constitute the largest group of alpine lakes on Earth. Some of the lakes are fed mainly by glacier meltwater and others by precipitation and groundwater. Past changes in the environments of these lakes differed because of differences in lake hydrological regimes and the complex pattern of climate change on the TP. Here we present records of scanning XRF, inorganic carbon (IC) concentration n-alkanoic acid average chain length (ACL) and percent aquatic inputs (Paq) in sediment cores from two non-glaciated lakes on the central TP (Dagze Co and Jiang Co), which span the past 19,000 years. We used these measures to investigate past changes in catchment hydrology, climate and environment. Variations in the concentration of Ti and other lithogenic elements at the two sites were influenced mainly by surface runoff, which is supported by the variation of IC, Ca/(Al, Ti, Fe) (reflecting authigenic carbonate precipitation), Rb/Sr (a chemical weathering proxy), and ACL and Paq. We attribute variations in surface runoff to changes in the precipitation/evaporation ratio, caused by the pattern of climate change on the central TP since the late

Pleistocene. During the late Pleistocene, stronger runoff (indicated by higher Ti, higher Rb/Sr and Paq, lower IC, Ca/(Al, Ti, Fe) and ACL) likely resulted from lower temperatures. Lower runoff during the Holocene may reflect intensified evaporation caused by higher temperatures. Comparison with records from glaciated lakes in the region reveals opposite trends in catchment hydrology. Overall, our results suggest that since the late Pleistocene the central TP was influenced mainly by the Indian Summer Monsoon.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2017, 58(2): 257-273）

Pairing paleolimnological inference models with mechanistic water column models enhances assessment of lake water quality

Rowell, H. Chandler; Bloomfield, Jay A.; Charles, Donald F.; et al.

Reconciliation of paleolimnology inference models with hindcasts from mechanistic water column models aided the reconstruction of past relationships for total phosphorus/dissolved oxygen and acid neutralizing capacity/pH in highly polluted lake ecosystems in New York State. Pre-disturbance Onondaga Lake, Syracuse, NY, was shown to have experienced seasonal hypolimnetic anoxia even under oligotrophic (< 10 ug l(-1)) phosphorus levels. In the Adirondack Mountains of New York State the paired modeling confirmed that, while many lakes have the potential to eventually recover from acidification by atmospheric deposition, approximately 30% likely experienced naturally acidic conditions (pH < 6) prior to increases in industrial emissions. Comparison between the model results illuminated areas of individual model inadequacy, improved understanding of lake ecology, and increased confidence in the ability of predictive water column models to accurately develop restoration scenarios representing improved conditions. The work presented here is the first such comparison modeling for total phosphorus, dissolved oxygen, and acid neutralizing capacity. The technique remains to be more widely applied geographically and extended to less heavily stressed lake systems. Because a fossil inference and mechanistic hindcast should independently lead to similar results, comparison modeling is a potentially powerful tool for examining past interactions between ecosystem structure and ecosystem functioning.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2017, 58(2): 119-133）

重点关注

第三极河湖源科考将填补多项湖泊河流资料空白

第二次青藏高原综合科学考察研究之河湖源考察，正在西藏阿里地区进行。其中，湖泊河流与环境变化考察研究将填补这一区域多项湖泊与河流的资料空白。

此次湖泊河流与环境变化考察研究对象，主要是西藏日喀则和阿里地区的10余个(条)主要湖泊及河流，考察内容为湖泊水深、水下地形、水量、多参数水质和湖泊分层特征等，后续研究还包括湖泊水生生态系统的状态和未来可能变化的趋势。

湖泊河流与环境变化考察队现已由日喀则转入阿里。阿里地区因其地质构造、自然地理背景以及气候和植被特征的特殊性，受到中外学界重视。但由于地理区域和交通条件等因素限制，这一地区的科学考察很少。20世纪70年代的第一次青藏高原综合科考，在阿里开展了考察，但仍存在空白。在以往研究基础上，此次考察试图进一步填补阿里湖泊和河流方面的资料空白。

河湖源湖泊河流与环境变化考察队执行队长、中国科学院青藏高原研究所副研究员王君波介绍，和40多年前相比，现在的科学技术和后勤保障水平已经明显提升，所以第二次青藏高原综合科考的主要任务之一就是“填补空白”，“比如这次考察的昂拉仁错，是羌塘内陆地区的重要湖泊之一，但此前几乎没有相关数据。”

此次考察获得的数据还将为研究阿里等地区的环境变化，以及设计建设“第三极”国家公园提供重要依据。王君波告诉记者，考察队正在几个有代表性的湖泊中采集沉积物岩芯，以便开展百年及万年尺度古环境变化研究。这将揭开研究区域近百年来气候变化的特征、规律及其控制因素，有助于预测未来的气候变化，并为“第三极”国家公园的规划、建设及长期管理提供科学基础。

（来源：新华网 2017-09-05）

升温导致世界最大湖泊水位连年下降

新华社北京 9 月 2 日电 一个国际科研小组报告说，1996 年至 2015 年间，世界最大湖泊—里海的水位以每年近 7 厘米的速度下降，主要原因是气温上升导致湖水蒸发速度加快。

里海是位于欧洲与亚洲之间的一个咸水湖，面积超过 37 万平方公里，是全球最大的内陆封闭水体。几百年来，里海水位曾多次大幅波动。

美国地球物理学联合会日前发布的一份新闻公报说，美国、俄罗斯、阿塞拜疆等国科学家组成的团队结合卫星和地面观测数据，分析了最近几十年里海水位的变化及其原因。

研究小组在新一期美国《地球物理通讯》杂志上报告说，里海水位在 20 世纪 70 年代末达到有记录以来最低点，随后持续上升，但在 1996 年转为下降，到 2015 年总共下降了约 1.5 米。目前里海水位约为海平面以下 27.5 米，仅比历史最低值高出 1 米多。

由于里海不与任何海洋相连，研究人员可以比较准确地估算其水量收支。分析显示，过去 20 年来的水位下降约有一半是蒸发速度加快导致，另一半由河流汇入里海的水量以及降雨量变化造成。

气温上升导致湖水蒸发速度加快。据统计，1996 年至 2015 年间里海的年平均表面温度比 1979 年至 2015 年间的平均温度上升了约 1 摄氏度。

研究人员说，鉴于地球气候将持续变暖，预计里海水位会继续下降，不久就将重回历史最低水平。如果每年下降 7 厘米的趋势稳定持续下去，里海北部较浅区域将在约 75 年后消失。

（来源：http://news.xinhuanet.com 2017-09-02）

pH 值为 0 的强酸池塘中首现活微生物

据英国广播公司（BBC）网站 8 月 9 日消息称，一组科学家团队在埃塞俄比亚一个 pH 值为 0 的强酸池塘中首次发现了活的微生物，该池塘也因此成为地球上有生命“现身”的最酸环境。

埃塞俄比亚的达纳基勒洼地位于“地球伤疤”——东非大裂谷的最北端，此处雨水极少，是地球上最酷热、最干燥的地方，平均温度高达 45 摄氏度；而当地水塘的 pH 值平均为 0.2。通常，在这种世所罕见的极端环境下，生命不可能存活。

此前，人们对这一地带的相关讯息知之甚少。自 2013 年以来，一个国际科研团队开始在该地区进行研究工作，才慢慢揭开此地的秘密。2017 年以来，在当地多次收集样本的科学家于一个 pH 值为 0 的池塘中发现了活的微生物，他们隔离并提取了微生物的 DNA，近日确认这是一种“多嗜极生物”。研究还发现，该微生物已经完全适应了达纳基勒的强酸以及高温、高盐环境。这是人们在达纳基勒的强酸池塘中发现的第一种生命，这一池塘也创下了生命存活的“最酸”环境纪录。

此前，科学家们曾分别报告称，他们在美国黄石国家公园间歇泉（PH 值为 1）盆地的沙石层上以及西班牙一个 PH 值为 2 的河流中发现了微生物。

研究人员表示，绝大多数生物体都不能应付极端的酸度，超高温也会损害酶；高盐则会使水流出细胞，将生物体变成干燥的皮壳。但在埃塞俄比亚、黄石和其他热液环境中发现的微生物，已经适应了强酸环境。对这些在地球极端环境下生存的生命进行深入分析，将有助于人们理解火星等行星的可居住性。

（来源：《科技日报》 2017-08-11）

人类对水资源干预导致河流下游水资源短缺

近日，Nature Communications 在线发表题为“20 世纪到 21 世纪人类干预致使水资源短缺的热点地区向下游转移（Water scarcity hotspots travel downstream due to human interventions in the 20th and 21st century）”一文。研究指出人类对水资源的干预，如水库、水坝和灌溉措施，已经增加了全球大部分人口的水资源可用性，但同时也将水资源短缺的问题转加到下游地区。研究人员利用多模型评估方法评估人类干预对月度河流水供应以及水资源短缺的影响。研究结果表明，人类干预对水资源的正面影响主要发生在上游区域，对下游地区将会加剧水资源的短缺。通常认为，从上游河流中取水必然会导致下游河流中水资源的缺乏，但是其实际的影响并非如此直接、简单。降水的季节变化以及水库等使得模型工作者很难去估测水的可利用性以及人工干预的影响，并且很难把气候变化的影响与其他影响（比如人类活动等）区分开来。这项研究是首次在考虑季节变化和人类干预类型（水库储水、取水、土地利用变化及灌溉等）影响下的地方和区域水资源影响的全球解释。文中集成5个全球水文模型，分析了1971-2010年水资源可获取性、需求以及水资源缺少等，同时强调了气候变化和人类干预的单独影响。这种系统的方法使研究人员能够得出比以往更现实的估计，同时研究结果也显示出比先前估计更多的水资源短缺。研究发现从1971-2010年人类干预改变了水资源短缺状况并且影响全球大约1/3的人类用水。平均来说，全球范围内大约20%的人口其用水得到增加，23%的人口正经历着可获取水源的减少。人类活动彻底改变了水资源短缺的严重程度，加剧了全球8.8%（7.4%~16.5%）人口的水资源短缺，但却又缓解了8.3%（6.4~15%）人口的水资源短缺。 研究建议，在进行水资源人工干预时必须要对上游和下游通盘考虑，分析其可 能带来的潜在的全球及区域影响，而不仅仅是考虑人工干预对地方的影响。另外，气候变化及人口数量也正加剧水资源的压力，研究人员发现政策制定者及水资源管理人员在制定地方决策的时候需要从全球和地方上统筹考虑，这对于跨界河流极为重要，一个国家的水资源管理政策可能会影响下游其他国家的水资源利用。复杂的水资源问题急需更好地理解社会经济发展、气候变化与水文学之间的关系，这项研究为我们理解这三者之间的关系提供了重要的途径。

原文来源： https://www.nature.com/articles/ncomms15697

（来源：科学研究动态监测快报 2017-07-01，第 13 期总第 306 期）

PNAS：地下水抽取对鱼群变化的影响

2017年7月12日，PNAS在线发表“美国大平原区域地下水减少与鱼群变化之间关系（Groundwater declines are linked to changes in Great Plains stream fish

assemblages）”的文章，研究人员在多尺度框架下采用模型方法回顾（1950~2010年）并展望（2011~2016年）大平原河流鱼类与地下水抽取的关系。研究表明大平原河流水量减少以及河流中鱼类的均质化与地下水的抽取有很大关系，研究预测未来全球范围内，局地和区域含水层的减少会导致类似的现象发生。自然和社会依赖于地下水来维持生态系统和人类的生计，但是局地和区域地下水供应正在减少，因为人类的用水已经超过了地下水的补给。虽然地下水枯竭是一个全球性的问题，但对诸如鱼类这样的水生物种的生态影响却很少被研究。研究人员指出，半个多世纪以来，从美国大平原含水层抽取的地下水，与大型鱼类的崩溃和小型河流鱼类的扩张之间存在关系，而且地下水的大量抽取导致这些河流的水文条件变化最为严重。预测表明，如果地下水抽运不被修改，这些栖息地在未来半个世纪将继续萎缩，在全球范围内地下水的抽取将会对全球的生物环境产生影响。在1950~2010年间，地下水抽取和大坝建设迅速而广泛增加，并在整个研究地区大幅改变了河流中鱼类的栖息地。文中研究区域堪萨斯地区的大平原含水层每年的地下水抽取量从1950年的0 km^3增加到1980年的峰值1.31 km^3，整个研究区域的大坝和水库的数量从1950年的37个增加到1980年的141个。在同一时期，高平原含水层的总长度从2640千米下降到2082千米(558公里)。在1980~2010年期间，堪萨斯州的地下水开采每年从0.55km^3 到1.30 km^3不等，平均为0.91 km^3，而引水大坝和水库的数量增加到了154个。同时，含水层的总长度从2046到2194千米，平均为2117公里。对2011~2060年的预测表明，耦合流的长度进一步减少到1796公里（另一个286公里）。尽管在1950~1980年间，溪（二、三阶）流的长度迅速下降，但大部分的损失是由大型（主要是四阶）的溪流长度的下降所推动的，在1980~2060年间河流长度保持相对稳定或略有增加。在区域尺度上，在1950~1980年期间，河流中鱼群从以大型鱼类为主转变为以小型鱼类为主。在1980~2010 年期间，这些鱼群保持相对稳定，但2011~2060年的预测表明，大型鱼类和小溪流鱼类将进一步受到抑制。大型鱼类的平均捕集概率下降了一半，从1950年的0.42（95%置信区间CI=0.28～0.56）到1980年的0.20（95%置信区间CI=0.11～0.29），预计到2060年将进一步下降到0.16（95%置信区间CI=0～0.24）。这项分析为未来45年的河流含水层耦合和大平原鱼类的生态状况提供了基线预测。

原文来源： http://www.pnas.org/content/114/28/7373

（来源：科学研究动态监测快报 2017-08-01，第15期总第308期）

西藏第一大湖面积扩四成 高原湖泊缘何急剧扩张？

青藏高原是地球上平均海拔最高、面积最大的高原，是地球“第三极”的主体区域。它是全球气候变化的放大镜，是亚洲多条大型河流的发源地，也影响着我国矿产资源的形成，蕴藏着地球生态环境的无穷奥秘。

今年6月我国启动第二次青藏高原综合科考，首先聚焦于江湖源区域，即西藏最大湖泊色林错和青藏高原中部重要冰川发育区。中科院科研人员组成湖泊与水文气象、古生态与古环境、冰川与环境变化、生物与生态变化4个考察队进行了系统科学考察。

高原湖泊缘何急剧扩张

青藏高原分布着全球海拔最高、数量最多、面积最广的湖泊群，总体持续扩张。其中色林错面积在过去40年间增加逾四成，现已成为西藏第一大湖。色林错的扩张不仅会淹没低湖岸带的牧场，且可能影响道路通行。

色林错为何会“长大”?会不会继续“长大”?中国科学院青藏高原研究所初步研究成果表明，降水是色林错“长大”的主因；近十年来，色林错依然扩张，但变化趋缓。

包括色林错在内的藏北，降水从哪来?中科院青藏高原研究所副所长朱立平给出了一种可能的解释：“藏南降水近年来在减少，说明南部季风在减弱。我们猜测，藏北降水来源可能来自冰川融水的蒸发，即藏北存在内部水循环。”

青藏高原湖泊面积大小会影响东部季风区的旱涝灾害格局，如其扩张势头不减，东部地区就要调整气象灾害防控机制。然而色林错流域面积达45530平方公里，地理条件复杂，要获得以上问题更为确切的答案，迫切需要进行大规模综合考察。

因此，第二次青藏高原综合性科考首期科学考察把色林错区域列为重点区域，其中一支科考队主要负责考察湖泊、地表水文和气象，将色林错-长江源这一完整的冰川-河流-湖泊水文系统作为考察重点区。

朱立平是这支考察队的负责人。他介绍说，此次科考不限于地表探查，还采集了各类水体、沉积物等样品进行分析与研究，包括钻取10米长的湖底沉积岩芯。将之与40年前第一次青藏高原科考时获取的资料进行对比，可以为生态系统总体演变趋势研究提供依据。

青藏高原曾是“暖湿低地”

亿万年前的高原到底是什么样子的?此次科考古生态与古环境考察队试图解开这个谜。

科学家们对青藏高原隆起时间分歧很大。有观点认为高原在距今5000万年前即已形成，但也有人判断迟至约700万年前高原才抬升至如今程度。此次古生态与古环境考察队利用花岗岩低温热年代学等多种先进研究手段，初步确定高原“脊柱”唐古拉山一线在距今5000万年前，便已隆升到今天的高度。

只是，青藏高原不是铁板一块，内部存在六个构造带，“生长”速度并不同步。在唐古拉山脉以南海拔稍低的盆地中，考察队所发现的化石证据，将这一地区隆升的时间点大大推后。

中科院古脊椎动物与古人类研究所副研究员吴飞翔团队在高原中部伦坡拉和尼

玛盆地发现的化石，可证明这些区域在2600多万年前仍处于暖湿环境，海拔不会高于2000米。吴飞翔表示，此次发现的鲤科鱼类化石意义尤为重大。鱼类因其冷血的生理特征，加上生存分布受水域限制，具有很强的环境指示性。水域水文条件会在鱼类的演化史上留下印记，而水系的变迁又与地质事件紧密相联，通过鱼类的生理特征变化，可以反推高原的地质地理变迁。

破译冰川“无字天书”

作为国家生态安全屏障，青藏高原不但是“亚洲水塔”，也是气候启动区，对我国乃至北半球气候环境的变化至为关键。而冰川作为“大自然的博物馆”，破译冰川这本“无字天书”对于探索气候奥秘具有重要意义。

此次考察队队长，中国科学院青藏高原研究所研究员徐柏青介绍，冰川冰层越深，形成年代越久远，并且，冰川在积累过程中“封存”了气温变化、降水变化、大气成分演变等自然环境变迁的宝贵信息。因此，在冰川中竖直钻取一根冰芯，便如同获得了一部自然“编年史”。

冰芯要向何处寻?考察队成员、中科院青藏高原研究所博士后朱美林概括为“位置越高越好，地势越平越好，冰层越厚越好”。位置越高、地势越平，冰雪融化得越慢，其他地方吹来的雪难以留存，不会影响冰川物质积累的稳定性;冰层越厚则证明冰川积累时间越久，可以获得的环境信息越丰富。

考察队这次原计划在龙匣宰陇巴冰川海拔5650米处钻取浅冰芯，以图恢复过去100年特别是近50年来江湖源区气候变化。但入夏以来，唐古拉冰川表层积雪消融较快，雪面下隐藏的冰裂隙等给科考队员带来很大危险。最后考察队改为在5250米的冰川末端打钻，成功钻取4根长约10米的冰芯。徐柏青说，这样可以直接从冰川最“年长”的部分下手研究。

探秘“第三极”动植物世界

来自中科院多个研究所的19名科研人员参加了生物与生态变化考察队，对色林错湖区和那曲北部、西部的动植物情况进行全方位考察。

“色林错湖区和整个藏北地区广泛分布着许多高原珍稀动植物物种。”考察队队长、中科院昆明植物研究所研究员杨永平说。据他介绍，这次科考要对区域内动植物种类、数量、分布区进行摸底，绘制出区域内的植被图和动物重点栖息地分布图。

中科院昆明动物研究所助理研究员赵亚鹏告诉半月谈记者，青藏高原鱼类寿命较长，令人惊叹。高原地区水生环境相对单一，鱼类天敌较少，加之高原湖泊河流水温低，鱼类生长迟缓，代谢也较为缓慢，这些都为高原鱼“长寿”奠定了基础。

小型兽类的观测也是这次考察的重点任务，由中科院昆明动物研究所研究员蒋学龙负责。蒋学龙说，鼠害破坏草原，已成草原治理的重要课题。实现草原食物链动态平衡，借力于鼠兔的上游动物鹰、狼等猛禽猛兽，或是解决问题的根本之策。

羌塘草原考察的主题离不开藏羚羊。专家称，藏羚羊种群数量仅西藏境内就已达到15万只以上，可以说已经成功摘掉濒危“帽子”。中科院西北高原生物研究所副研究员连新明说：“在弄清楚藏羚羊种群数量之外，我们正试图搞清楚藏羚羊迁徙的原因，以及迁徙的路线，并据此为将来高原工程建设提供依据，为藏羚羊预留野生动物通道。”

（来源：http://www.chinanews.com 2017-09-15）

南极湖泊冰盖下面存在食甲烷细菌

2017年7月31日，Nature Geoscience发表文章《南极西部冰盖下微生物氧化汇集甲烷》，南极西部冰盖下面湖泊中有一种细菌可能吸收温室气体甲烷，阻止了大量的甲烷释放到大气中。

该研究由美国国家科学基金会（NSF）资助，由来自蒙大拿州立大学、路易斯安那州立大学和威尔士阿伯里斯特威斯特大学的研究团队执行。早在2013年，研究人员已经成功钻破了位于南极西部800米厚的冰盖，并获取了长期与大气隔绝的冰盖下威尔兰斯湖（Lake Whillans）的水体和沉积物的样本。通过综合考察细菌的基因组和样品中甲烷的浓度，研究人员描述了湖泊细菌将甲烷进行化学转化的过程，以及如何降低冰层融化过程中冰下气体的升温。

研究发现，在湖泊上面普遍存在的食甲烷细菌形成“甲烷生物过滤器”，防止甲烷气体进入冰川水域，阻止了更多的甲烷排入海洋并最终被释放到大气中。这些细菌通过消化甲烷而获取能量。研究人员指出，如果他们的分析正确，那么就意味着巨大的南极冰盖下面所蕴藏着的大量甲烷不太可能被释放到大气中。这不仅对全球气候非常重要，而且甲烷氧化可能是南极冰盖下深处永久生物圈微生物广泛的生存方式。南极冰盖下面的湖泊中只有一小部分已经被探索，主要是为了防止对原始的生态以及与此未知的相关环境造成破坏。研究人员使用专门设计的热水钻，确保冰下的环境保持原始状态，而且防止样本被污染。

由于甲烷是强大的温室气体，所以对于其来源的研究，掌握其在气候系统的汇集和输送非常重要。研究结果描述了湖底沉积物中将甲烷转化为二氧化碳的生物过程。该水域处于与大气热和阳光永久隔绝的地带，对于冰川湖生态系统稳定至关重要。南极冰盖下湖泊的研究可能对太阳系中由冰覆盖的较大的行星上微生物的生存提供线索。了解甲烷的潜在来源以及甲烷可能“沉没”的地方可能有助于我们改进气候模式，甚至可能找到改善捕捉温室气体的方法。

（来源：https://www.eurekalert.org 2017-07-31）

业界动态

WRI 剖析全球水危机产生原因

2017 年 8 月 24 日，世界资源研究所（WRI）水项目科学家剖析了全球面临水资源危机的七个原因，主要为气候、人口与收入、地下水总量、人工水利设施、自然基础设施、浪费、水价。具体如下：（1）气候变化加剧水资源危机。气候变化正在导致干旱区域更加干旱、降水更加极端，居住在河流和溪流附近的人们受降雨增加的影响其损失最大。目前，全球每年至少有 2100 万人面临洪水泛滥的危险。到 2030 年，这一数字将增加到 5400 万。据悉，世界上最受洪水侵袭的国家都是最不发达国家或发展中国家，这使得它们更容易受到气候变化和自然灾害的影响。2017 年夏天，洪水淹没了孟加拉国三分之一的地区，夺走了 115 条生命，影响了 570 万居民。（2）人口和收入影响水资源需求。 随着全球人口数量的增加及收入水平的提高，对水资源的需求将会增加。目前 世界人口为 75 亿，预计到 2050 年将增加 23 亿人。日益增长的收入也加剧了水问题， 因为较富裕的人口需要从化石燃料中获得能源。（3）地下水面临枯竭。地球上大约30%的淡水深藏于地下蓄水层中。它每天都被提取用于农业、饮用水和工业过程。印度54%的地下水正在减少，这意味着水的使用速度比它补充的要快。除非模式发生改变，在未来 20 年内，印度 60%的含水层将处于危急状态。（4）水利基础设施处于严重失修状态。在世界各地，水的基础设施（处理厂、管道和下水道系统）处于一种失修状态。 在美国，每天有 60 亿加仑的处理水从漏水的管道中流失。建设基础设施是出了名的昂贵，要安装和修复，这意味着许多地方忽视了不断增长的基础设施问题，直到灾难发生。（5）健康的生态系统作为“自然基础设施”常常被忽视。健康的生态系统是“自然的基础设施”，对清洁、充足的水至关重要。它们过滤污染物，缓冲洪水和风暴，调节供水。植物和树木对于补充地下水至关重要；如果没有它们，雨水将会滑过旱地，而不是渗入土壤。森林砍伐、过度放牧和城市化造成的植被损失，限制了我们的自然基础设施和它所提供的好处。世界各地的森林水域都面临着威胁：在过去的 14 年里，流域的森林面积减少了 22%。（6）水资源浪费。尽管水是一种可再生资源，但它经常被浪费掉。在火力发电厂，像洪水灌溉和 用水密集的湿冷却等低效的做法所使用的水比实际必要用水要多。世界上大约 80% 的废水在没有得到进一步的处理或再利用的情况下被排放回大自然。在许多国家，饮用干净的饮用水比处理废水更便宜，这就鼓励了水的浪费。（7）不合理的水价。在全球范围内，水的价值被严重低估。从基础设施的运输到它的处理和处置，其价格并没有反映出服务的真实总成本。这导致了水资源的分配不当，以及缺乏对基础设施和新的、高效率用水技术的投资。当清洁水的价格接近实际的服务成本时，有效的用水将受到激励。另一方面，穷人往往以过高的价格购买水，阻碍发展。

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：http://www.wri.org/blog/2017/08/7-reasons-were-facing-global-water-crisis

（来源：科学研究动态监测快报 2017-09-15，第 18 期总第 311 期）

斯德哥尔摩国际水研究所 2018-2021 年战略

2017年8月，斯德哥尔摩国际水研究所（SIWI）在线发布《SIWI 2018-2021年战略》。这项战略明确指出了该时段研究所的发展方向，确定了全球水资源面临的与发展有关的主要挑战，以及应对挑战和实现研究所使命的目标和方法。众所周知，SIWI以“加强水治理，建设一个公正、繁荣和可持续的未来”作为其使命。尤其是加强全球、区域、国家及本地的淡水资源治理。在 2018-2021年战略执行期间，SIWI打算通过发挥其召集能力与在水资源治理方面的专业知识相结合，通过建立对话、改善政策和改变水资源治理的做法，来直接和间接地影响决策者。

1 战略目标

（1）利用 SIWI 的召集能力来促进和影响水治理对话。将继续从政策、研究、实践等方向，把不同领域、不同地区从事水资源治理工作人员联系起来，交换知识

并提出水治理的解决方案。在改善水治理的背景下，将支持国家、区域和国际治理发展对话平台。在相关的地方，我们将创建新的平台。在跨界水域范围内，支持水资源治理的多方利益相关者对话，以促进公平、有远见和可持续的水资源利用。作为世界水周的组织者，SIWI 将努力保持水社区的联系，并讨论水相关的挑战和解决方案。此外，还将引进来自水社区之外的成员，努力打破固有思维。（2）提高水治理的优先设置。SIWI为政府间、区域和国家水相关问题提供咨询意见，是一个值得信赖的合作伙伴。该机构具有独特的能力将水治理相关的成员们聚集在一起，就共同的目标达成共识，让其在重要的国际议程中发声。SIWI 将在战略上与媒体合作，影响公众辩论，主张在国家和国际进程中提高水的优先地位。SIWI 具有独特的网络，可以为国家、区域和国际会议的结果和全球进程作出贡献。（3）促进改善水治理的政策发展。SIWI 作为一个值得信赖和知识渊博的合作伙伴，将与国家、地方政府和企业在水政策制定等方面一起工作。以SIWI在世界各地区的经验，以及与多边组织的长期伙伴关系，支持所有地区的国家政策发展。（4）促进水政策的改善和实践的实施。除了政策制定阶段，我们还将促进政策的实施和水实践的改变。我们将与公众、民间社会和私营部门的参与者一起，在国家层面上实施改革政策，例如，在现有机 构内发展能力，支持建立新机构，或改善企业用户管理水资源的方式。（5）提高水科学、政策和实践方面的知识，奖励并促进卓越。在国际和国家水资源问题上，应用多学科研究为复杂的水资源挑战的政策选择提供了基础。通过最初的研究，在世界一流的研究项目中进行合作，继续在研究政策实践层面上进行重要的工作。每年我们都会颁发斯德哥尔摩水奖和斯德哥尔摩青年水奖。斯德哥尔摩水奖是世界上最负盛名的水相关活动奖项。斯德哥尔摩青年水奖竞赛汇集了世界上最聪明的年轻科学家，鼓励他们继续对水问题产生兴趣。（6）使 SIWI 成为一个有具有吸引力、弹性的、可持续发展的组织。SIWI将吸引、选择、激励和留住有才华的员工，并系统性地减少管理组织和社会风险，努力提高我们的工作效率。

2 战略实施途径

SIWI将以中长期和短期的方式来实施这项战略。以每年或两年的行动计划（2018-2019，2019-2020 等）作为补充，并详细描述开展的具体工作。行动计划将根据这一战略，为每个优先领域制定国家目标，并为每一优先领域指定产出和业务目标，同时为它们的执行制定指标和关键模式。其具体实现途径如下：（1）将知识、政策和实践联系起来，加强供水服务和水资源治理。

开发并应用研究工具和方法来解决复杂的水挑战，向各国政府和国际组织提供咨询服务，支持政策制定和执行。与多层级和多利益相关者的水治理平台合作（包括政府、私营部门、民间社会和学术界），开发和促进公共和私营部门决策者的解决方案。（2）对撒哈拉以南非洲的水治理改善提供支持。在不破坏自然生态系统或损害社区的情况下实现非洲可持续发展的目标（SDGs），将是提供可持续用水的关

键。支持非洲部长级理事会（AMCOW）的努力，以增强非洲大陆水投资项目的经济可行性，并加强这些项目的发展影响。与发展融资机构和项目筹备机构直接合作，帮助有资格的水基础设施项目更接近于银行的资金，最终目标是能够吸引来自公共资源和私人的投资。采用创新方法，使当地社区参与这些项目的开发和发展，包括投资于自然基础设施（如恢复湿地和洪水平原），以提供生态系统服务。（3）加强共享水域的合作。在实践经验、社会学习、创新方法和学术成果的基础上，加强在共享水域的和平合作。通过多层次、多轨的方式，将主要关注于构建信任对话，支持知识共享和能力建设，帮助利益相关者参与，支持解决方案空间的识别和构建，从而促进更有效的合作。采用了水外交途径，利用不同的关键政策领域释放与区域水资源有关的挑战管理。（4）继续建设瑞典水屋。通过活动、论坛和对话，SIWI 与瑞典的利益攸关方广泛接触，以改善水治理，提高对水资源系统管理的认识，以确保公正和可持续的分配。通过研讨会、讲习班和圆桌会议，阐明水资源相关的全球性的挑战并突出解决办法。利用事件和政策对话为政策制定者和广泛的利益相关者提供信息，强调改善政策以确保长期可持续解决方案的必要性。（5）世界水周及斯德哥尔摩奖。通过保持世界水周的领先地位，SIWI 处于一种独特的地位，可以吸引包括领袖、科学家、青年政治家（当局代表、当地社区）等人员，从而影响全球和当地改善水治理的政策，创造一个公正、繁荣和可持续的未来。开发新产品，比如瑞典水治理知识馆；建立它的流动优势-即增加网络机会，并确保参与者之间的知识交流。斯德哥尔摩水奖和斯德哥尔摩青年水奖是全球享有盛誉的奖项，鼓励在水和水相关 的领域上取得杰出成就的项目和人员。（6）影响和支持国际水治理政策议程。SIWI向全球政策制定过程作出贡献，与联合国组织、各国政府或不确定的机构合作。自坎昆会议以来，在气候变化问题上，SIWI积极地解决了水问题。将继续在世界水周举行股东会议，并在超过60家全球水适应（AGWA）成员网络联盟中担任领导职务。将更加努力地支持《2030年议程》和2020年生效的《巴黎气候协定》。国家和地方议程的2030年执行计划，以及所谓的国家决定贡献（NDCs），将对未来与各国和不同参与者的潜在合作中发挥决定性作用。（7）通过交流增进水的知识和影响。SIWI将努力提高水及水相关问题的知识，旨在提高人们对加强水治理建立可持续社会中的重要性的认识。将努力通过媒体和公众直接与公共和私人领域的决策者联系，重点关注 SIWI 活跃的地区。把媒体作为提高公众对水挑战认识的重要伙伴，通过公众辩论，向领导人施加压力，让他们做出明智的决定。

原文来源：http://www.siwi.org/publications/siwi-strategy-2018-2021/

（来源：科学研究动态监测快报 2017-09-15，第18期总第311期）

百余专家“问诊”太湖蓝藻治理

近日，第四届“蓝藻水华与环境因子相互作用的生态学机制”学术研讨会在锡开幕，百余位“藻专家”相聚无锡，就研究、治理蓝藻进行为期两天的学术交流，共同探讨蓝藻水华治理良方。

捞了十年的太湖蓝藻为何并未大幅减少？中国科学院水生生物研究所藻类研究中心主任、中国藻类学会副秘书长李仁辉说，对于蓝藻治理，其实还有很多机制没搞清楚。“目前太湖治理蓝藻的大方向没错，且是向好发展。”李仁辉说，从去年的公报来看，太湖水质已整体转好为四类水。太湖蓝藻的研究和治理，已为国内外提供了治理经验。

“蓝藻水华主要是受总磷驱动。”中国科学院南京地理与湖泊研究所副研究员张民说，蓝藻水华形势还是没有明显改观，特别是今年的“暖冬+暖春”，春季时蓝藻水华出现比较早。磷主要来自岸上的生活污水、农业面源、畜禽养殖等，因此控制外来污染源是当务之急，也是一项长期的工作。

“太湖的外来污染源如果得不到削减，在湖内做再多的治理都是浪费。”中国科学院南京地理与湖泊研究所的史小丽说，毕竟湖内防控属于末端治理，要想进行湖内防控目前只能在局部水面做一些生态修复、消除蓝藻的尝试，对于治理太湖蓝藻来说，当下减外源比治内源更重要，减少外来污染物是目前治理蓝藻最重要的一个手段。

（来源：中国江苏网 2017-07-02）

藻类生物燃料未来有望代替汽油

俄罗斯学术期刊《欧洲材料科学杂志》发表的一篇文章称，莫斯科物理技术研究院、莫斯科大学、斯科尔科沃科技研究院以及俄罗斯科学院一些研究所的研究人员，发现了单细胞藻类生物燃料的准确化学成分，这有助于使其生产更有效。

藻类比其他光合有机体获得生物物质要快几倍，因此，许多研究人员认为，藻类是代替汽油和其他燃料的主要候选燃料。除了生长速度快以外，海藻还有许多其他优势，如培育海藻不需要占地，海藻所具有的单细胞性质使得它们更容易被加工成燃料等。将温度加热到300摄氏度，同时增大压力，就可以将藻类直接转换成生物燃料，这实际上是模拟地下石油产生的过程。

俄罗斯专家发现，海洋生物燃料的组成物质大多数类似于一些有机染料，与碳氢化合物和石油中所含的其他分子没有共同点。文章作者认为，进一步研究“生物绿素”，将有助于了解最好用什么样的藻类生产生物燃料，以及如何对它们进行变型，使其能代替汽油和其他矿物燃料。

（来源：《科技日报》 2017-07-04）

三峡库区水质总体稳定或优于蓄水前

近期，长江进入了汛期，三峡等重大工程在抗洪防灾方面起到了重大作用，三峡库区以及干、支流的水生态环境状况也备受关注。国家水专项“十二五”三峡项目“不同水位运行下水环境问题诊断及安全保障研究”课题也公布了最新研究成果，在超大型水库生态环境演化的科学认知等方面获得创新性突破。

三峡工程立项之初，库区等地可能会出现大规模水污染是项目争议最激烈的部分之一。国家水专项三峡项目课题负责人、中国水利水电科学研究院水环境研究所副所长王雨春在接受科技日报记者专访时说，通过长期实地观测和原位研究证实，三峡工程蓄水后，库区水质整体良好，总体稳定或优于蓄水前，多为Ⅱ类水；但是由于受干流“顶托”影响，支流水质富营养化程度增加，总体断面水质类别以较差的Ⅳ类—Ⅴ类为主，占比为54.5%。

作为特大型水利工程，三峡工程最高蓄水位达到175米。王雨春说，从自然界来看，从未出现过如此深的水体。因此，国内外关于此类高坝大库水体生态环境理论研究十分薄弱，在系统性和深度上都明显不足，缺乏可有效借鉴的研究案例。

“我们的研究是个全新开始。”王雨春说，三峡的特殊性还在于，其流域控制集雨面积超100万平方公里，占长江流域面积56%；库区生活着1200万人，涉及重庆、湖北26个县（区）。幅员辽阔的流域面积、强烈的人类活动扰动，使三峡水生态环境演化的“湖沼化进程”中表现出高度复杂性和不确定性。三峡还关系着长江中下游沿线、南水北调东线几亿人的饮用水与生产、生活用水安全。

课题按照“动态观测—多维模拟—流域污染负荷解构—综合评价”技术路线，结合三峡工程生态环境监测系统重点支流站的工作，在三峡水库典型支流及毗邻干流开展了全方位监测、原位研究工作，获取水文、水化学、水生态、底质、污染负荷等海量科学观测数据，从宏观层面揭示水文情势、水沙相互作用等对库区水质的总体影响，揭示和诊断出三峡水库富营养化及支流藻华暴发的作用规律、主要存在问题；以自主开发的、基于流域分布式过程污染负荷估算技术，解析了三峡入库污染负荷组成，进而提出“着眼整体、强支控干、生态优先、稳定发展”的三峡水库富营养化控制及污染防治对策，不但为水专项三峡项目的其他课题实施奠定基础，也为三峡水库及上游流域水污染防治规划、后续工作规划、长江大保护战略等实施提供了重要科技支撑。

“目前，我国已修建了83000多座水库，该课题的研究成果对其他深水库区的生态环境认识、治理和规划等提供了可借鉴的理论依据、技术方案。”王雨春说，随着三峡上游更多水利项目的建设，水动力等情况可能会发生变化。在“十三五”，

还应加强环境监测，提高对大型水库富营养化控制理论的科学认知水平，以水华控制为重点，突破关键技术，开展整装集成示范。

（来源：《科技日报》 2017-07-25）

新技术 30 分钟清除水中 99%双酚 A

双酚A几乎无处不在，与日常生活有着千丝万缕的联系。无论是DVD、信用卡、牙科填充物，还是罐装食物及饮料瓶，甚至土壤、空气和饮用水中，都含有对人体有害的双酚A。据《新科学家》网站2日报道，美国科学家研发出一种简单方便的新技术，能在30分钟内清除水中99%的双酚A，而且任何人都可随时随地使用。

60年来，人类对双酚A的消费量持续增加。虽然存在争议，但大量研究证明，双酚A能导致心血管疾病和肝功能异常等一系列健康问题。最严重的是，鱼类、哺乳动物和人体试验均证明，它能“冒充”孕妇体内的一种雌激素——雌二醇，破坏内分泌功能，对生殖系统和胚胎发育造成不良影响。欧盟和美国正在考虑逐渐从市场上淘汰双酚A，但其替代产品可能也有健康隐患。

美国卡耐基梅隆大学科学家泰伦斯·柯林斯和同事经过长达15年的研发，终于找到这种从水中清除双酚A的简单方法。他们向被双酚A污染的水中先后加入一组催化剂（TAML）和过氧化氢，催化剂与过氧化氢结合后，在pH值为中性的废水中，能加速双酚A聚合，使其在30分钟内快速形成大分子的寡聚体，并从水中过滤出来。

柯林斯团队还在TAML催化剂处理过的水中培育酵母细菌和斑马鱼胚胎，结果没有出现与双酚A有关的任何发育异常。双酚A是地球上最难攻克的污染物之一，该成果证明他们的技术已能有效将其清除。柯林斯表示：“我们解决了可能会耗费数十亿美元研究经费的难题，使用新技术，只要2斤催化剂就能清除数万吨水中的双酚A污染。”

（来源：《科技日报》 2017-08-04）

污水生物处理新技术再上新台阶

9 月 6 日在京召开的“KDL 固定化定向生物法治水科技成果转化应用研讨会”上获悉，我国首创了污水生物处理新技术。

该技术命名为“KDL 固定化定向生物法”，由广东金明环保科技公司首席专家、享受国务院特殊津贴专家汪凯民领衔发明。据介绍，这项技术是经过十余年科学实验和技术攻关，自主研发的最新科研成果，为国际首创，通过固定化技术，使微生物固定着生长，在适宜条件下保持高的生物活性，进行生物处理的一系列污水生物处理技术方法。

与现有的活性污泥法、生物膜法和固定化微生物法等生化方法相比，该项技术有利于提高生物反应器内的微生物浓度和反应后的固液分离，能缩短处理所需时间，还有效地实现了对氮以及其他重金属离子的去除，可广泛应用于生活、工业污水处理，河道污染治理和水资源回用等领域。

“使用这种方法处理过的水质，可以达到国家一级 A 标准。”汪凯民说，这项技术可以解决二次污染大、水处理效果不稳定、水处理成本较高等一系列问题。

目前，该技术通过在国内一些厂区工业污水处理及农村生活污水处理实际应用，已经实现了以较低的投资和运行成本，取得高水质可回用的污水处理效果。

北京大学环境学院 E20 联合研究院副院长薛涛表示，这项技术为推进水污染处理 PPP 模式提供了新的技术支撑，变污水、废水为资源，符合现代社会对“循环经济”的追求。

研讨会由中国国际科技交流中心、中国科协新技术开发中心主办。

（来源：《科技日报》 2017-09-07）

兰德公司：水资源的智能市场

2017 年 7 月，兰德公司（RAND）在线发布了题为《水资源的智能市场》（Smart Markets for Water）的报告，该报告探讨了水资源在构建智能市场的环境下，如何进行有效的交易，从而降低传统水交易带来的高成本，旨在消除传统水资源交易市场的不完善，水的低效率利用与不合理分配现象。探讨如何利用互联网大数据进行用户报价，建设具有高度数学优化的水文模拟平台，在满足所有环境限制的前提下，科学合理地量化分配水资源的价值。随着全球人口经济的快速增长，水需求正在迅速增长，全球很多地区已出现较为严重的水危机状况，从水资源供给角度来说，淡水资源因为全球气候变化和环境破坏，呈逐渐减少趋势，如何将水的供应、消费与经济发展和社会责任统筹起来，既能最大效用地使用水资源，又能体现自然资源使用与保护人人面前平等的原则，也能反映水资源在市场经济环境下市场调节资源配置的能力。这是当前全球水资源配置研究的迫切命题。因为水资源利用存在一定的“外部性”。它的高效利用区别于其他商品。所以从它本身的经济性与环保性角度来说将更为复杂，本报告试图讨论利用互联网、大数据分析等工具，建立一个区别于传统能源（天然气、电力）的虚拟智慧网络平台。该平台应该坚持以下几个原则：①建立一套确定水的产权范围的法律制度，旨在消除与水有关的社会共性问题。②水权确定以后，明确使用的时间与期限，这为水资源在私人部门与公共服务领域之间流动提供明确的依据。③提供开放的平台机构，确保个人、私人机构与公共机构可以共享，并且形成互相监督机制。④建立“外部性”补偿机制，保护水权所有者免受污染、洪水和排水带来的有害影响，建立“损失”等级进行补偿。⑤开发建立有

关水资源的相关信息库，并进行透明公开化。

原文来源：https://www.rand.org/pubs/commercial_books/CB901.html

（来源：科学研究动态监测快报 2017-08-01，第 15 期总第 308 期）

山西：决战大水网 修复水生态

9月4日，山西大水网建设四大骨干工程之一——小浪底引黄工程Ⅰ标取水口建设工地，机声隆隆，一片繁忙。小浪底引黄工程建设管理局局长宋建庆说：“在大水网建设的决胜阶段，取水口建设工地正在大战100天，工人采用倒班工作制，24小时不停歇施工，争取10月份完成进水塔施工。”

今年以来，山西省进入了以超常举措持续加强生态文明建设的重要阶段，同时启动实施汾河、桑干河、滹沱河、漳河、沁河、涑水河、大清河7条重点河流生态修复建设。

山西大水网工程以黄河和汾河两条天然河道为主干，通过总长近千公里的隧洞，将包括黄河和永定河、子牙河各源头的6条河流连成一体，形成了“两纵十横、六河连通”的新水系。工程包含中部引黄、小浪底引黄、东山供水、辛安泉供水四大骨干工程。

经过6年紧张建设，山西大水网工程目前已进入决战决胜阶段，上万名建设者正昼夜不息奋战在大水网建设一线，力争今年年内完成建设任务。

（来源：《科技日报》 2017-09-06）

滇池流域综合管理研究培训会举行

近日，为积极推进滇池环境保护与治理领域的学术交流与国际合作，“滇池流域综合管理研究”培训在昆举行，来自国内外的10位专家将在两天的时间内进行滇池流域管理、污水治理等方面的交流培训。

副市长吴涛参加培训会并在开幕式上致辞。

市委、市政府一直致力于滇池流域环境治理与生态建设，多年来，通过综合实施截污治污、农业农村面源治理、生态修复与建设、入湖河道整治、生态清淤、外流域引水及节水工程等多项措施，滇池流域入湖河道水质明显提升，滇池湖体水质企稳向好。

吴涛致辞时说，随着经济全球化、区域经济一体化进程的加快，滇池保护治理工作与国外机构和人员的合作势必更加紧密与深入。昆明市历来高度重视并积极推进滇池保护治理领域的学术交流与国际合作。希望通过国内外专家机构和学院的参与，充分吸收借鉴国内外湖泊保护和治理的先进经验和技术成果，进一步推进滇池

保护治理工作。

本次培训会是云南外国专家局和昆明市外国专家局支持的引进外国专家到滇培训项目。培训会围绕国内外湖泊治理研究成果和先进技术，邀请瑞士、德国、美国、法国、以色列以及国内的10位专家结合滇池保护与治理现状，就滇池流域综合管理、城市水环境治理、生态建设和水资源保护等方面进行培训交流，探索今后滇池保护与治理的办法，加强湖泊治理管理经验交流与学习，提高滇池保护治理工作水平。来自昆明市滇管、环保、水务、规划以及滇投公司、水务公司等滇池治理相关部门及滇池流域相关县区、省内外涉及滇池保护治理相关科研所约200人参加培训。

（来源：http://www.km.gov.cn 2017-08-24）

洞庭湖湿地保护亟待加强法制保障

近日，由湖南师范大学主办的洞庭湖-琵琶湖环境治理政策与法律国际研讨会在湖南师范大学法学院隆重举行。来自日本滋贺县立大学、湖南师范大学、中南大学、湘潭大学、中南林业科技大学的20余位中日环境法、环境科学领域的专家学者参加会议。

研讨会上，日本滋贺县立大学环境科学学院香川雄一、林宰司、平山奈央子三位专家重点阐释了日本在治理琵琶湖外来物种入侵、湖面缩减等方面的技术策略和日本政府在保护琵琶湖生态环境方面的立法进程及法律制度。湖南省李爱年、颜运秋、周训芳、吴勇、毛德华、肖爱等专家学者从洞庭湖湿地保护状况出发，结合一体化法制保障理念，从监管体制、立法规范、司法保障、风险防范等方面提出了保护洞庭湖湿地的路径与思考。

与会专家一致认为，洞庭湖是湖南省的“母亲湖”，洞庭湖湿地是湖南省“一湖三山四水”的生态屏障。保护洞庭湖湿地，法治需先行。洞庭湖与日本琵琶湖的地理情势、水文特征相近，湖南可借鉴日本在琵琶湖环境治理方面的立法经验，加快制定洞庭湖地方性法规，为保护洞庭湖的生态环境提供强有力的法律支撑。

据悉，琵琶湖是日本的第一大淡水湖泊，日本琵琶湖的环境治理号称全球治水典范。日本滋贺县立大学位于琵琶湖之滨，该校长期致力于琵琶湖环境治理领域研究，在该领域享有较高声誉。目前，该校与湖南师范大学在环境科学、环境法学的教学科研、人才培养方面展开了深入地交流合作。

（来源：法制日报 2017-09-23）

新疆乌伦古湖生态保护成效显现

乌伦古湖是我国西北干旱平原地区现存的少数几处天然湿地之一，也是我国重要湿地之一，是新疆最重要的渔业生产基地之一，是第四批国家级水产种质资源保

护区。湖区栖息着天鹅、黑颈鹤、鹭鸶、海鸥等47种名贵鸟类，盛产贝加尔雅罗鱼（小白鱼）、东方欧鳊、银鲫、梭鲈、赤鲈等27种名贵野生鱼类，具有“鸟类天堂”和“名贵鱼乡”的美名。

2011年，新疆福海县委、县政府主动出击，积极响应国家生态文明建设的号召，坚持绿色主线，把握生态红线，紧扣环保底线，把保护母亲湖作为出发点，申请建设了乌伦古湖国家湿地公园，2012年经国家林业局批准同意开展试点工作。

该县依托湿地保护项目，有效改善和保护了湿地生态环境和野生动植物栖息地，提高了湖区周围的植被覆盖率，保证了湿地植物种群的多样性，为野生动物提供了较好的生息繁衍场所和必要的食物。

据了解，自2010年以来，共完成了封滩育草949.7公顷，环湖植被恢复450公顷，芦苇复壮540.70公顷，人工育苇300公顷，水鸟栖息地恢复100公顷。

同时，该县通过实施“政府主导、部门协作、社会参与”的湿地公园发展模式，着力解决乌伦古湖湿地受人为干扰强度高、湿地生态系统较为破碎的问题。“我们对湿地公园建设进行指导、监督和管理，林业、环保、畜牧、旅游、国土等主管部门各司其职，形成协同联动机制。还出台规划和相关政策指引，突出基础设施建设硬性指标，高标准推进湿地公园建设。”福海县乌伦古湖国家湿地公园管理局局长郭权胜说，“随着这些设施、设备的投入使用，湿地公园的管理、监测、巡护等硬实力均得到了显著提高，保护能力得到了大幅度提升。”

据悉，该县坚持“在保护中发展，在发展中保护”的方针，凭借得天独厚的旅游资源和便捷的交通条件，通过招商引资，在国家湿地公园管理服务区建立起了乌伦古湖国家4A级海滨景区，严格监管与合理利用双管齐下，通过发展旅游业反哺国家湿地公园建设。

通过近几年的建设和保护，乌伦古湖国家湿地公园（试点）的生态环境得到较好的保护和恢复，于2015年荣获地区级环境教育示范基地称号。2017年6月，乌伦古湖国家湿地公园顺利迎来国家林业局专家组验收。

“今后，我们将以更加饱满的热情投入到工作中，认真履行工作职责，努力把乌伦古湖国家湿地公园建设得更加绿色、生态、环保，为打造西北地区绿色屏障贡献自己的力量。”郭权胜说。

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