

# 湖泊科学动态

## 本期导读

- ▢ *Nature Communication*: 全球湖泊和水库的有机碳埋藏研究
- ▢ *Science Advance*: 亚马逊河大坝影响下的水文变化
- ▢ 《全球生态环境遥感监测 2017 年度报告》出炉
- ▢ *Science*: 为可持续发展评估水资源
- ▢ 全国首张湖长地图发布

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## 热点文章

### ➤ Organic carbon burial in global lakes and reservoirs

Raquel Mendonça; Roger A. Müller; David Clow; et al.

Burial in sediments removes organic carbon (OC) from the short-term biosphere-atmosphere carbon (C) cycle, and therefore prevents greenhouse gas production in natural systems. Although OC burial in lakes and reservoirs is faster than in the ocean, the magnitude of inland water OC burial is not well constrained. Here we generate the first global-scale and regionally resolved estimate of modern OC burial in lakes and reservoirs, deriving from a comprehensive compilation of literature data. We coupled statistical models to inland water area inventories to estimate a yearly OC burial of 0.15 (range, 0.06–0.25) Pg C, of which ~40% is stored in reservoirs. Relatively higher OC burial rates are predicted for warm and dry regions. While we report lower burial than previously estimated, lake and reservoir OC burial corresponded to ~20% of their C emissions, making them an important C sink that is likely to increase with eutrophication and river damming.

(来源: Nature Communications, 2017, doi:10.1038/s41467-017-01789-6)

#### 中文点评:

#### 全球湖泊和水库的有机碳埋藏研究

有机碳埋藏在沉积物中会脱离短期生物圈到大气圈的碳循环过程,从而阻止了这部分碳转化成温室气体排放到自然系统中。尽管相较海洋而言,湖泊和水库中有机碳的埋藏更快,但内陆水体的有机碳埋藏量并未得到很好的控制。本研究通过汇编文献数据中已发布的首个全球及区域范围估算出的现代湖泊和水库的有机碳埋藏量作为源数据,并将统计模型耦合到内陆水体区域的各个单元中,估算出每年有机碳埋藏量为 0.15 (范围在 0.06~0.25) Pg/C,其中约 40%是储存在水库中;并预测了相对较高的有机碳埋藏速率出现在温暖和干燥的区域。同时,研究发现湖泊和水库中有机碳埋藏导致了大约 20%的 C 释放,而之前报道的预测值是明显偏低的,证明了湖泊和水库是重要的 C 汇,这与富营养化和拦河筑坝效应此呼彼应。

(来源: 根据相关资料编译)

### ➤ The changing hydrology of a dammed Amazon

Kelsie Timpe; David Kaplan

Developing countries around the world are expanding hydropower to meet growing energy demand. In the Brazilian Amazon, >200 dams are planned over the next 30 years, and questions about the impacts of current and future hydropower in this globally important watershed remain unanswered. In this context, we applied a hydrologic indicator method to quantify how existing Amazon dams have altered the natural flow regime and to identify predictors of alteration. The type and magnitude of hydrologic alteration varied widely by dam, but the largest changes were to critical characteristics of the flood pulse. Impacts were largest for low-elevation, large-reservoir dams; however, small dams had enormous impacts relative to

electricity production. Finally, the “cumulative” effect of multiple dams was significant but only for some aspects of the flow regime. This analysis is a first step toward the development of environmental flows plans and policies relevant to the Amazon and other megadiverse river basins.

(来源: Science Advances 2017, 3(11): e1700611)

## 中文点评:

### 亚马逊河大坝影响下的水文变化

2017 年 11 月 1 日, 美国《科学进展》(Science Advances) 期刊在线发表“亚马逊河大坝影响下的水文变化(The changing hydrology of a dammed Amazon)”一文, 文中应用了一种水文指标方法量化亚马逊河现有水坝的环境影响, 研究结果表明亚马逊河流所建大坝的水文变化类型和大小差异很大, 尤其是在对洪水脉动的反应方面。这项研究是制定亚马逊和其他大型河流流域有关的环境流动计划和政策的第一步。

流动变异性被广泛认为是河流生态系统中生物和非生物条件的主要驱动因素。水坝通过改变流量的大小、频率、持续时间和速度, 以及改变河流沉积物、营养物质和生物群的运输, 改变自然的流动方式。尽管大坝的负面环境影响已经得到相当充分的了解, 但人们普遍认为, 开发新水电来支持日益增长的全球能源需求是一种可持续的电力来源。目前, 在亚马逊、刚果和湄公河流域都有 450 座大型水坝被规划或在建。未来三十年, 巴西亚马逊河流将会建设超过 200 个大坝用于水力发电。基于上述现状, 文中利用水文变化的指标 (IHA) 方法对建坝前后施工流程数据分析, 通过五个“组”来计算 33 个生态相关参数, 描述了流动状态的主要方面: 幅度、频率、持续时间和流量变化速率。在前后影响参数值之间的相对差异(百分比)用于评估和比较系统之间的大坝影响, 以量化亚马逊水文变化, 确定环境和管理变量, 预测水文变化的观测值, 以告知未来的大坝选址和运行, 量化多个水坝对河流的累积效应。研究表明, 低海拔、大型水库大坝的环境影响最大, 多个水坝的“累积”效应是显著的, 但仅仅是在流态的某些方面。采取措施减少水坝对环境的影响可以被认为是“下一个最佳”的做法, 包括优化大坝的运作, 以减少水文体制的改变, 并提高我们对改变的水文学与生态和社会系统的影响之间的联系的理解。

这项工作将亚马逊河流域 33 个小型水坝和大型水坝的水文影响量化, 从而深入了解大坝影响的物理驱动力, 并强调所观察到的水文变化所带来的重要生态水文影响。科研人员认为这种类型的区域水文分析是未来制定亚马逊和其他大型热带河流流域有关的环境流动管理计划和政策的第一步。环境流动方法的应用需要综合分析, 以了解大坝实施前的水文变化和生态环境对水系统的影响。因此, 这些研究作为一个基线, 从自然变化中隔离人为的影响, 并衍生出大坝保护和缓解策略。这种类型的分析在缺乏持续数据的领域很困难, 阻碍了这些地区的社区和政府制定适当和可持续的水文影响的决策。

(来源: 科学研究动态监测快报 2017-11-15, 第 22 期总第 315 期)

## 摘要精选

### Decline of the world's saline lakes

Wayne A. Wurtsbaugh; Craig Miller; Sarah E. Null; et al.

Many of the world's saline lakes are shrinking at alarming rates, reducing waterbird habitat and economic benefits while threatening human health. Saline lakes are long-term basin-wide integrators of climatic conditions that shrink and grow with natural climatic variation. In contrast, water withdrawals for human use exert a sustained reduction in lake inflows and levels. Quantifying the relative contributions of natural variability and human impacts to lake inflows is needed to preserve these lakes. With a credible water balance, causes of lake decline from water diversions or climate variability can be identified and the inflow needed to maintain lake health can be defined. Without a water balance, natural variability can be an excuse for inaction. Here we describe the decline of several of the world's large saline lakes and use a water balance for Great Salt Lake (USA) to demonstrate that consumptive water use rather than long-term climate change has greatly reduced its size. The inflow needed to maintain bird habitat, support lake-related industries and prevent dust storms that threaten human health and agriculture can be identified and provides the information to evaluate the difficult tradeoffs between direct benefits of consumptive water use and ecosystem services provided by saline lakes.

(来源: Nature Geoscience, 2017, 10: 816-821)

### Ecological resilience in lakes and the conjunction fallacy

Bryan M. Spears; Martyn N. Futter; Erik Jeppesen; et al.

There is a pressing need to apply stability and resilience theory to environmental management to restore degraded ecosystems effectively and to mitigate the effects of impending environmental change. Lakes represent excellent model case studies in this respect and have been used widely to demonstrate theories of ecological stability and resilience that are needed to underpin preventative management approaches. However, we argue that this approach is not yet fully developed because the pursuit of empirical evidence to underpin such theoretically grounded management continues in the absence of an objective probability framework. This has blurred the lines between intuitive logic (based on the elementary principles of probability) and extensional logic (based on assumption and belief) in this field.

(来源: Nature Ecology & Evolution, 2017, 1: 1616-1624)

### Recovery of lake vegetation following reduced eutrophication and acidification

Baastrop-Spohr, Lars; Sand-Jensen, Kaj; Olesen, Sissel C. H.; et al.

1. In recent decades, many aquatic ecosystems in Europe and North America have experienced reduced inputs of nutrients and acidifying substances because of improved sewage treatment and reduced emission of sulphur oxides. We evaluated the consequences of these efforts to changes in water chemistry, species richness and community composition of aquatic macrophytes in 56 lakes in Denmark around 1990 and again around 2010.

2. Reductions in lake water concentrations of phosphorus and nitrogen were strongest in eutrophic and

hypertrophic lakes, for example, lakes which had been heavily affected by domestic sewage. These changes translated into decreased algal biomass in the most eutrophied lakes. Oligo- and mesotrophic lakes did not change significantly in terms of nutrients or algal biomass. Water clarity increased across all lakes but not significantly in specific trophic lake groups. Alkalinity and pH increased significantly (up to 2pH-units) in low-alkaline lakes, while well-buffered high-alkaline lakes (>0.5meq/L) did not show any change.

3. Macrophyte species richness per lake increased, on average, by 13% during the 20-year study period. The increase was strongest in species preferring nutrient-rich conditions and could be directly attributed to reductions in phytoplankton biomass in lakes of medium water clarity. The similarity among all lakes in terms of species composition increased over the study period. This development was closely related to higher average species richness and was mainly caused by recolonisation of lakes, recovering from past eutrophication, by relatively common species (e.g., *Lemna trisulca*, *Sparganium emersum* and *Potamogeton berchtoldii*). Higher pH in low-alkaline lakes was accompanied by a shift from acid-tolerant to more acid-sensitive species. 4. Our results demonstrate that investment in pollution control has been successful in terms of markedly improving water quality of lakes and, with a time lag, macrophyte species richness. Although relatively common species have spread across lakes and resulted in homogenised macrophyte communities, continued efforts to reduce pollution could ensure the survival of rare specialist species and perhaps even increase their abundance in the future..

(来源: FRESHWATER BIOLOGY, 2017, 62(11): 1847-1857)

## Paleo-ecotoxicology: What Can Lake Sediments Tell Us about Ecosystem Responses to Environmental Pollutants?

Korosi, Jennifer B.; Thienpont, Joshua R.; Smol, John P.; et al.

The development of effective risk reduction strategies for aquatic pollutants requires a comprehensive understanding of toxic impacts on ecosystems. Classical toxicological studies are effective for characterizing pollutant impacts on biota in a controlled, simplified environment. Nonetheless, it is well-acknowledged that predictions based on the results of these studies must be tested over the long-term in a natural ecosystem setting to account for increased complexity and multiple stressors. Paleolimnology (the study of lake sediment cores to reconstruct environmental change) can address many key knowledge gaps. When used as part of a weight-of-evidence framework with more traditional approaches in ecotoxicology, it can facilitate rapid advances in our understanding of the chronic effects of pollutants on ecosystems in an environmentally realistic, multistressor context. Paleolimnology played a central role in the Acid Rain debates, as it was instrumental in demonstrating industrial emissions caused acidification of lakes and associated ecosystem-wide impacts. "Resurrection Ecology" (hatching dormant resting eggs deposited in the past) records evolutionary responses of populations to chronic pollutant exposure. With recent technological advances (e.g, geochemistry, genomic approaches), combined with an emerging paleo-ecotoxicological framework that leverages strengths across multiple disciplines, paleolimnology will continue to provide valuable insights into the most pressing questions in ecotoxicology.

(来源: ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(17): 9446-9457)



## Characteristics and causal factors of hysteresis in the hydrodynamics of a large floodplain system: Poyang Lake (China)

Zhang, X. L.; Zhang, Q.; Werner, A. D.; et al.

A previous modeling study of the lake-floodplain system of Poyang Lake (China) revealed complex hysteretic relationships between stage, storage volume and surface area. However, only hypothetical causal factors were presented, and the reasons for the occurrence of both clockwise and counterclockwise hysteretic functions were unclear. The current study aims to address this by exploring further Poyang Lake's hysteretic behavior, including consideration of stage-flow relationships. Remotely sensed imagery is used to validate the water surface areas produced by hydrodynamic modeling. Stage-area relationships obtained using the two methods are in strong agreement. The new results reveal a three-phase hydrological regime in stage-flow relationships, which assists in developing improved physical interpretation of hysteretic stage-area relationships for the lake-floodplain system. For stage-area relationships, clockwise hysteresis is the result of classic floodplain hysteretic processes (e.g., restricted drainage of the floodplain during recession), whereas counterclockwise hysteresis derives from the river hysteresis effect (i.e., caused by backwater effects). The river hysteresis effect is enhanced by the time lag between the peaks of catchment inflow and Yangtze discharge (i.e., the so-called Yangtze River blocking effect). The time lag also leads to clockwise hysteresis in the relationship between Yangtze River discharge and lake stage. Thus, factors leading to hysteresis in other rivers, lakes and floodplains act in combination within Poyang Lake to create spatial variability in hydrological hysteresis. These effects dominate at different times, in different parts of the lake, and during different phases of the lake's water level fluctuations, creating the unique hysteretic hydrological behavior of Poyang Lake.

(来源: JOURNAL OF HYDROLOGY, 2017, 553: 574-583)

## Water quality and ecosystem management: Data-driven reality check of effects in streams and lakes

Destouni, Georgia; Fischer, Ida; Prieto, Carmen

This study investigates nutrient-related water quality conditions and change trends in the first management periods of the EU Water Framework Directive (WFD; since 2009) and Baltic Sea Action Plan (BSAP; since 2007). With mitigation of nutrients in inland waters and their discharges to the Baltic Sea being a common WFD and BSAP target, we use Sweden as a case study of observable effects, by compiling and analyzing all openly available water and nutrient monitoring data across Sweden since 2003. The data compilation reveals that nutrient monitoring covers only around 1% (down to 0.2% for nutrient loads) of the total number of WFD-classified stream and lake water bodies in Sweden. The data analysis further shows that the hydro-climatically driven water discharge dominates the determination of waterborne loads of both total phosphorus and total nitrogen across Sweden. Both water discharge and the related nutrient loads are in turn well correlated with the ecosystem status classification of Swedish water bodies. Nutrient concentrations do not exhibit such correlation and their changes over the study period are on average small, but concentration increases are found for moderate-to-bad status waters, for which both the WFD and the BSAP have instead targeted concentration decreases. In general, these results indicate insufficient distinction and mitigation of human-driven nutrient components in inland waters and their discharges to the sea by the internationally harmonized applications of the WFD and the BSAP. The results call for further comparative investigations of observable large-scale effects of such



regulatory/management frameworks in different parts of the world.

(来源: WATER RESOURCES RESEARCH, 2017, 53(8): 6395-6406)

## Copula-based probability of concurrent hydrological drought in the Poyang lake-catchment-river system (China) from 1960 to 2013

Zhang, Dan; Chen, Peng; Zhang, Qi; et al.

Investigation of concurrent hydrological drought events is helpful for understanding the inherent mechanism of hydrological extremes and designing corresponding adaptation strategy. This study investigates concurrent hydrological drought in the Poyang lake-catchment-river system from 1960 to 2013 based on copula functions. The standard water level index (SWI) and the standard runoff index (SRI) are employed to identify hydrological drought in the lake-catchment-river system. The appropriate marginal distributions and copulas are selected by the corrected Akaike Information Criterion and Bayesian copulas selection method. The probability of hydrological drought in Poyang Lake in any given year is 16.6% (return period of 6 years), and droughts occurred six times from 2003 to 2013. Additionally, the joint probability of concurrent drought events between the lake and catchment is 10.1% (return period of 9.9 years). Since 2003, concurrent drought has intensified in spring due to frequent hydrological drought in the catchment. The joint probability of concurrent drought between the lake and the Yangtze River is 11.5% (return period of 8.7 years). This simultaneous occurrence intensified in spring, summer and autumn from 2003 to 2013 due to the weakened blocking effect of the Yangtze River. Notably, although the lake drought intensified in winter during the past decade, hydrological drought in the catchment and the Yangtze River did not intensify simultaneously. Thus, this winter intensification might be caused by human activities in the lake region. The results of this study demonstrate that the Poyang lake-catchment-river system has been drying since 2003 based on a statistical approach. An adaptation strategy should be urgently established to mitigate the worsening situation in the Poyang lake-catchment-river system.

(来源: JOURNAL OF HYDROLOGY, 2017, 553: 773-784)

## Water quality assessment based on the water quality index method in Lake Poyang: The largest freshwater lake in China

Zhaoshi Wu; Dawen Zhang; Yongjiu Cai; et al.

Twenty-four samplings were conducted every 3 months at 15 sites from January 2009 to October 2014 in Lake Poyang, and 20 parameters were analyzed and classified into three groups (toxic metals, easily treated parameters, and others). The assessment results based on water quality index (WQI) showed that the water quality in Lake Poyang was generally "moderate", according to the classification of the surface water quality standard (GB3838-2002) in China, but a deteriorating trend was observed at the interannual scale. Seasonally, the water quality was best in summer and worst in winter. Easily treated parameters generally determined the WQI value in the assessment, especially total nitrogen (TN) and total phosphorus (TP), while toxic metals and other parameters in Lake Poyang were generally at low and safe levels for drinking water. Water level (WL) has a net positive effect on water quality in Lake Poyang through dilution of environmental parameters, which in practice means TN. Consequently, local management agencies should pay more attention to nutrient concentrations during the monitoring

schedule, as well as during the low-water periods which manifest a relatively bad water quality state, especially with the prevailing low WL observed recently in Lake Poyang.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-18285-y)

## Evaluation of water quality based on a machine learning algorithm and water quality index for the Ebinur Lake Watershed, China

Xiaoping Wang; Fei Zhang; Jianli Ding

The water quality index (WQI) has been used to identify threats to water quality and to support better water resource management. This study combines a machine learning algorithm, WQI, and remote sensing spectral indices (difference index, DI; ratio index, RI; and normalized difference index, NDI) through fractional derivatives methods and in turn establishes a model for estimating and assessing the WQI. The results show that the calculated WQI values range between 56.61 and 2,886.51. We also explore the relationship between reflectance data and the WQI. The number of bands with correlation coefficients passing a significance test at 0.01 first increases and then decreases with a peak appearing after 1.6 orders. WQI and DI as well as RI and NDI correlation coefficients between optimal band combinations of the peak also appear after 1.6 orders with R<sup>2</sup> values of 0.92, 0.58 and 0.92. Finally, 22 WQI estimation models were established by POS-SVR to compare the predictive effects of these models. The models based on a spectral index of 1.6 were found to perform much better than the others, with an R<sup>2</sup> of 0.92, an RMSE of 58.4, and an RPD of 2.81 and a slope of curve fitting of 0.97.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-12853-y)

## Variation in particulate C:N:P stoichiometry across the Lake Erie watershed from tributaries to its outflow

Prater, Clay; Frost, Paul C.; Howell, E. Todd; et al.

Human activities can cause large alterations in biogeochemical cycles of key nutrients such as carbon (C), nitrogen (N), and phosphorus (P). However, relatively little is known about how these changes alter the proportional fluxes of these elements across ecosystem boundaries from rivers to lakes. Here, we examined environmental factors influencing spatial and temporal variation in particulate C:N:P ratios across the Lake Erie watershed from its tributaries to its outflow. Throughout the study, particulate nutrient ratios ranged widely (C:N 2.0-25.8, C:P 32-530, N:P 3.7-122.9), but mean values were generally lower than previous estimates from different aquatic environments. Particulate C:N ratios varied the least across all environments, but C:P and N:P ratios increased between tributaries and coastal areas and throughout the growing season in coastal environments. These ratios also differed temporally in offshore waters as particulate C:P and N:P were higher in the spring and summer and lower in the fall and winter. Particulate C:P ratios also increased between the western/central and eastern basins indicating differential nutrient processing across the lake. These stoichiometric changes were associated with unique environmental factors among ecosystems as tributary stoichiometry was related to terrestrial land use and land cover, coastal ratios were a product of mixing between riverine and offshore waters, and offshore patterns were influenced by differences in temperature and particulate nutrient loading among basins. Overall, by studying changes in particulate C:N:P ratios across the Lake Erie watershed, our study demonstrates the power of using mass balance principles to study nutrient transformations along

the aquatic continuum.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(1) : S194-S206)

## Benthic carbon is inefficiently transferred in the food webs of two eutrophic shallow lakes

Lischke, Betty; Mehner, Thomas; Hilt, Sabine; et al.

The sum of benthic autotrophic and bacterial production often exceeds the sum of pelagic autotrophic and bacterial production, and hence may contribute substantially to whole-lake carbon fluxes, especially in shallow lakes. Furthermore, both benthic and pelagic autotrophic and bacterial production are highly edible and of sufficient nutritional quality for animal consumers. We thus hypothesised that pelagic and benthic transfer efficiencies (ratios of production at adjacent trophic levels) in shallow lakes should be similar. We performed whole ecosystem studies in two shallow lakes (3.5ha, mean depth 2m), one with and one without submerged macrophytes, and quantified pelagic and benthic biomass, production and transfer efficiencies for bacteria, phytoplankton, epipelton, epiphyton, macrophytes, zooplankton, macrozoobenthos and fish. We expected higher transfer efficiencies in the lake with macrophytes, because these provide shelter and food for macrozoobenthos and may thus enable a more efficient conversion of basal production to consumer production. In both lakes, the majority of the whole-lake autotrophic and bacterial production was provided by benthic organisms, but whole-lake primary consumer production mostly relied on pelagic autotrophic and bacterial production. Consequently, transfer efficiency of benthic autotrophic and bacterial production to macrozoobenthos production was an order of magnitude lower than the transfer efficiency of pelagic autotrophic and bacterial production to rotifer and crustacean production. Between-lake differences in transfer efficiencies were minor. We discuss several aspects potentially causing the unexpectedly low benthic transfer efficiencies, such as the food quality of producers, pelagic-benthic links, oxygen concentrations in the deeper lake areas and additional unaccounted consumer production by pelagic and benthic protozoa and meiobenthos at intermediate or top trophic levels. None of these processes convincingly explain the large differences between benthic and pelagic transfer efficiencies. Our data indicate that shallow eutrophic lakes, even with a major share of autotrophic and bacterial production in the benthic zone, can function as pelagic systems with respect to primary consumer production. We suggest that the benthic autotrophic production was mostly transferred to benthic bacterial production, which remained in the sediments, potentially cycling internally in a similar way to what has previously been described for the microbial loop in pelagic habitats. Understanding the energetics of whole-lake food webs, including the fate of the substantial benthic bacterial production, which is either mineralised at the sediment surface or permanently buried, has important implications for regional and global carbon cycling.

(来源: FRESHWATER BIOLOGY, 2017, 62(10): 1693-1706)

## Altered food-web dynamics under increased nitrogen load in phosphorus deficient lakes

Trommer, Gabriele; Poxleitner, Monika; Lorenz, Patrick; et al.

Atmospheric nitrogen deposition predominantly influences ecosystems by shifting their available nutrient budgets towards excess nitrogen conditions. In temperate lakes nitrogen is often naturally in excess and phosphorus is deficient, when compared with the optimal Redfield ratio of 16:1. To investigate effects of

future increasing nitrogen conditions on lake plankton communities, we performed mesocosm experiments in three different nitrogen rich lakes, all characterised by high nitrogen to phosphorus ratios. In order to determine functional responses to increased nitrogen loading, we conducted six nitrogen fertilization treatments. Nitrogen fertilization was based upon existing nitrate and ammonium concentrations in natural wet deposition and multiple loadings of these concentrations. Despite the initial conditions of excess nitrogen, removal of additional nitrogen by the plankton community was observed in all of the lakes. In one lake, an increasing phosphorus limitation became visible in seston stoichiometry. Over all of the lakes and within each lake's experimental nitrogen gradient, we found evidence for decreased mesozooplankton due to nitrogen enrichment. The negative responses of mesozooplankton to N enrichment were mainly restricted to cladocerans and nauplii. The results indicate that nitrogen enrichment within the magnitudes of projected future atmospheric nitrogen depositions may lead to a long-term reduction of mesozooplankton in phosphorus deficient lakes. The transfer of nitrogen enrichment effects on lower food-web dynamics could have consequences for higher trophic levels, such as fish.

(来源: AQUATIC SCIENCES, 2017, 79(4): 1009-1021)

## Role of gas ebullition in the methane budget of a deep subtropical lake: What can we learn from process-based modeling?

Schmid, Martin; Ostrovsky, Ilia; McGinnis, Daniel F.

We analyzed the processes affecting the methane ( $\text{CH}_4$ ) budget in Lake Kinneret, a deep subtropical lake, using a suite of three models: (1) a bubble model to determine the fate of  $\text{CH}_4$  bubbles released from the sediment; (2) the one-dimensional physical lake model Simstrat to calculate the mixing dynamics; and (3) a biogeochemical model implemented in Aquasim to quantify the  $\text{CH}_4$  sources and sinks. The key pathways modeled include diffusive and bubble release of  $\text{CH}_4$  from the sediment, aerobic  $\text{CH}_4$  oxidation, and atmospheric gas exchange. The temporal and spatial dynamics of dissolved  $\text{CH}_4$  concentrations observed in the lake during 3 years could be well represented by the combined models. Remarkably, the relative contributions of ebullition and diffusive transport to the accumulation of  $\text{CH}_4$  in the hypolimnion during the stratified period could not be accurately constrained based only on the observed evolution of  $\text{CH}_4$  concentrations in the water column. Importantly, however, our analysis showed that most (approximate to 99%) of the  $\text{CH}_4$  supplied to the water column by bubble dissolution and diffusive transport from the sediment is aerobically oxidized, whereas a substantial fraction (approximate to 60%) of the sediment-released bubble  $\text{CH}_4$  is directly transported to the atmosphere. Ebullition is thus responsible for the bulk of the emissions from Lake Kinneret to the atmosphere. Therefore, as in all freshwaters, ebullition quantification is crucial for accurately assessing  $\text{CH}_4$  emissions to the atmosphere. This task remains challenging due to high spatio-temporal variability, but combining in situ measurements with a process-based modeling can help to better constrain flux estimates.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(6): 2674-2698)

## Methane bursts as a trigger for intermittent lake-forming climates on post-Noachian Mars

Edwin S. Kite; Peter Gao; Colin Goldblatt; et al.

Lakes existed on Mars later than 3.6 billion years ago, according to sedimentary evidence for deltaic deposition. The observed fluviolacustrine deposits suggest that individual lake-forming climates persisted for at least several thousand years (assuming dilute flow). But the lake watersheds' little-weathered soils indicate a largely dry climate history, with intermittent runoff events. Here we show that these observational constraints, although inconsistent with many previously proposed triggers for lake-forming climates, are consistent with a methane burst scenario. In this scenario, chaotic transitions in mean obliquity drive latitudinal shifts in temperature and ice loading that destabilize methane clathrate. Using numerical simulations, we find that outgassed methane can build up to atmospheric levels sufficient for lake-forming climates, if methane clathrate initially occupies more than 4% of the total volume in which it is thermodynamically stable. Such occupancy fractions are consistent with methane production by water-rock reactions due to hydrothermal circulation on early Mars. We further estimate that photochemical destruction of atmospheric methane curtails the duration of individual lake-forming climates to less than a million years, consistent with observations. We conclude that methane bursts represent a potential pathway for intermittent excursions to a warm, wet climate state on early Mars.

(来源: Nature Geoscience, 2017, 10: 737-740)

## Role of organic phosphorus in sediment in a shallow eutrophic lake

Shinohara, Ryuichiro; Hiroki, Mikiya; Kohzu, Ayato; et al.

We tested the hypothesis that mineralization of molybdenum unreactive phosphorus (MUP) in pore water is the major pathway for the changes in the concentration of molybdenum-reactive P (MRP) in pore water and inorganic P in sediment particles. The concentration of inorganic P in the sediment particles increased from December to April in Lake Kasumigaura, whereas concentrations of organic P in the sediment particles and MUP in pore water decreased. These results suggest that MUP mineralization plays a key role as the source of MRP, whereas desorption of inorganic P from the sediment particles into the pore water is a minor process. One-dimensional numerical simulation of sediment particles and the pore water supported the hypothesis. Diffusive flux of MUP was small in pore water, even in near-surface layers, so mineralization was the dominant process for changing the MUP concentration in the pore water. For MRP, diffusion was the dominant process in the surface layer, whereas adsorption onto the sediment was the dominant process in deeper layers. Researchers usually ignore organic P in the sediment, but organic P in sediment particles and the pore water is a key source of inorganic P in the sediment particles and pore water; our results suggest that in Lake Kasumigaura, organic P in the sediment is an important source, even at depths more than 1 cm below the sediment surface. In contrast, the large molecular size of MUP in pore water hampers diffusion of MUP from the sediment into the overlying water.

(来源: WATER RESOURCES RESEARCH, 2017, 53(8): 7175-7189)

## Full-scale evaluation of methane production under oxic conditions in a mesotrophic lake

D. Donis; S. Flury; A. Stöckli; et al.

Oxic lake surface waters are frequently oversaturated with methane (CH<sub>4</sub>). The contribution to the global CH<sub>4</sub> cycle is significant, thus leading to an increasing number of studies and stimulating debates. Here

we show, using a mass balance, on a temperate, mesotrophic lake, that ~90% of CH<sub>4</sub> emissions to the atmosphere is due to CH<sub>4</sub> produced within the oxic surface mixed layer (SML) during the stratified period, while the often observed CH<sub>4</sub> maximum at the thermocline represents only a physically driven accumulation. Negligible surface CH<sub>4</sub> oxidation suggests that the produced  $110 \pm 60 \text{ nmol CH}_4 \text{ L}^{-1} \text{ d}^{-1}$  efficiently escapes to the atmosphere. Stable carbon isotope ratios indicate that CH<sub>4</sub> in the SML is distinct from sedimentary CH<sub>4</sub> production, suggesting alternative pathways and precursors. Our approach reveals CH<sub>4</sub> production in the epilimnion that is currently overlooked, and that research on possible mechanisms behind the methane paradox should additionally focus on the lake surface layer.

(来源: Nature Communications, 2017, doi:10.1038/s41467-017-01648-4)

## Factors controlling the stable isotope composition and C:N ratio of seston and periphyton in shallow lake mesocosms with contrasting nutrient loadings and temperatures

Trochine, Carolina; Guerrieri, Marcelo; Liboriussen, Lone; et al.

1. Carbon (C) and nitrogen (N) stable isotope composition (N-15:N-14, delta N-15 and C-13:C-12, delta C-13) have been widely used to elucidate changes in aquatic ecosystem dynamics created by eutrophication and climate warming, often, however, without accounting for seasonal variation.
2. Here, we aim to determine the factors controlling the stable isotope composition and C:N ratio of seston and periphyton in shallow lakes with contrasting nutrient loadings and climate; for this purpose, we followed the monthly stable isotope composition (c. 1 year) of seston (SES) and periphyton (PER) in 24 mesocosms mimicking shallow lakes with two nutrient treatments (enriched and unenriched) and three temperature scenarios (ambient, +3 and +5 degrees C).
3. Nutrient enrichment and warming had a stronger impact on the delta N-15 and delta C-13 values of seston than on periphyton, and the temporal isotopic variability in both communities was large.
4. delta N-15(PER) did not differ markedly between nutrient treatments, whereas delta N-15(SES) was lower in the enriched mesocosms, possibly reflecting higher N-2-fixation by cyanobacteria. delta N-15(SES) was higher in winter in the heated mesocosms and its dynamics was linked with that of NH<sub>4</sub>-N, whereas delta N-15(PER) showed a stronger association with NO<sub>3</sub>-N. delta N-15(SES) demonstrated a positive relationship with mean monthly temperature, indicating less isotope fractionation among autotrophs when production increased.
5. delta C-13(SES) was lowest in the enriched mesocosms during winter, whereas delta C-13(PER) did not differ between nutrient treatments. delta C-13(SES) and delta C-13(PER) were positively related to pH, likely reflecting a pH-induced differential access to dissolved carbon species in the primary producers. The positive delta C-13-temperature relationship suggested less fractionation of CO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> and/or larger use of HCO<sub>3</sub><sup>-</sup> at higher temperatures.
6. The C:N ratios varied seasonally and the differences between the enriched and unenriched mesocosms were stronger for seston than for periphyton. Particularly, the C:N-SES ratios did not indicate deficiencies in N as opposed to the C:N-PER ratios, supporting the observed changes in delta N-15 and suggesting that seston and periphyton have access to different sources of nutrients. We did not observe any clear effect of temperature warming on the C:N ratios.

7. Our study provides evidence of strong seasonality in the isotopic composition and C:N ratios of seston and periphyton across nutrient and temperature levels; also, we identified several factors that are likely to modulate the strength and variability in stable isotopes values and stoichiometry of sestonic and periphytic communities under these scenarios..

(来源: FRESHWATER BIOLOGY, 2017, 62(9): 1596-1613)

## Variability in organic carbon reactivity across lake residence time and trophic gradients

Chris D. Evans; Martyn N. Futter; Filip Moldan; et al.

The transport of dissolved organic carbon from land to ocean is a large dynamic component of the global carbon cycle. Inland waters are hotspots for organic matter turnover, via both biological and photochemical processes, and mediate carbon transfer between land, oceans and atmosphere. However, predicting dissolved organic carbon reactivity remains problematic. Here we present in situ dissolved organic carbon budget data from 82 predominantly European and North American water bodies with varying nutrient concentrations and water residence times ranging from one week to 700 years. We find that trophic status strongly regulates whether water bodies act as net dissolved organic carbon sources or sinks, and that rates of both dissolved organic carbon production and consumption can be predicted from water residence time. Our results suggest a dominant role of rapid light-driven removal in water bodies with a short water residence time, whereas in water bodies with longer residence times, slower biotic production and consumption processes are dominant and counterbalance one another. Eutrophication caused lakes to transition from sinks to sources of dissolved organic carbon. We conclude that rates and locations of dissolved organic carbon processing and associated CO<sub>2</sub> emissions in inland waters may be misrepresented in global carbon budgets if temporal and spatial reactivity gradients are not accounted for.

(来源: Nature Geoscience, 2017, 10: 832-835)

## The influence of lake water alkalinity and humic substances on particle dispersion and lanthanum desorption from a lanthanum modified bentonite

Reitzel, Kasper; Balslev, Kristiane Astrid; Jensen, Henning S.

A 12 days laboratory study on potential desorption of Lanthanum (La) from a commercial La modified clay (Phoslock) was conducted using lake water from 17 Danish lakes with alkalinities between 0.02 and 3.7 meq L<sup>-1</sup> and varying concentrations of DOC and humic acids (HA's). A similar study was conducted in artificial lake water with alkalinities from 0 to 2.5 meq L<sup>-1</sup> order to exclude interference from dissolved HA's. To test if La in solution (FLa) was associated with fine particles, the water samples were filtered sequentially through three filter sizes (1.2 µm, 0.45 µm and 0.2 µm), and finally, ultracentrifugation was used in an attempt to separate colloidal La from dissolved La. The study showed that higher FLa (up to 2.5 mg L<sup>-1</sup> or 14% of the total La in the Phoslock) concentrations were found in soft water lakes compared to hard water lakes, probably due to dispersion of the clay at low alkalinities. In addition, this study showed that HA's seem to increase the FLa concentrations in soft water lakes, most likely through complexation of La retained in the Phoslock matrix. In summary, we conclude that elevated La



concentrations in lake water after a Phoslock treatment should only be expected in soft water lakes rich in DOC and HA's.

(来源: WATER RESEARCH, 2017, 125: 191-200)

## Assessing the role of bed sediments in the persistence of red mud pollution in a shallow lake(Kinghorn Loch, UK)

Olszewska, Justyna P.; Heal, Kate V.; Winfield, Ian J.; et al.

Red mud is a by-product of alumina production. Little is known about the long-term fate of red mud constituents in fresh waters or of the processes regulating recovery of fresh waters following pollution control. In 1983, red mud leachate was diverted away from Kinghorn Loch, UK, after many years of polluting this shallow and monomictic lake. We hypothesised that the redox-sensitive constituents of red mud leachate, phosphorus (P), arsenic (As) and vanadium (V), would persist in the Kinghorn Loch for many years following pollution control as a result of cycling between the lake bed sediment and the overlying water column. To test this hypothesis, we conducted a 12-month field campaign in Kinghorn Loch between May 2012 and April 2013 to quantify the seasonal cycling of P, As, and V in relation to environmental conditions (e.g., dissolved oxygen (DO) concentration, pH, redox chemistry and temperature) in the lake surface and bottom waters. To confirm the mechanisms for P, As and V release, a sediment core incubation experiment was conducted using lake sediment sampled in July 2012, in which DO concentrations were manipulated to create either oxic or anoxic conditions similar to the bed conditions found in the lake. The effects on P, As, and V concentrations and species in the water column were measured daily over an eight-day incubation period.

Phosphate ( $\text{PO}_4\text{-P}$ ) and dissolved As concentrations were significantly higher in the bottom waters ( $75.9 \pm 30.2 \mu\text{g L}^{-1}$  and  $23.5 \pm 1.83 \mu\text{g L}^{-1}$ , respectively) than in the surface waters ( $12.9 \pm 1.50 \mu\text{g L}^{-1}$  and  $14.1 \pm 2.20 \mu\text{g L}^{-1}$ , respectively) in Kinghorn Loch. Sediment release of As and P under anoxic conditions was confirmed by the incubation experiment and by the significant negative correlations between DO and P and As concentrations in the bottom waters of the lake. In contrast, the highest dissolved V concentrations occurred in the bottom waters of Kinghorn Loch under oxic conditions ( $15.0 \pm 3.35 \mu\text{g L}^{-1}$ ), with the release from the bed sediment apparently being controlled by a combination of competitive ion concentrations, pH and redox conditions.

(来源: WATER RESEARCH, 2017, 123: 569-577)

## Long-Term and Ontogenetic Patterns of Heavy Metal Contamination in Lake Baikal Seals (*Pusa sibirica*)

Ozersky, Ted; Pastukhov, Mikhail. V.; Poste, Amanda E.; et al.

Little is known about the history of heavy metal pollution of Russia's Lake Baikal, one of the world's largest lakes and a home to numerous endemic species, including the Baikal Seal, *Pusa sibirica*. We investigated the history of heavy metal (V, Cu, Zn, Cd, Hg, Tl, Pb, U) pollution in Lake Baikal seals over the past 8 decades. C and N stable isotope analysis (SIA) and laser-ablation ICP-MS of seal teeth were used to examine changes in feeding ecology, heavy metal levels associated with life history events and long-term variation in metal exposure. SIA did not suggest large changes in the feeding ecology of Baikal seals over the past 80 years. LA-ICP-MS analyses revealed element-specific ontogenetic variability in

metal concentrations, likely related to maternal transfer, changes in food sources and starvation. Hg and Cd-levels in seals varied significantly across the time series, with concentrations peaking in the 1960s - 1970s but then declining to contemporary levels similar to those observed in the 1930s and 1940s. Trends in atmospheric emissions of Hg suggest that local sources as well as emissions from eastern Russia, and Europe may be important contributors of Hg to Lake Baikal and that, despite the size of Lake Baikal, its food web appears to respond rapidly to changing inputs of contaminants.

(来源: ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(18): 10316-10325)

## Relationships Between Dissolved Organic Matter Composition and Photochemistry in Lakes of Diverse Trophic Status

Maizel, Andrew C.; Li, Jing; Remucal, Christina K.

The North Temperate Lakes Long-Term Ecological Research site includes seven lakes in northern Wisconsin that vary in hydrology, trophic status, and landscape position. We examine the molecular composition of dissolved organic matter (DOM) within these lakes using Fourier transform-ion cyclotron resonance mass spectrometry (FT-ICR MS) and quantify DOM photochemical activity using probe compounds. Correlations between the relative intensity of individual molecular formulas and reactive species production demonstrate the influence of DOM composition on photochemistry. For example, highly aromatic, tannin-like formulas correlate positively with triplet formation rates, but negatively with triplet quantum yields, as waters enriched in highly aromatic formulas exhibit much higher rates of light absorption, but only slightly higher rates of triplet production. While commonly utilized optical properties also correlate with DOM composition, the ability of FT-ICR MS to characterize DOM subpopulations provides unique insight into the mechanisms through which DOM source and environmental processing determine composition and photochemical activity.

(来源: ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(17): 9624-9632)

## Grand challenges for research in the Laurentian Great Lakes

Sternern, Robert W.; Ostrom, Peggy; Ostrom, Nathaniel E.; et al.

The Laurentian Great Lakes (LGL) constitute one of the largest freshwater systems in the world while providing social and economic value to two powerful nations. The spatial scale of these inland seas falls between two endpoints: small lakes and oceans. Lacustrine in many characteristics, the LGL often require a scientific approach with attributes similar to those of oceanography. There is a strong sense that within the LGL support for scientific research has not kept pace with the need for process-oriented research and that we lack basic information needed to forecast change, mitigate impacts and restore and preserve the LGL. Consequently, 58 researchers met in September 2014 and identified five Grand Challenges for Research in the LGL: (1) How has this vast inland freshwater system responded to shifting climate in the past, and how will it respond in the future? (2) What is the current status of the most important ecosystem processes, including their variability in space and time? (3) What processes are characteristic only of large lakes, and how do the distinct habitats integrate into a whole? (4) What are the ecosystem responses to major anthropogenic forces such as nutrients and invasive species, and are these reversible? and (5) What are the small to large-scale linkages and feedbacks among societal decisions, biological systems, and physicochemical dynamics? An urgent need exists for a unified

scientific voice that articulates the Grand Challenges for research in the LGL and the need for associated funding. This treatise describing the Grand Challenges develops that voice.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(6): 2510-2523)

## Seasonality of change: Summer warming rates do not fully represent effects of climate change on lake temperatures

Winslow, Luke A.; Read, Jordan S.; Hansen, Gretchen J. A.; et al.

Responses in lake temperatures to climate warming have primarily been characterized using seasonal metrics of surface-water temperatures such as summertime or stratified period average temperatures. However, climate warming may not affect water temperatures equally across seasons or depths. We analyzed a long-term dataset (1981-2015) of biweekly water temperature data in six temperate lakes in Wisconsin, U.S.A. to understand (1) variability in monthly rates of surface- and deep-water warming, (2) how those rates compared to summertime average trends, and (3) if monthly heterogeneity in water temperature trends can be predicted by heterogeneity in air temperature trends. Monthly surface- water temperature warming rates varied across the open-water season, ranging from 0.013 in August to 0.0738 degrees C yr<sup>-1</sup> in September (standard deviation [SD]: 0.0258 degrees C yr<sup>-1</sup>). Deep-water trends during summer varied less among months (SD: 0.0068 degrees C yr<sup>-1</sup>), but varied broadly among lakes (-0.0568 degrees C yr<sup>-1</sup> to 0.0358 degrees C yr<sup>-1</sup>, SD: 0.0348 degrees C yr<sup>-1</sup>). Trends in monthly surface- water temperatures were well correlated with air temperature trends, suggesting monthly air temperature trends, for which data exist at broad scales, may be a proxy for seasonal patterns in surface- water temperature trends during the open water season in lakes similar to those studied here. Seasonally variable warming has broad implications for how ecological processes respond to climate change, because phenological events such as fish spawning and phytoplankton succession respond to specific, seasonal temperature cues.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(5): 2168-2178)

## Surface river plume in a large lake under wind forcing: Observations and laboratory experiments

Demchenko, Natalia; He, Cheng; Rao, Yerubandi R.; et al.

Observations of a small riverine plume (Grand River, ON) in the nearshore zones of Lake Erie were analyzed to describe its spatial variability and its thickness under different wind forcing conditions during late spring of 2012. Observational results reveal a well-marked frontal region in the vicinity of the river mouth, causing the plume to discharge into the lake in the surface layers (positive buoyant). Wind driven alongshore currents at the mid-depth had speeds of 2-9 cm/s, in comparison to those in the cross-shore 3-6 cm/s, which transported the plume along the shore during the measurement period. Series of laboratory experiments were conducted to obtain the propagation speed ( $U$ ) of the buoyant plume in terms of buoyancy anomaly ( $Ba$ ), Richardson number ( $Ri$ ), dimensionless time ( $t'$ ), and aspect ratio ( $A$ ). Based on our experiments, we developed two non-dimensional relationships describing the speed of propagation ( $U$ ) as  $U/Ba^{1/2} = 8 Ri^{(-1/2)} t'^{(1/3)} A$  and the plume thickness ( $h$ ) as  $h/H = 0.8 Ri^{(-1/4)} t'^{(1/2)} A$  in the water depth ( $H$ ), which are in agreement with field observations.

(来源: JOURNAL OF HYDROLOGY, 2017, 553: 1-12)

## 青藏高原中部纳木错流域孢粉多样性的时空变化及其对高寒植被恢复的启示

李泉

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

(来源: 中国科学: 地球科学 2017, doi:10.1360/N072017-0185)

## Size-based interactions across trophic levels in food webs of shallow Mediterranean lakes

Brucet, Sandra; Tavsanoglu, Ulku Nihan; Ozen, Arda; et al.

1. Body size is a key trait of an organism which determines the dynamics of predator-prey interactions. Most empirical studies on the individual size distribution of the aquatic community have focused on the variations in body size of a single trophic level as a response to certain environmental variables or biotic factors. Few studies, however, have evaluated how individual size structure is altered simultaneously across interacting trophic levels and locations. Such comparative examinations of the size distribution in predator and prey communities may bring insight into the strength of the interactions between adjacent trophic levels.

2. We assessed the potential predation effect of size-structured predators (i.e. predation by individuals of different sizes) on prey size structure using data from 30 shallow Turkish lakes spanning over five latitudinal degrees. We correlated size diversity and size evenness of predator and prey assemblages across the planktonic food web after accounting for the confounding effects of temperature and resource availability which may also affect size structure. We expected to find a negative relationship between size diversity of predators and prey due to the enhanced strength of top-down control with increasing predator size diversity. We also hypothesised that competitive interactions for resources in less productive systems would promote a higher size diversity. We further expected a shift towards reduced size diversity and evenness at high temperatures.

3. In contrast to our hypothesis, we found a positive correlation between size structures of two interacting trophic levels of the planktonic food web; thus, highly size-diverse fish assemblages were associated with highly size-diverse zooplankton assemblages. The size evenness of fish and phytoplankton assemblages was negatively and positively related to temperature, respectively. Phytoplankton size diversity was only weakly predicted by the resource availability.

4. Our results suggest that size structure within a trophic group may be controlled by the size structure at adjacent trophic levels, as well as by temperature and resource availability. The positive relationship between the size diversity of fish and zooplankton suggests that higher diversity of the resources drives a higher size diversity of consumers or vice versa, and these effects are beyond those mediated by taxonomic diversity. In contrast, the size diversity and size evenness of phytoplankton are mainly influenced by physical factors in this region and perhaps in warm shallow lakes in general.

(来源: FRESHWATER BIOLOGY, 2017, 62(11): 1819-1830)

## Functional redundancy and sensitivity of fish assemblages in European rivers, lakes and estuarine ecosystems

Nils Teichert; Mario Lepage; Alban Sagouis; et al.

The impact of species loss on ecosystems functioning depends on the amount of trait similarity between species, i.e. functional redundancy, but it is also influenced by the order in which species are lost. Here we investigated redundancy and sensitivity patterns across fish assemblages in lakes, rivers and estuaries. Several scenarios of species extinction were simulated to determine whether the loss of vulnerable species (with high propensity of extinction when facing threats) causes a greater functional alteration than random extinction. Our results indicate that the functional redundancy tended to increase with species richness in lakes and rivers, but not in estuaries. We demonstrated that i) in the three systems, some combinations of functional traits are supported by non-redundant species, ii) rare species in rivers and estuaries support singular functions not shared by dominant species, iii) the loss of vulnerable species can induce greater functional alteration in rivers than in lakes and estuaries. Overall, the functional structure of fish assemblages in rivers is weakly buffered against species extinction because vulnerable species support singular functions. More specifically, a hotspot of functional sensitivity was highlighted in the Iberian Peninsula, which emphasizes the usefulness of quantitative criteria to determine conservation priorities.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-17975-x)

## Impact of macrozoobenthic bioturbation and wind fluctuation interactions on net methylmercury in freshwater lakes

Wang, Peifang; Yao, Yu; Wang, Chao; et al.

The methylmercury (MeHg) as the toxic fractions has presented significant threats to biota in freshwater ecosystems. Hg methylation process is demonstrated to be manipulated by biota process (benthic disturbance and algae bloom existence) as well as the abiotic influence (wind fluctuation and illumination intensity) in freshwater ecosystems. However, the mechanisms influencing Hg methylation are still unclear, and the coupled influences of the biotic and abiotic process with the shifts in variation on

methylmercury remain unexplored. Accordingly, an annular flume experiment which simulated the freshwater ecosystem, was conducted for 108 days to examine the influences of typical disturbance by chironomid larvae and wind fluctuations on MeHg variation in sediment profiles. The passive sampler technique of revealing diffusive gradients in thin films (DGT) encompassed the special resin, based on referenced extraction and coloration-computer imaging densitometry, were employed to obtain labile MeHg, Fe, and S concentrations at high resolution. The results indicate that larval bioturbation during the initial period of the experiment could diminish bioavailable MeHg concentrations and change the diffusion direction of MeHg fluxes. However, this inhibitive effect on MeHg concentrations ceased with larvae eclosion. Compared to bioturbation, wind fluctuation exerted slow but sustained inhibition on MeHg release. Furthermore, the eight parameters (dissolved organic carbon (DOC), DO, labile Fe and S concentrations, pH, sulfate-reducing bacteria (SRB) abundance in sediment, oxidation-reduction potential (ORP) and EC) could explain more of variation in MeHg concentrations which indicated by the canonical correspondence analysis. And these eight parameters manifest higher explanatory power for MeHg distributed in newly formed sediment. More notably, the comparison results of the multiple and simple regression directly demonstrated the DOC was the fundamental and robust factor to control the MeHg variation in the freshwater ecosystem.

(来源: WATER RESEARCH, 2017, 124: 320-330)

### **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)

### **Influence of invasive quagga mussels, phosphorus loads, and climate on spatial and temporal patterns of productivity in Lake Michigan: A biophysical modeling study**

Rowe, Mark D.; Anderson, Eric J.; Vanderploeg, Henry A.; et al.

We applied a three-dimensional biophysical model to Lake Michigan for the years 2000, 2005, and 2010 to consider the mechanisms controlling spatial and temporal patterns of phytoplankton abundance (chlorophyll *a*) and lake-wide productivity. Model skill was assessed by comparison to satellite-derived

Chl a and field-measured water quality variables. We evaluated model sensitivity to scenarios of varying mussel filter feeding intensity, tributary phosphorus loads, and warm vs. cool winter-spring climate scenarios. During the winter-spring phytoplankton bloom, spatial patterns of Chl a were controlled by variables that influenced surface mixed layer depth: deep mixing reduced net phytoplankton growth through light limitation and by exposing the full water column to mussel filter feeding. Onset of summer and winter stratification promoted higher surface Chl a initially by increasing mean light exposure and by separating the euphotic zone from mussels. During the summer stratified period, areas of relatively high Chl a were associated with coastal plumes influenced by tributary-derived nutrients and coastal upwelling-downwelling. While mussels influenced spatial and temporal distribution of Chl a, lake-wide, annual mean primary production was more sensitive to phosphorus and warm/cool meteorology scenarios than to mussel filter feeding scenarios. Although Chl a and primary production declined over the quagga mussel invasion, our results suggest that increased nutrient loads would increase lake-wide productivity even in the presence of mussels; however, altered spatial and temporal patterns of productivity caused by mussel filter feeding would likely persist.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(6): 2629-2649)

## Responses of trophic structure and zooplankton community to salinity and temperature in Tibetan lakes: Implication for the effect of climate warming

Lin, Qiuqi; Xu, Lei; Hou, Juzhi; et al.

Warming has pronounced effects on lake ecosystems, either directly by increased temperatures or indirectly by a change in salinity. We investigated the current status of zooplankton communities and trophic structure in 45 Tibetan lakes along a 2300 m altitude and a 76 salinity gradient. Freshwater to hyposaline lakes mainly had three trophic levels: phytoplankton, small zooplankton and fish/Gammarus, while mesosaline to hypersaline lakes only had two: phytoplankton and large zooplankton. Zooplankton species richness declined significantly with salinity, but did not relate with temperature. Furthermore, the decline in species richness with salinity in lakes with two trophic levels was much less abrupt than in lakes with three trophic levels. The structural variation of the zooplankton community depended on the length of the food chain, and was significantly explained by salinity as the critical environmental variable. The zooplankton community shifted from dominance of copepods and small cladoceran species in the lakes with low salinity and three trophic levels to large saline filter-feeding phyllopod species in those lakes with high salinity and two trophic levels. The zooplankton to phytoplankton biomass ratio was positively related with temperature in two-trophic-level systems and vice versa in three-trophic-level systems. As the Tibetan Plateau is warming about three times faster than the global average, our results imply that warming could have a considerable impact on the structure and function of Tibetan lake ecosystems, either via indirect effects of salinization/desalinization on species richness, composition and trophic structure or through direct effects of water temperature on trophic interactions.

(来源: WATER RESEARCH, 2017, 124: 618-629)



## **Winds and the distribution of nearshore phytoplankton in a stratified lake**

Cyr, Helene.

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)

## **Environmental and spatial processes influencing phytoplankton biomass along a reservoirs-river-floodplain lakes gradient: A metacommunity approach**

Bortolini, Jascieli Carla; Pineda, Alfonso; Rodrigues, Luzia Cleide; et al.

Evaluation of the relative influences of environmental and spatial processes in structuring aquatic metacommunities is an essential first step for understanding how these factors govern species distributions and affect spatial and temporal variability in community structure. Such variability has many causes and consequences at different scales. In the case of phytoplankton metacommunities, both species sorting and mass effect processes are likely to be important in structuring the patterns of biomass distribution on large spatial scales. We investigated the influences of environmental and spatial components on the phytoplankton community on a large spatial scale, consisting of a reservoirs-river-floodplain lakes gradient in a Neotropical region. Using partial redundancy analysis, we partitioned the relative role of environmental (environmental filters) and spatial (asymmetric eigenvector maps) processes structuring phytoplankton biomass. A clear difference of the limnological conditions was observed between the reservoirs and river-floodplain lakes system. High species richness and higher mean values of phytoplankton biomass were recorded in the floodplain lakes. Variation partitioning demonstrated the importance of both environmental and spatial process in phytoplankton biomass structuring. However, the relative importance of these processes may vary over time. Our results suggest that from a metacommunity perspective, the phytoplankton biomass of upstream reservoirs and a downstream river-floodplain lakes system is determined by environmental conditions (species sorting process), mainly in the floodplain lakes; and by high dispersion rates favoured by the connectivity and unidirectional flow (mass effect process), mainly between the reservoirs and the river.

## Seasonal variability in phytoplankton stable carbon isotope ratios and bacterial carbon sources in a shallow Dutch lake

Lammers, J. M.; Reichart, G. J.; Middelburg, J. J.

Ecosystem metabolism of lakes strongly depends on the relative importance of local vs. allochthonous carbon sources and on microbial food-web functioning and structure. Over the year ecosystem metabolism varies as a result of seasonal changes in environmental parameters such as nutrient levels, light, temperature, and variability in the food web. This is reflected in isotopic compositions of phytoplankton and bacteria. Here, we present the results of a 17-month study on carbon dynamics in two basins of Lake Naarden, The Netherlands. One basin was restored after anthropogenic eutrophication, whereas the other basin remained eutrophic. We analyzed natural stable carbon isotope abundances (C-13) of dissolved inorganic carbon, dissolved organic carbon and macrophytes, and combined these data with compound-specific C-13 analyses of phospholipid-derived fatty acids, produced by phytoplankton and bacteria. Isotopic fractionation (epsilon) between phytoplankton biomass and CO<sub>2</sub>(aq) was similar for diatoms and other eukaryotic phytoplankton, and differences between sampling sites were small. Highest epsilon values were observed in winter with values of 23.5 +/- 0.6 parts per thousand for eukaryotic phytoplankton and 13.6 +/- 0.3 parts per thousand for cyanobacteria. Lowest epsilon values were observed in summer: 10.5 +/- 0.3 parts per thousand for eukaryotic phytoplankton and 2.7 +/- 0.1 parts per thousand for cyanobacteria. The annual range in C-13(bact) was between 6.9 parts per thousand and 8.2 parts per thousand for the restored and eutrophic basin, respectively, while this range was between 11.6 parts per thousand and 13.1 parts per thousand for phytoplankton in the restored and eutrophic basin, respectively. Correlations between C-13(phyto) and C-13(bact) were strong at both sites. During summer and fall, bacterial biomass derives mainly from locally produced organic matter, with minor allochthonous contributions. Conversely, during winter, bacterial dependence on allochthonous carbon was 39-77% at the restored site, and 17-46% at the eutrophic site.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2017, 62(6): 2773-2787)

## Influence of water level fluctuations on phytoplankton communities in an oxbow lake

Dembowska, Ewa A.; Kubiak-Wojcicka, Katarzyna.

The study was aimed at examining phytoplankton communities in an oxbow lake of the Vistula River during two different hydrological stages: potamophase and limnophase. River level fluctuations influenced the lake water level. The study investigated the abundance, biomass, species composition, and functional groups of phytoplankton. The observations were made for four years during the growing season at two-week intervals. We identified a total of 304 taxa of algae. Species with the highest biomass belonged to 16 functional groups (FGs). Although the trophic state of the lake did not change (eutrophy), dominant algal species varied between stages. During limnophase the phytoplankton was dominated by coccal chlorophytes, mainly from FG J, while during potamophase, by centric diatoms from FG C and D (mainly by *Cyclotella nieneghiniana*, *Actinocyclus normanii* and *Stephanodiscus hantzschii*). Our results indicate that hydrological conditions affect the water transparency as well as the predominance of certain

algal species in the oxbow lake, periodically connected with the river.

(来源: FUNDAMENTAL AND APPLIED LIMNOLOGY, 2017, 190(3): 221-233)

## The sensitivity and stability of bacterioplankton community structure to wind-wave turbulence in a large, shallow, eutrophic lake

Jian Zhou; Boqiang Qin; Xiaoxia Han; et al.

Lakes are strongly influenced by wind-driven wave turbulence. The direct physical effects of turbulence on bacterioplankton community structure however, have not yet been addressed and remains poorly understood. To examine the stability of bacterioplankton communities under turbulent conditions, we simulated conditions in the field to evaluate the responses of the bacterioplankton community to physical forcing in Lake Taihu, using high-throughput sequencing and flow cytometry. A total of 4,520,231 high quality sequence reads and 74,842 OTUs were obtained in all samples with  $\alpha$ -proteobacteria,  $\gamma$ -proteobacteria and Actinobacteria being the most dominant taxa. The diversity and structure of bacterioplankton communities varied during the experiment, but were highly similar based on the same time of sampling, suggesting that bacterioplankton communities are insensitive to wind wave turbulence in the lake. This stability could be associated with the traits associated with bacteria. In particular, turbulence favored the growth of bacterioplankton, which enhanced biogeochemical cycling of nutrients in the lake. This study provides a better understanding of bacterioplankton communities in lake ecosystems exposed to natural mixing/disturbances.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-17242-z)

## Changes in bacterioplankton community structure during early lake ontogeny resulting from the retreat of the Greenland Ice Sheet

Hannes Peter; Erik Jeppesen; Luc De Meester; et al.

Retreating glaciers and ice sheets are among the clearest signs of global climate change. One consequence of glacier retreat is the formation of new meltwater-lakes in previously ice-covered terrain. These lakes provide unique opportunities to understand patterns in community organization during early lake ontogeny. Here, we analyzed the bacterial community structure and diversity in six lakes recently formed by the retreat of the Greenland Ice Sheet (GrIS). The lakes represented a turbidity gradient depending on their past and present connectivity to the GrIS meltwaters. Bulk (16S rRNA genes) and putatively active (16S rRNA) fractions of the bacterioplankton communities were structured by changes in environmental conditions associated to the turbidity gradient. Differences in community structure among lakes were attributed to both, rare and abundant community members. Further, positive co-occurrence relationships among phylogenetically closely related community members dominate in these lakes. Our results show that environmental conditions along the turbidity gradient structure bacterial community composition, which shifts during lake ontogeny. Rare taxa contribute to these shifts, suggesting that the rare biosphere has an important ecological role during early lakes ontogeny. Members of the rare biosphere may be adapted to the transient niches in these nutrient poor lakes. The directionality and phylogenetic structure of co-occurrence relationships indicate that competitive interactions among closely related taxa may be important in the most turbid lakes.

(来源: The ISME Journal, 2017, doi:10.1038/ismej.2017.191)

## Homogenization of lake cyanobacterial communities over a century of climate change and eutrophication

Marie-Eve Monchamp; Piet Spaak; Isabelle Domaizon; et al.

Human impacts on biodiversity are well recognized, but uncertainties remain regarding patterns of diversity change at different spatial and temporal scales. Changes in microbial assemblages are, in particular, not well understood, partly due to the lack of community composition data over relevant scales of space and time. Here, we investigate biodiversity patterns in cyanobacterial assemblages over one century of eutrophication and climate change by sequencing DNA preserved in the sediments of ten European peri-Alpine lakes. We found species losses and gains at the lake scale, while species richness increased at the regional scale over approximately the past 100 years. Our data show a clear signal for beta diversity loss, with the composition and phylogenetic structure of assemblages becoming more similar across sites in the most recent decades, as have the general environmental conditions in and around the lakes. We attribute patterns of change in community composition to raised temperatures affecting the strength of the thermal stratification and, as a consequence, nutrient fluctuations, which favoured cyanobacterial taxa able to regulate buoyancy. Our results reinforce previous reports of human-induced homogenization of natural communities and reveal how potentially toxic and bloom-forming cyanobacteria have widened their geographic distribution in the European temperate region.

(来源: Nature Ecology & Evolution, 2017, doi:10.1038/s41559-017-0407-0)

## Novel anammox bacteria and nitrogen loss from Lake Superior

Sean A. Crowe; Alexander H. Treusch; Michael Forth; et al.

Anaerobic ammonium oxidizing (anammox) bacteria own a central position in the global N-cycle, as they have the ability to oxidize  $\text{NH}_4^+$  to  $\text{N}_2$  under anoxic conditions using  $\text{NO}_2^-$ . They are responsible for up to 50% of all  $\text{N}_2$  released from marine ecosystems into the atmosphere and are thus indispensable for balancing the activity of N-fixing bacteria and completing the marine N-cycle. The contribution, diversity, and impact of anammox bacteria in freshwater ecosystems, however, is largely unknown, confounding assessments of their role in the global N-cycle. Here we report the activity and diversity of anammox bacteria in the world's largest freshwater lake—Lake Superior. We found that anammox performed by previously undiscovered bacteria is an important contributor to sediment  $\text{N}_2$  production. We observed striking differences in the anammox bacterial populations found at different locations within Lake Superior and those described from other locations. Our data thus reveal that novel anammox bacteria underpin N-loss from Lake Superior, and if more broadly distributed across inland waters would play an important role in continental N-cycling and mitigation of fixed nitrogen transfer from land to the sea.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-12270-1)

## Abrupt stop of deep water turnover with lake warming: Drastic consequences for algal primary producers

Yana Yankova; Stefan Neuenschwander; Oliver Köster; et al.

After strong fertilization in the 20th century, many deep lakes in Central Europe are again nutrient poor

due to long-lasting restoration (re-oligotrophication). In line with reduced phosphorus and nitrogen loadings, total organismic productivity decreased and lakes have now historically low nutrient and biomass concentrations. This caused speculations that restoration was overdone and intended fertilizations are needed to ensure ecological functionality. Here we show that recent re-oligotrophication processes indeed accelerated, however caused by lake warming. Rising air temperatures strengthen thermal stabilization of water columns which prevents thorough turnover (holomixis). Reduced mixing impedes down-welling of oxygen rich epilimnetic (surface) and up-welling of phosphorus and nitrogen rich hypolimnetic (deep) water. However, nutrient inputs are essential for algal spring blooms acting as boost for annual food web successions. We show that repeated lack (since 1977) and complete stop (since 2013) of holomixis caused drastic epilimnetic phosphorus depletions and an absence of phytoplankton spring blooms in Lake Zurich (Switzerland). By simulating holomixis in experiments, we could induce significant vernal algal blooms, confirming that there would be sufficient hypolimnetic phosphorus which presently accumulates due to reduced export. Thus, intended fertilizations are highly questionable, as hypolimnetic nutrients will become available during future natural or artificial turnovers.

(来源: Scientific Reports, 2017, doi:10.1038/s41598-017-13159-9)

## 青藏高原中部兹格塘错沉积物中厌氧光合 细菌叶绿素的发现及意义

李华勇; 张虎才; 常凤琴; 等.

位于青藏高原中部的兹格塘错是中国为数不多的典型半混合型湖泊之一, 其稳定的分层特征使水生生态系统中出现若干相对独立的微生物群落。兹格塘错表层沉积物中发现的细菌脱镁叶绿素 a(bacteriopheophytin a, Bph-a)证实了厌氧光合细菌(anoxigenic phototrophic bacteria, APB)群落的存在。研究指出, 该细菌群落主要集中在永滞层顶部至化跃层底部的狭窄范围内, 形成 APB 薄层, 是细菌叶绿素 a(bacteriochlorophylla, Bchl-a) 的主要生产区域。厌氧光合细菌死亡后在湖底经变质作用, Bchl-a 脱镁( $Mg^{2+}$ )形成 Bph-a。APB 总生产力高低主要受光照度控制, 因此, 沉积物中 Bph-a 高值对应化跃层变浅的暖期, 低值对应冷期, 而零值则表示湖泊半混合状态消失, 水体完全混合, 对应极端寒冷的气候或湖泊水位大幅降低的时期。利用沉积物中 Bph-a 含量变化, 可以重建兹格塘错湖泊分层及区域气候变化历史。在湖泊现代过程、重建气温-湖泊分层-APB 生产量-沉积物 Bph-a 含量变化四者关系充分研究的基础上, 具有定量重建古气温的潜力。

(来源: 中国科学: 地球科学 2017, doi: 10.1360/N072017-00135)

## To what extent is the DNA of microbial eukaryotes modified during burying into lake sediments? A repeat-coring approach on annually laminated sediments

Capo, Eric; Domaizon, Isabelle; Maier, Dominique; et al.

Paleogenetics provides a powerful framework to reconstruct the long-term temporal dynamics of various biological groups from aquatic sediments. However, validations are still required to ensure the

authenticity of the molecular signal obtained from sedimentary DNA. Here, we investigated the effects of early diagenesis on the DNA signal from micro-eukaryotes preserved in sediments by comparing metabarcoding inventories obtained for two sediment cores sampled in 2007 and 2013 respectively. High-throughput sequencing (Illumina MiSeq) of sedimentary DNA was utilized to reconstruct the composition of microbial eukaryotic communities by targeting the V7 region of the 18S rDNA gene. No significant difference was detected between the molecular inventories obtained for the two cores both for total richness and diversity indices. Moreover, community structures obtained for the two cores were congruent as revealed by procrustean analysis. Though most of the eukaryotic groups showed no significant difference in terms of richness and relative proportion according to the core, the group of fungi was found to differ both in terms of richness and relative proportion (possibly due to their spatial heterogeneity and potential activity in sediments). Considering the OTUs level (i.e. Operational Taxonomic Units as a proxy of ecological species), our results showed that, for the older analyzed strata (age: 15-40 years), the composition and structure of communities were very similar for the two cores (except for fungi) and the DNA signal was considered stable. However, for the uppermost strata (age < 15 years), changes of moderate magnitude were detected in the relative abundance of few OTUs. Overall, this study points out that, in Nylandssjon sediments, early diagenesis did not induce marked modifications in the micro-eukaryotic DNA signal, thus opening new perspectives based on the analysis of eukaryotic sedimentary DNA to address scientific issues both in the domains of paleolimnology and microbial ecology. Because this study site is ideal for DNA preservation in sediment (quick sedimentation processes, no sediment resuspension, anoxic conditions at sediment-water interface), the generalization of our conclusions, in particular for less favorable sites, must be considered cautiously.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2017, 58(4): 479-495)

## 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  $\mu\text{g/L}$ , and unbiased RMS uncertainties of <65% for PC between 10 and 500  $\mu\text{g/L}$ . 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)

## Unravelling Contaminants in the Anthropocene Using Statistical Analysis of Liquid Chromatography-High-Resolution Mass Spectrometry Nontarget Screening Data Recorded in Lake Sediments

Chiaia-Hernandez, Aurea C.; Gunthardt, Barbara F.; Frey, Martin P.; et al.

The significant increase in traces of human activity in the environment worldwide provides evidence of the beginning of a new geological era, informally named the Anthropocene. The rate and variability of these human modifications at the local and global scale remain largely unknown, but new analytical methods such as high-resolution mass spectrometry (HRMS) can help to characterize chemical contamination. We therefore applied HRMS to investigate the contamination history of two lakes in central Europe over the preceding 100 years. A hierarchical clustering analysis (HCA) of the collected time series data revealed more than 13 000 profiles of anthropogenic origin in both lakes, defining the beginning of large-scale human impacts during the 1950s. Our results show that the analysis of temporal patterns of nontarget contaminants is an effective method for characterizing the contamination pattern in the Anthropocene and, an important step in prioritizing the identification of organic contaminants not yet successfully targeted by, environmental regulation and pollution reduction initiatives. As proof of the Concept, the success of the method was demonstrated with the identification of the pesticide imazalil, which probably originated from imported fruits. This new approach applicable to palaeoarchives can effectively be used to document the time and rate of change in contamination over time and provide additional information on the onset of the Anthropocene.

(来源: ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2017, 51(21): 12547-12556)



## 重点关注

### 《全球生态环境遥感监测 2017 年度报告》出炉

11 月 21 日,科技部发布《全球生态环境遥感监测 2017 年度报告》。该报告继续关注全球生态环境热点问题和区域,选定“‘一带一路’生态环境状况”和“全球典型重大灾害对植被的影响”2 个专题开展监测分析。

“‘一带一路’生态环境状况”专题是 2015 年度该专题报告的延续与深化,将亚洲、欧洲、非洲、大洋洲全域及周边大洋纳入专题监测区域,覆盖了 170 多个国家和地区,以及西北太平洋、西南太平洋和印度洋这三个大洋海域以及日本海等 9 个主要海区。

科技部国家遥感中心主任王琦安介绍,该专题秉承“一带一路”倡议提出的“互联互通、合作共赢”理念,瞄准联合国 2030 年可持续发展议程的基准年,生成国际首套 2015 年全球 30m 土地覆盖数据集,可作为“一带一路”倡议实施过程中生态环境动态监测评估的基准。

“全球典型重大灾害对植被的影响”专题,则是 2017 年新拓展的专题。专题聚焦重大灾害对陆地植被的影响,利用全球陆表特征参量系列产品,对 1982—2016 年间 11 个典型的森林火灾、旱灾、水灾与地震灾害事件对植被的影响及灾后植被遥感参数变化过程和时空差异进行分析,并评估了植被对不同灾害类型响应的差异性以及人工干预在灾后植被恢复中的作用,可为自然灾害防治与生态环境保护规划与管理提供科学依据。

据悉,2017 年度报告和相关数据集产品,分别在国家遥感中心门户网站、国家综合地球观测数据共享平台和中国搜索同步发布。

(来源:科技日报 2017-11-22)

### Science: 为可持续发展评估水资源

在 2017 年 11 月 24 日,Science 期刊政策论坛栏目(policy forum)在线发表“为可持续发展评估水资源(Valuing water for sustainable development)”一文,由牛津大学和世界各地的合作伙伴领导的一个国际研究小组为可持续发展目标制定了一个新的框架来评估水资源的价值。

牛津大学领导的研究提出了一种新的四部分框架,将水资源用于可持续发展,以指导更好的政策和实践。强调在当地和全球范围内测量、监测和管理水资源的压力。对水资源的评估和管理需要在四个方面开展平行且协调的行动:测量、评估、权衡和寻求有能力的机构来分配和资助水资源。但是,人们越来越需要重新思考水

资源的价值，文中列举两条原因如下：①水不只是维持生命，它在可持续发展中起着至关重要的作用。水资源的价值体现在联合国17个可持续发展目标上，从消除贫困和消除饥饿，到可持续发展的城市与和平与正义，在这些地区，水的复杂影响现已得到充分的重视。②水资源短缺、洪水和污染带来的负面影响，已将与水相关的风险置于全球五大威胁之中。早在2015年，牛津大学领导的水安全研究小组量化水资源短缺、供水不足、卫生设施不足等，指出每年洪水造成约500亿美元的经济损失。

世界银行高级水资源委员会于2017年启动水资源评估计划，以绘制水资源的原则和路径，提供全球重新思考水资源的价值的机会。文中概括了四个步骤，以更好地评估和管理每一个领域的最新进展，并认为这四个步骤必须综合起来，以克服阻碍过去努力的障碍。分别为：①测量：分水岭地位、水的使用、以及场景信息。理解和衡量全球水循环的组成部分，当地的水资源预算和用水量。②评价：多个值以及多种方法来评估它们。在多重时间和空间尺度上识别和重视与水有关的好处，包括环境、社会文化和经济价值。③决策：将不同的水的价值和它们之间的权衡纳入系统的和具有包容性的决策过程中。④治理：在多种尺度下建立机构能力。加强水资源管理，通过一套自适应的制度、激励机制和工具以确保政策和管理决策在实际工作中能够得以实现。

未来工作中，水资源的可持续发展需要在这四个步骤上取得进展，包括：①在测量和建模方面的投资，抓住低成本传感和通信的机会，同时避免重要的长期监测网络的倒退。②开展水资源评估方面的创新，以解决人们对不完整、近似和相互矛盾的估计。现有方法的专业知识，如支付意愿、自然资本核算和参与式地图等，需要加强，更多的注意力必须集中在经济和文化评估技术的界面上。③改进不同价值的水计划方案。多种价值、不确定性和排序的决策方法现在已经成熟，需要进一步的创新和经验，以确保这些方法具有包容性，并适用于广泛的环境。④通过开发机构、信息和基础设施的投资途径，确定并解决治理赤字问题。进行制度改革，制定规则和激励措施，以实现公平和高效的跨多个部门和规模的分配。。

原文来源：<http://science.sciencemag.org/content/358/6366/1003>

（来源：科学研究动态监测快报 2017-12-15，第24期总第317期）

## 研究发现淡水湖泊产生大量温室气体

瑞士日内瓦大学近日发布的一项最新研究显示，湖泊和淡水系统释放的甲烷占大气中甲烷排放总量的20%以上，所产生的温室效应比二氧化碳高出28倍。

过去人们一直认为甲烷只能在缺氧的环境下产生，比如湖底的沉积层。但日内瓦大学的一个研究小组经过两年的实地研究发现，即使是常年有风吹过且富含氧气的地表水也会产生大量甲烷。

这项研究最初是为了测量位于瑞士北部阿尔高州的哈尔维尔湖水面至水下5米间水域的甲烷浓度和含量，但结论出乎意料。研究论文作者之一、日内瓦大学环境和水资源系的丹尼尔·麦金尼斯表示，地表水正在发生巨大变化，至今还没有人注意到这一点。

研究人员指出，地球海洋表面也会释放甲烷，但规模是地表淡水释放量的千分之一。因此，虽然淡水覆盖的地球面积比海洋少，但对温室效应的贡献却不容忽视。

研究显示，哈尔维尔湖面积约为10平方公里，每年排放甲烷量约25吨，这相当于240头奶牛排放的甲烷，其中约90%被认为是由水面至水下5米间的水域产生的，其他具有类似特征的湖泊中也会出现相同的现象。

研究认为，湖泊可能是巨大的甲烷“生产者”，其甲烷排放量比以前估计的要多得多，但这种现象背后的原因目前还不得而知。

这项研究已发表在最新一期英国《自然·通讯》杂志上。

（来源：[http://news.xinhuanet.com/tech/2017-11/23/c\\_1121999925.htm](http://news.xinhuanet.com/tech/2017-11/23/c_1121999925.htm) 2017-11-23）

## WMO 宣布启动全球水文状态监测与预测系统计划

2017年9月27日，世界气象组织宣布启动世界首个全球水文状态监测与预测系统（Hydrological Status and Outlook System, HydroSOS）建设计划，旨在为全球有效应对洪水与干旱灾害提供支持。整个系统建设周期为4年。

全球所面临的洪水与干旱灾害风险正日益加剧。据世界资源研究所（WRI）预测，未来15年全球面临洪水灾害风险的人口将由现在的2000万人增长至5000万人；与此同时，据世界经济论坛（WEF）估算，全球每年因干旱所导致的农业及相关经济损失高达80亿美元。但迄今为止，由于没有全球性的水文监测、模拟及报告系统，科学家尚无法对即将发生的洪水或干旱灾害进行预警。对此，WHO HydroSOS计划负责人Alan Jenkins教授指出，鉴于气候变化及全球人口激增所带来的诸多挑战。建立能够获知地表及地下水系统当前状态及其未来数周或数月变化的全球监测与预测系统就显得愈发紧迫。

HydroSOS系统的建设将依托WHO水文监测、数据共享以及季节性气象与水文预报计划，将全面整合局地的地基数据、全球尺度的卫星遥感数据、全球、区域及国家天气与气候预报模型以及全球水文模型，系统建成后将面向全球特别是受洪水和干旱灾害影响的地区提供有效的水文信息，以使政府部门、区域及国际援助机构以及受影响民众及时获知洪水或干旱灾害情况。此外，在系统建设过程中，科学家还将评估HydroSOS系统如何推动联合国可持续发展第六目标的实现，该目标强调通过保证水安全、卫生条件以及对淡水生态系统的合理管理而实现人类健康、环境可持续性以及经济繁荣的重要性。

原文来源:

<http://public.wmo.int/en/media/news/building-first-global-hydrological-status-and-outlook-system>

(来源: 科学研究动态监测快报 2017-10-15, 第 20 期总第 266 期)

## 人为气溶胶排放可能已改变自然变暖对高山湖泊环境的影响方式

20世纪60年代以来,随着我国经济和人口的快速发展,人为气溶胶含量迅速增加。这不仅造成了严重的环境问题,直接威胁公众的健康,而且通过与辐射和云的相互作用对大气环境、天气和气候产生不同程度的影响。中国所在的东亚是一个主要的亚洲季风气候区,气溶胶的生成、排放和输送等过程及其变化对季风环流的变化具有重要影响。目前,关于气溶胶对季风的影响已经有较多的研究。但关于这种由于气溶胶导致的季风变化会间接对水生生态系统会产生什么样的影响仍然为空白,而这种研究对于解答当前中国气溶胶环境污染及气候影响问题无疑很具重要性和紧迫性。2017年2月27日,以“Aerosol-weakened summer monsoons decrease lake fertilization on the Chinese Loess Plateau”为题Nature Climate Change在线发表了兰州大学陈发虎实验室、加拿大女王大学生物系John P. Smol实验室、美国德州农工大学大气科学学院徐阳阳实验室在气溶胶排放影响季风变化进而对亚洲高山湖泊生态系统产生影响的一项突破性的研究成果,并且Nature Climate Change还专门邀请了国际著名科学家Harry J. Dowsett教授同期撰写了一篇以“Aerosols shift lake ecosystem”为题的专题评论,以发表专题文章的形式给予了高度评价。该研究依托近2000年的高山湖泊记录,首次揭示出现代暖期和自然暖期(隋唐暖期、中世纪暖期等)高山湖泊环境变化过程存在显著差异,快速工业化产生的气溶胶对亚洲夏季风的显著影响可能是导致两种变化过程迥异的主要原因,进而揭示了气溶胶污染在对区域和全球气候产生影响的情况下对生态系统产生的可能潜在影响,对进一步理解全球变暖背景下的高山湖泊环境恶化和生态退化具有重要意义。已有研究认为,亚洲地区的快速工业-城市化发展导致近几十年来该地区气溶胶含量显著增多,在亚洲大陆上空产生“阳伞效应”,致使海陆热力差异减小,进而导致亚洲夏季风减弱。而在当前变暖背景下,气溶胶导致的这种夏季风减弱,使得该区域水生生态系统是否受到影响,已经发生哪些变化或可能存在哪些潜在的变化过程?这些问题对阐明全球变暖对高山湖泊环境的影响均至关重要。陈发虎研究组等依托位于黄土高原上过去2000年的高山湖泊记录,发现在自然暖期下,季风降水增强导致更多的营养物质被侵蚀输入到湖泊,致使湖泊发生了显著的富营养化;而在现代暖期,由于季风减弱,导致被侵蚀到湖泊中。

营养物质减少,致使湖泊并未发生富营养化。因此,在现代气候变暖背景下,快速工业化产生的气溶胶造成亚洲夏季风减弱的影响是导致其对高山湖泊生态和环



境产生不同于自然暖期下的影响过程的主要因素(图)。研究组通过研究还指出, 未来人为气溶胶的减排以及全球气候的持续变暖, 将可能导致亚洲夏季风气候又返回自然变暖下季风增强的状态, 从而可能导致更多营养物质输入到高山湖泊中, 进一步加剧高山湖泊的生态退化, 使该地区已经较为紧张的淡水供应的形势更加严峻。均一性原理是目前自然科学研究中普遍使用的原理之一, 即认为现在是过去的一把钥匙。而该研究成果表明, 当今气候变化能够对生态系统产生复杂的影响, 可以将生态系统改变到以前从来没有的状态, 未来的生态系统变化可能将找不到历史相似型, 或将对目前大部分的古环境研究手段提出挑战。同时, 该研究还为评估在全球变暖背景下人为气溶胶排放对亚洲气候和生态脆弱带的影响提供了科学依据。

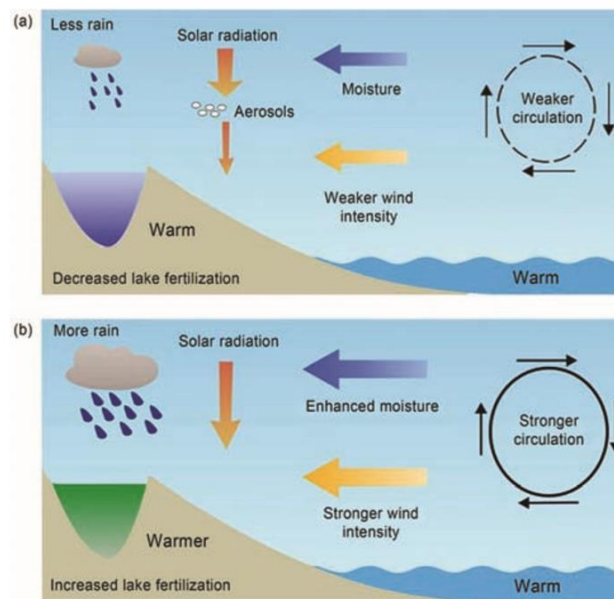


图 (网络版彩色) 现代暖期 (a) 与自然暖期 (b) 背景下的不同湖泊生态系统响应过程。(a) 现代暖期背景下, 由于人为气溶胶的影响, 亚洲夏季风减弱, 进而导致高山湖泊没有出现富营养化; (b) 自然暖期背景下, 由于夏季风增, 导致高山湖泊处于富营养化的状态

原文来源: <http://engine.scichina.com/doi/10.1360/N972017-00428>

(来源: 科学通报 2017, 62: 1670 doi: 10.1360/N972017-00428)

## 澜沧江—怒江分水岭是重要植物地理分界线

“澜沧江—怒江分水岭作为重要的植物地理分界线研究方面取得新进展, 这是我们在前人未深入探索的领域所作的一次突破, 它无论对深入探讨中国喜马拉雅植物区系的空间分异机制, 还是对生物多样性的保护都具有重要的意义。”

中国科学院昆明植物研究所青藏高原—喜马拉雅植物多样性形成与演变研究团队孙航研究组助理研究员罗冬 6 日告诉记者, 就在日前, 这项研究成果已发表在植物学主流期刊《林奈植物学报》上。

在我国西南，怒江、澜沧江、金沙江从西北奔流而南，形成了世界上罕见的江水并流不交汇的“三江并流”奇特自然地理景观。其间澜沧江与金沙江最短直线距离为 66 公里，澜沧江与怒江的最短直线距离不到 19 公里，这里也是生物多样性保护和研究的热点地区。

澜沧江—怒江分水岭，境外称湄公河—萨尔温江分水岭，最早在 1921 年由植物学家弗朗西斯·金登-沃德提出。作为博物学家，这位英国人写了相关的文章，从地质、环境、气候等角度来论述这条典型的地理屏障，并未引起后世研究者的广泛关注，而是将萨尔温江和高黎贡山一带作为中国—喜马拉雅森林亚区内东喜马拉雅和横断山两个区域的植物地理分界线。

从 2012 年开始长期从事高山植物多样性研究的中国科学院昆明植物研究所孙航研究组，采用谱系地理学研究手段，结合气候因子和生态位模型分析对喜马拉雅—横断山高山冰缘带特有类群扭连钱开展了研究。

高山冰缘带作为世界上最高的陆地生态系统，在喜马拉雅—横断山高山生态系统中占据了一定的比例，生境特殊、自然环境恶劣，但却拥有异常丰富的植物多样性及特有性。扭连钱即是高山冰缘带的一员，隶属于唇形科扭连钱属，多年生草本植物，生长于海拔 4300 米—5000 米的高山强度风化的乱石滩石隙间，在我国西藏东部、青海西部、四川西部亦有分布。

2012 年 7 月至 8 月，研究团队在扭连钱植物分布地开展野外观察及采集工作，收集 17 个居群的 202 个植株个体。经过分子生物学实验和数据分析整理，罗冬发现扭连钱的核基因遗传结构在澜沧江—怒江分水岭即西侧的东喜马拉雅地区，与东侧的横断山地区形成两大谱系分支，分化时间约在距今 4.49 百万年的上新世时期。

而气候因子分析显示，扭连钱位于东侧横断山的生境比西侧东喜马拉雅更加湿润；叶绿体和核基因数据均显示扭连钱遗传多样性及居群间遗传分化水平较高，同样呈现喜马拉雅—横断山区域内高山冰缘带类群特有的高山岛遗传分布式样。

新的研究结果揭示，澜沧江—怒江分水岭地理屏障是导致扭连钱谱系分化的主要因素，同时也为喜马拉雅—横断山高山冰缘带植物区系物种演化提供了新案例。

研究结果证实，澜沧江—怒江分水岭是东喜马拉雅植物区系与横断山植物区系的地理分界线，已有桃儿七、喜马拉雅红豆杉、牛肝菌等类群的谱系地理研究也表明，澜沧江—怒江分水岭对两边种系分化有隔离作用，这对深入探讨中国喜马拉雅植物区系的空间分异机制有着重要的意义。

罗冬说，正因为扭连钱分布在高山冰缘带，在全球气候变暖或人为因素干扰等大环境变化下，可能会压缩扭连钱的最适生存空间，导致物种居群量减少或遗传多样性降低等情况。因此揭示出它的遗传背景，对这个类群甚至于对区域内相同生境下的生物多样性保护具有积极的指导作用。

（来源：科技日报 2017-12-07）

## 美研究发现地下水枯竭将释放大量的二氧化碳

2017 年 11 月 16 日,《地球未来》(Earth's Future) 期刊发表题为《地下水枯竭: 一个重要的未报告的大气二氧化碳来源》(Groundwater Depletion: A Significant Unreported Source of Atmospheric Carbon Dioxide) 的文章指出, 过量地开采地下水, 会导致地下水枯竭, 同时向大气释放大量的二氧化碳。美国的地下水枯竭可能导致每年向大气释放 170 万吨的二氧化碳。直到现在, 这一问题被科学家们所忽略。

量化二氧化碳的年度通量及向大气的排放, 对于未来气候变化政策的决策和建模至关重要。考虑到温室气体排放对气候变化的重要性和公认的源与汇之间的不匹配, 量化这些参数非常重要。一个重要的且以前未被认识到的二氧化碳贡献源于地下水枯竭。雨水中二氧化碳含量与大气中二氧化碳含量相同。但土壤中二氧化碳含量是大气中二氧化碳含量的 100 倍, 这是因为土壤中的微生物会将有机碳降解为二氧化碳。当雨水冲刷地面并渗透到地表下的沉积物和岩石时, 水分会通过这些微生物溶解多余的碳。这些富含碳的水在经过数百年至数千年后, 汇集成大量的地下水。但是人类正在以前所未有的速度提取地下水, 仅美国就每天提取近 800 亿加仑(3030 亿升) 的地下水用以饮用和灌溉农作物。美国密歇根州立大学(Michigan State University) 的研究人员分析了来自美国地质调查局(USGS) 的地下水枯竭和地下水碳化学数据, 以计算每年从地下水转移到大气中的二氧化碳量。

研究发现, 美国的地下水枯竭可能导致每年向大气释放 170 万吨二氧化碳, 高于美国每年通过发电为 25 万户家庭供电所产生的二氧化碳。美国环境保护署(EPA) 向政府间气候变化专门委员会(IPCC) 报告的 23 个主要来源的年度二氧化碳排放量范围为 20 万吨(来自镁生产和加工)~52.08 亿吨(来自化石燃料燃烧)。地下水枯竭释放的二氧化碳高于这 23 个主要来源中 1/3 来源的二氧化碳排放。研究人员预测, 全球每年地下水枯竭将向大气释放 970~1350 万吨二氧化碳。地下水可能以相同或更高的速度枯竭, 因此, 地下水枯竭应被视为未来二氧化碳预算的来源。研究人员认为, 理解二氧化碳排放的所有来源对于准确预测气候变化和寻找解决方案尤为重要。

原文来源: <http://onlinelibrary.wiley.com/doi/10.1002/2017EF000586/abstract;jsessionid=1514DDD57EA78F9AFF3E7ECE791D9537.f02t02>

(来源: 科学研究动态监测快报 2017-01-15, 第 24 期总第 234 期)

## NERC 资助开发新一代陆地水文模型

2017 年 10 月 5 日, 英国自然环境研究理事会(NERC) 宣布其国家能力研究计划将资助 600 万英镑用于开发与英国陆地环境模拟器(JULES) 模型相关的新一代



陆地水文模型 (Hydro-JULES), 旨在形成一套完整的陆地水循环三维模型系统, 确保空间和时间尺度的一致性。

该项目来源于 2016 年 12 月 NERC 理事会会议的建议, 由于英国陆地水循环的模型有蒸发、降雨、河流、水库和沿海潮汐等不完全一致的独立模型, 而研究需要提供一个综合的模拟系统, 该系统通过陆地水文系统将全球天气和当地的降雨量、洪水淹没评估和后续影响结合起来, 因此就需要开发新一代的综合陆地水文模型。该系统将为高分辨率物理陆地水文学和综合建模提供研究基础。系统由 NERC 与英国国家大气科学中心 (NCAS)、英国地质调查局 (BGS) 和英国国家海洋学中心 (NOC) 合作, 在英国生态与水文中心 (CEH) 的整体管理下进行。CEH 研究团队的重点任务是推进英国高分辨率物理地理水文学及其综合建模。他们将在陆地和水文科学方面取得重大进展, 以充分表达模型中的陆地水循环。

Hydro-JULES 将在五年内形成完整的陆地水循环三维模型, 以确保空间和时间尺度的一致性。通过开发模拟水下垂直和横向运动的新模型, 推动陆面科学的发展。该项目将与国家、国际组织、大学和研究机构合作开发。Hydro-JULES 研究计划将于 2018 年 4 月开始, 国家能力计划将主要资助生态与水文学中心 (CEH)、英国地质调查局和国家大气科学中心 (NCAS) 进行项目的开发和实施。

作为英国地球系统模型的一部分, JULES 是一个社区地面模型, 既用作独立模型, 又与气象统一模型 (Met Office Unified Model) 一起使用。由于科学的不断发展和改进, JULES 被认为是国际陆地表面建模的最前沿。JULES 模型包括陆地地球系统的要素, 如动态植被、碳氮循环、以及水和能源的陆地大气相互作用模型。NERC 国家能力计划为 JULES 提供直接支持, 包括地球系统建模和英国环境预测项目以及与合作伙伴进行技术开发和管理的其他相关研究。

原文来源: <http://www.nerc.ac.uk/press/releases/2017/34-jules/>

(来源: 科学研究动态监测快报 2017-11-01, 第 21 期总第 314 期)

## 业界动态

### WWC 发布《水和气候——蓝皮书（2017）》

2017年11月8日,世界环境理事会发布(WWC)《水和气候—蓝皮书(2017)》(WATER AND CLIMATE -BLUE BOOK (2017)),以下简称“蓝皮书”,旨在提高国际社会对水作为气候变化后果影响最严重的资源的认识,帮助决策者将水作为国家政策的重点。在2017年的版本中,整合了第二次国际水与气候会议(ICWC)的讨论结果,以及在COP22举行的全球行动日的信息。蓝皮书还包含在气候变化背景下有关水安全和食物安全领域的为决策制定者服务的关键信息;水对气候变化的恢复力;通过应对和适应气候变化的水资源管理及项目资助的城市恢复力建设。本文简要整理了气候变化对水资源的影响以及减缓气候变化影响可采取的水资源管理措施。

#### (一) 气候变化与水

由于干旱和极端降雨事件发生频率的增加,气候变化直接影响水资源的可获取性。气候变化改变极端事件发生的频率和强度,并使得极端事件发生得更为频繁和猛烈。由于受到气候变化的影响,淡水资源、水质及水资源安全堪忧,甚至是危及食物安全。这些极端天气事件将对水供应造成损害,并使经济发展和人类健康面临风险。人口增长和工业扩张也将意味着对水的需求增加,并加剧气候变化的影响。以非洲为例,从现在到2100年,非洲的干旱和亚热带地区将成为受气候变化影响最严重的地区。受极端干旱影响的地区,如萨赫勒地区,预计在2010年至2040年期间,非洲的人口将增加50%,而生活在城市的人口比例将从44%上升到57%。非洲人口将面临水资源压力,预计将从2000年的47%上升到2025年的65%。因此,全球水危机将在非洲的背景下形成一个非常特别的维度。

#### (二) 良好的水资源管理可以增加对气候变化的恢复力

通过整合适应气候变化的水资源管理计划,可建立一致的和综合的水政策来加强对气候变化的适应能力。地下水比地表水更容易受到气候变化的影响,成为适应气候变化议程的优先事项。在干旱和水资源短缺的时期,水资源是一种战略资源。可采取以下措施应对气候变化的影响:①改善关于水资源和水信息系统的知识。收集和共享水资源信息对于水资源管理极为重要。因此,改善水资源监测系统、提供水和建模工具的信息系统是非常重要的,目的是减少与气候变化有关的不确定性,并支持水资源管理领域的决策。②水行业为其他领域的中心,并且起到相互关联的作用。水起着核心作用,它是几乎所有直接或间接受到气候变化影响的领域的基本因素:能源、食品、卫生和教育。如果我们能确保水的安全,我们就能确保所有其他部门的安全。③在流域层面开展对话与合作的必要性。在气候变化的背景下,流

域综合水资源管理是确保水资源可持续发展的关键。自然决定的贡献（NDCs）、适应和减缓计划必须在自然或跨流域水平上进行实施，并与该流域的上游和下游的所有利益相关方协商。在流域层面商定的应对气候变化的发展战略可以促进流域层面水资源的可持续管理。④为改善水对气候变化的适应能力而推荐的解决方案。更有效地利用水资源，特别是在撒哈拉以南非洲和北非的某些干旱和半干旱地区，因为农业部门使用了85%以上的水；通过水利基础设施的开发利用，吸引新的资源介入应对气候变化带来的影响；发展非传统水资源，比如咸水脱盐。

原文来源：

<http://www.worldwatercouncil.org/en/publications/water-and-climate-blue-book-2017>

（来源：科学研究动态监测快报 2017-12-01，第 23 期总第 316 期）

## OECD：通过地下水分配加强水质和水量管理

2017 年 10 月 17 日，OECD 在线发表研究报告《地下水分配：管理日益增长的水质和水量压力》（Groundwater Allocation Managing Growing Pressures on Quantity and Quality），进一步分析与地下水有关的具体挑战，以及如何根据地下水的点设计出分配安排。此报告是继 2015 年所发表的《水资源配置报告：风险分享和机遇》之后基于案例研究来制定政策指导的又一份关于水配置的报告，目的是改进水资源分配制度的设计，评估和加强地下水的分配制度。

报告分析了地下水的特点，并提出了地下水配置的政策指导。报告的第一部分列出水资源分配的健康检查包括一系列的 14 个问题（“检查”），用以确定分配制度的关键要素是否到位，以及如何改进它们的性能。分别为：

（1）在含水层或其他相关尺度下，是否有合法的责任机制来进行有效的地下水分配？

（2）地表水和地下水，以及其他来源的水资源是否有明确的法律地位？

（3）是否有地表水和地下水，以及可替代的水资源供应来源的获得性和水资源所存在的可能的稀缺性？

（4）是否存在反映现场要求和可持续使用的抽取限制（“上限”）？

（5）是否有一种有效的方法来有效和公平地管理水资源短缺的风险，从而确保水的基本用途？

（6）在处理特殊情况（如旱灾或严重污染事件）时，是否有适当的安排？

（7）是否有处理新进入者和增加或改变现有权利的程序？

（8）是否有有效的监督和执行机制，明确而合法的制裁？

（9）水基础设施是否到位，以便分配制度有效运作？

（10）不同部门间是否存在影响水资源分配的一致性政策？

(11) 是否有明确的关于水权益的法律定义?

(12) 地下水的抽取会造成其他用户对资源获取性以及周边环境产生影响, 对所有用户收取适当的抽取费用是否合理?

(13) 与返流及排放有关的义务是否有适当的规定和执行措施?

(14) 该系统是否允许水使用者重新分配水, 提高系统的配置效率?

报告的第二部分分析了 9 个案例 (丹麦、亚利桑那州图森市、日本的熊本、墨西哥、西班牙的上古迪亚纳流域、德克萨斯州、法国、印度的古吉拉特邦和中国北方), 强调健康检查的要素如何在不同的环境中被应用。在对我国的案例研究中, 报告总结了我国北方地下水资源的使用情况, 得出了以下经验: 认为我国地下水的私有化引起了非正式的水交易。我国北方的地下水市场构成了水资源重新分配的一种手段, 地下水市场允许农民增加地下水的使用权, 而这些农民缺乏安装水井的手段。增加地下水的稀缺性往往导致地下水市场活动的扩大, 但也使得水资源更有效地被利用。由于我国的电价是基于计量消费设定的, 所以地下水被抽吸的深度决定了运行管道的成本。当泵的成本更高时, 水卖家和买家倾向于优化他们的地下水消费。由于非正规市场对价格变动的反应, 一些观察人士认为, 政府应该引入正式的地下水定价机制, 允许收回全部的供应成本, 并加强价格信号以反映资源的稀缺性。

原文来源: <http://www.oecd-ilibrary.org/docserver/download/9715391e.pdf?expires=1511246843&id=id&accname=ocid56017385&checksum=1C62969609C2927ABE277E699E4420E26>

(来源: 科学研究动态监测快报 2017-12-01, 第 23 期总第 316 期)

## WWF 发布报告《聆听河流——来自全球河流流量保护的成功案例》

2017年9月18日, 世界自然基金组织 (WWF) 发布报告《聆听河流-来自全球河流流量保护的成功案例的经验》(listen to river-lessons from a global review of 4 environmental flow success stories) 回顾了来自澳大利亚、中国、英国、印度、墨西哥、巴基斯坦、南非和美国的 8 个河流流量保护成功案例, 提出了河流水资源保护的经验和教训, 指出世界正面临着一个转折点, 呼吁各国政府、水资源管理机构、国际资助机构、私营部门、非政府组织和研究社区的决策者采取行动。

由于日益增长的人口和农业、工业、城镇和城市的需要, 全球淡水资源正日益被广泛的开发。有学者在 2016 年发表的研究中指出, 世界上三分之一的河流流域正在严重枯竭, 缺水正在影响全球一半的人口和四分之三的灌溉地区。WWF 根据淡水生活星球指数的衡量, 河流的变化可能是 1970 年以来淡水物种数量下降 81% 的最主要因素。河流中物种下降速度是世界海洋和陆地物种数量下降的 2 倍。在全球范围内, 自然河流的流动已经被水坝的泛滥、土地利用和城市化的改变以及过度抽取水的影



响所改变, 不尽人意的水资源管理以及气候变化加剧了河流水量威胁。为此, WWF 提出了实现河流环境流量保护的7条共性经验 (图)。



图 河流环境流量实现的七条共性经验

(1) 制定清晰有效的法律和法规, 并保持政治意愿实施和强制执行。政府层面: 为规范水的使用、分配、权利和许可证制定一个明确的法律基础; 承认环境流量是保护生态系统服务的首要要求, 也是水资源规划和管理的核心组成部分, 理想情况下, 法律地位至少与消耗性的使用相等; 为河流水资源的消费使用设定一个限制或上限, 或创建一个环境流量储备, 作为保护环境流的一种手段, 为国家和综合流域水资源规划提供一个框架。水资源管理机构层面: 根据现有的水分配系统, 提供有关全面或渐进式改革的指导意见。全球非政府组织层面: 推动州和联邦政府采取行动保护和恢复环境流量; 根据其他具有类似法律框架的地区的经验, 提供立法和监管方面的指导。地方非政府组织及私人层面: 在环境流量缺乏或不充分的情况下, 推动流域水资源管理的改革; 识别本地专家并鼓励他们参与到河流环境流量的评估和实施中; 与公众就解决当地需求的问题和潜在解决方案进行沟通。

(2) 与利益相关者进行有意义的接触, 以获得理解和支持。政府水资源管理机构层面: 让所有的水用户参与到一个流域的环境流量决策过程中, 以确保利益相关者的参与; 确保地区/区域的知识在决策过程中被考虑; 对不同河流亦或是同一河流的不同管理部门, 设计并实施一个明确的、详细的环境流目标。所有的用户和利益相关者包括农民团体、水坝管理员、私营部门的参与者层面: 愿意倾听不同的观点, 理解不同的价值观, 并在经常被持有的立场上达成妥协。地方非政府层面: 教育和召集利益攸关方, 帮助他们就水资源的可用性和使用问题表达他们的关切。大量用水的用户层面: 开放和透明的水使用和估计未来的需求。研究共同体层面: 通过清晰地描述环境流量实现的预期效果和与预测相关的不确定性来支持环境流评估; 确

保社会价值观在环境流动的建议中得到解决；在不同的环境流管理场景下，构建和应用工具来评估不同的水使用部门之间的权衡。

(3) 为河流环境流量设计充足的资源和容量保证河流流量保护法规等的实施及对河流环境监测。政府层面：为水资源的有效管理提供资金支持。政府水资源管理层面：推动政府获得充足资金，有效实施、管理和监督水资源分配体系；建立内部能力，促进机构知识的连续性。全球非政府组织层面：利用其他国家获得的经验来支持环境流的决定和实施；推动来自州和联邦政府的资金；帮助从诸如基金会这样的非政府组织筹集资金。国际资助机构层面：评估为环境流实施计划提供资金的机会，作为水资源管理和基础设施计划的关键组成部分。所有的用户和利益相关者包括农民团体、水坝管理员、私营部门的参与者层面：准备好进行生态和社会经济研究，以了解资金流出的影响，以告知适当的电子流量评估。研究共同体：利用获得研究资助继续研究自然地理、地貌学、生态、社会和经济参数对环境流量实施的反应；与其他利益相关者合作，确保科学成为目标和战略。

(4) 考虑河流环境流量的控制不仅影响不同群体的生态环境还会影响经济和社会条件。政府水资源管理机构：采用一种全面的途径来理解水资源分配如何影响下游水使用者。全球非政府组织：收集关于环境流量实施的成本/效益的数据，以告知环境流量评估，并展示广泛的利益。国际资助层面：利用杠杆效率来确保适当的评估，以确定适合环境和社会经济目标的环境流动。研究团体层面：继续研究自然、地形、生态、社会和经济参数对环境流量实施的反应。

(5) 尽可能早地对河流实施某种程度的保护措施，因为限制分配比重重新分配水资源更容易。政府水资源部门层面：尽可能早地保护自然流，以避免过度分配；全球非政府组织：利用其他国家获得的经验来支持保护环境流动的计划。

(6) 尽可能根据用水量的风险水平和强度，并在可用财力和人力资源约束下，科学地执行法律、法规保持河流环境流量，并针对非技术问题与利益相关者沟通。水资源管理机构层面：使用适合研究区域的评估工具，以及一个公开、透明的决策过程，以确定环境流量需求，但是要尽可能简单地将这些建议用于帮助实现和理解河流环境流量。大量用水的用户层面：继续创新，协助开发决策支持和预测工具，以改善实时管理。

(7) 履行河流环境流量的生态、社会和经济监测结果并开展适应性管理。水资源管理机构层面：确保进行后续监控以确定环境流量实现的成功和失败，从而使管理实践能够被调整。大量用水的用户层面：准备进行生态和社会经济研究，以监测流量退出对适应性管理的影响。当地非政府组织层面：倡导适当的资助和实施监测网络，收集水文和生态参数的数据，以协助环境流量的确定和管理。研究团体层面：为监控网络的设计和实现提供输入，并根据需要协助数据收集和分析。继续创新，改进技术，使数据能够收集、存储、管理和分析，以提高效率。

原文来源: [http://wwf.panda.org/about\\_our\\_earth/about\\_freshwater/?311491/Protecting%2Driver%2Dflows%2Dcritical%2Dfor%2Dglobal%2Dwater%2Dsupplies%2Dand%2Dsustainable%2Ddevelopment](http://wwf.panda.org/about_our_earth/about_freshwater/?311491/Protecting%2Driver%2Dflows%2Dcritical%2Dfor%2Dglobal%2Dwater%2Dsupplies%2Dand%2Dsustainable%2Ddevelopment)

(来源: 科学研究动态监测快报 2017-10-15, 第20期总第313期)

## World Bank: 节约和重新分配农业用水以缓解水资源短缺

2017年10月18日, 世界银行(WorldBank, 简称WB)发布信息称“水相关的农业创新系列”研讨会在华盛顿召开, 农业创新系列中的水是世界银行和学术界、公共和私人机构以及民间社会在农业和水问题上的合作知识平台。探讨私人影响投资者如何激励用水效率, 并重新分配农业用水以恢复枯竭的河流的例子。

来自美国的研究团队为了评估在灌溉农业中节水和输送水的可行性, 研究小组进行了文献和互联网审查, 以确定有记录的实地实验和案例研究, 认为技术文献中对灌溉农业节水的批评和怀疑是有根据的, 建议可以采取必要的政策和规章, 以确保成功的节水和 water 权转移, 具体可包括以下内容:

(1) 建立基于权利的水分配系统。来自世界各地的大量证据表明, 在缺乏治理机制的情况下——如发放地表水权或水井许可证或其他公共安排——来规范允许的开采, 可能会导致水资源枯竭耗尽。通过水权获得的消费总量应明确水的可用性, 考虑到淡水生态系统在任何时候都需要保留的水量, 以支持它们的生态健康。

(2) 限制消费用水。对水资源总量的限制是成功的必要条件, 它可以使政府部门或灌溉区等防止用户过度使用水资源。通过限制发放的水使用权利或许可的总量控制上限, 在执行过程中可根据水供应季节性或年度变化来调整消费使用机制。

(3) 允许转让水权。明确界定的水权的发放不仅可以限制全面的消费使用, 而且还为不同用户或部门之间的用水权转让或交易提供了一种手段。转让部分水权有助于建立一个运转良好的水市场, 在这一市场中, 用水权的持有者可以被鼓励减少他们的消费使用, 出售他们不再需要的部分权利。

研讨会指出地球上的淡水资源中有超过三分之一的水资源因过度消耗而消耗殆尽, 其中灌溉农业占淡水流域水资源消耗的90%以上; 到2050年我们必须面临养活一个90亿到100亿人口的世界同时将使用更少的水来养活75亿人口。为了应对这些挑战, 需要协调公众和私人行动, 以激励节水措施(包括有效的土壤和作物管理、节水技术的灌溉应用和基础设施改善、基于自然的植物性自身的恢复能力)的实施。

原文来源: <http://www.worldbank.org/en/events/2017/05/09/water-in-agriculture-innovation-series>

(来源: 科学研究动态监测快报 2017-11-01, 第21期总第314期)



## 提升韩国水利用效率：政策问题与建议

韩国的水资源管理已经能够应对和促进快速的城市化和经济增长。这一显著成就的取得归因于对大量开发战略的大规模投资，以满足对水的需求和抵御旱涝灾害风险。目前，韩国的水管理面临三方面的长期趋势，这对当前的政策和投资反应提出了挑战：一是，人口趋势，尤其是人口的快速老龄化将提升水需求和收紧税收；二是，经济趋势和财政整顿将影响公共资金为水管理提供资金的能力；三是，气候变化将影响水的可获得性和与水相关的风险的暴露情况。

为此，韩国土地、基础设施和交通部回顾了当前的政策响应，并对其是否能应对未来的挑战进行了评估。2017 年 9 月，经合组织（OECD）发布报告《提升韩国的水利用效率——政策问题和建议》（Enhancing Water Use Efficiency in Korea--POLICY ISSUES AND RECOMMENDATIONS）公布了其评估结果。此次评估的这些政策在韩国的水质管理中发挥着重要作用，包括提升韩国水利用效率的经济手段；智能水管理以及水和信息、通讯技术的融合来管理水资源和提供水服务；水配置机制。

### （1）三大经济手段的优势和局限性

三大经济手段有助于韩国的水质管理并有可能提升其用水效率：①对从河流中取水的用户（电厂、工业和家庭用户）征收河流用水费；②大坝水资源税是对通过与韩国水资源公司（K-water）的合同从河流或大坝中取水的用户征收的统一的容积费；③跨区域水资源税是在全国范围内设置的由两个部分组成的水费，以收回通过跨区域系统供水的成本，不同的水费标准适用于不同的水质等级（原水、处理水、纯净水）。

这些工具并不是为提升水利用效率或应对水短缺而制订的。它们不会产生维持和扩展现有基础设施所需的足够税收。这意味着错失了一个机会来管理水的需求和减少未来在水基础设施的投资需求从而增加水供给。经合组织（OECD）的分析和国际良好实践表明，韩国当局将受益于对这些工具的调整，从而提升韩国的水利用效率。首先，税费应该更好地反映取水地的水供应成本。第二，税收可以为支出计划提供经费支持，从而为流域内的河流养护做出有效贡献。此外，从长远来看，可以考虑取水费，它反映了缺水盆地中利用水资源的机会成本。这方面的任何进步都将得益于逐步的、长期的、具有包容性的、分阶段的做法，而这些做法将使国家和地方各级的利益相关者参与进来。

### （2）加快韩国部署智能水管理的措施

韩国的智能水管理可为韩国和国外水利用效率的提升做出重大贡献。它可以支持关于大坝和水库管理以及系统中水配置方面的决策。它还可以为水公用事业（如漏水检测）和水用户提供增值服务（如关于水质的实时信息），从而提高韩国和国外供水设施的性能。

但是,在韩国和国外,智能水管理的推广受到了一些瓶颈的阻碍,但可以通过有针对性的措施加以克服,例如促进开展水管理综合方法、反映供水全部成本的税费或者将新数据的需求降至最低的模式。这样的措施还应包括最终水用户参与确定有助于满足其需求的额外服务和市民的能力建设。

### (3) 水配置机制:一个悬而未决的问题

设计合理的水配置机制可以提高水的使用效率,防止浪费。通过水配置为韩国社区创造最大的价值,从而促进更好的水资源管理。但是,由于在建造水坝之前和之后所获得的水权利共存,导致韩国的水配置机制在实现这些成果和提升用水效率方面的能力受到阻碍:这种情况造成了法律上关于谁获得水和在哪些条件下获得水方面存在争端和不平等。改革水资源配置机制可以在韩国产生额外的福利。目前,这些改革面临着挑战。国际经验有助于探讨如何管理这样的改革,并采取适当的附带措施。

### (4) 加强水资源管理以提高水资源利用效率的机会

建议修改体制框架,以提高韩国的用水效率。它应该能够反映当地的情况,并在国家、流域或地方范围内与相关利益攸关者建立合作关系。应鼓励最近在这些方面取得的一些进展:对人们和用水户进行教育,并告知他们缺水的情况、滥用和不当分配水所产生的机会成本以及供水成本;制定一个由利益相关者参与的战略方案,并施以结果为导向的绩效管理;流域组织发挥重要作用。

原文来源: [http://www.oecd-ilibrary.org/environment/enhancing-water-use-efficiency-in-korea\\_9789264281707-en](http://www.oecd-ilibrary.org/environment/enhancing-water-use-efficiency-in-korea_9789264281707-en)

(来源: 科学研究动态监测快报 2017-10-15, 第20期总第313期)

## 全国首张湖长地图发布

科技日报绍兴12月5日电,一张绘有绍兴市重点湖泊(水库)名称和位置的地图上,该市市级和县级湖长的名字被印在了醒目的位置,这张图就是绍兴市湖长地图。12月5日,该图在“关爱山川河流·保护城市水体”志愿服务活动启动仪式上正式发布。记者从水利部获悉,这是国内首次发布湖长地图。

绍兴市治水办(河长办)专职副主任杨骅介绍,绍兴湖长地图对市县两级总湖长进行了公示,展示了市县两级湖长管理湖(库)的具体地点,标明了市县镇村各级湖长职责,还明确了2017-2020年绍兴湖(库)管护的主要目标。

(来源: 科技日报 2017-12-06)

## 洪水的拷问：自然保护区内该建水电站吗

11月24日晚，西双版纳回龙山小电站截流3天即遭遇20年一遇洪水。22日刚刚举行截流仪式的回龙山水电站破堰，造成下游水位急剧上涨约150厘米，部分居民家中进水。

据西双版纳州外宣办工作人员介绍，23日下午到24日白天，西双版纳全州普降暴雨，东部勐腊县降雨量尤大。24日下午1点，监测到入库流量和库水位激增后，回龙山水电站施工现场指挥部启动应急预案。当晚8点，水位已经上涨至临近截流大坝极限的604.14米。鉴于水位呈快速上升趋势，现场指挥部在确认下游人员已安全疏散的情况下，进行非常泄洪。洪水按预定缺口位置下泄，约120分钟后，险情基本解除。

西双版纳外宣办发布的信息显示，此次主动破堰没有造成直接人员伤亡。主动破堰后，下游水位一度快速上涨。据有关部门观测，水库约1026万方水，预计流量最大达4000立方/秒，为当地20年一遇。

由于泄洪对下游造成了影响，同时电站位于西双版纳自然保护区，从而引发了人们对电站建设合理性的议论。

罗梭江是澜沧江的一条主要支流，在勐腊县象明乡的一段叫小黑江。2015年开工的回龙山水电站位于西双版纳州勐腊县境内小黑江与曼赛河汇合的速底村上游河段，是云南省“四个一百”及西双版纳州“四个一”重点建设项目。电站设计坝高79米，水库总容量为2.054亿立方米，电站装机容量为11.3万千瓦。

11月22日，大坝如期截流，如果一切正常，该电站将在2019年7月实现首台机组发电。但2016年，云南省就已叫停25万千瓦及以下装机的电站建设。且云南不愁用电，为何还要在保护区建这样的小规模电站？对此，西双版纳外宣办回应，回龙山水电站所有相关审批手续，均在云南省2016年叫停25万千瓦及以下规模小水电建设前的2012年获批。

西双版纳州相关负责人向科技日报记者介绍，“回龙山水电站所有手续齐全、合法”，并于25日晚间给记者发来了云南省环境保护厅于2011年12月23日签批的《云南省环境保护厅关于小黑江回龙山水电站环境影响报告书的批复》扫描件。

这份批复中强调：“在不影响西双版纳州罗梭江鱼类自然保护区的前提下，我厅同意该项目环境影响报告书所述的性质、规模、地点和环境保护对策措施进行项目建设。”

西双版纳自然保护区是我国建立的第一个自然保护区。回龙山水电站紧临州级保护区——罗梭江鱼类保护区。北京工业大学2016年5月为建设单位所编制的环境影响报告表称，西双版纳国家级自然保护区由勐腊、尚勇、勐仑、勐养、曼搞等互不相连的5片组成，总面积约24.12万公顷，占自治州总面积的12.7%。回龙山电站工程

及线路离勐仑子保护区相对较近。

勐仑子保护区在地域上与州级保护区——罗梭江鱼类保护区基本重叠。这里拥有较完好的热带雨林生物多样性生态系统，澜沧江纵贯境内，初步查明，境内有野生和天然鱼类107种，占全国总属数的40%。

《中华人民共和国自然保护区条例》第三十二条规定：“在自然保护区的核心区和缓冲区内，不得建设任何生产设施。在自然保护区的实验区内，不得建设污染环境、破坏资源或者景观的生产设施。”一位知名的鱼类学专家对科技日报记者表示，罗梭江是众多大型珍稀鱼类洄游繁殖的产卵场，一座79米高的大坝，是否会导致一些鱼类的灭绝还不好评估，但影响是可预见的。

云南省环境保护厅在前文所述环境影响报告书的批复中也认为，电站距离罗梭江鱼类自然保护区试验区3.4千米，工程建设将对南线河口产粘沉性鱼类产卵场和曼赛河口下游产卵场产生较大影响，导致鱼类生境产生较大变化。

该批复要求，建设方须依法承担责任，采取集运鱼系统过坝、人工增殖放流、人工模拟产卵场和完善罗梭江鱼类自然保护区等补偿措施。要建设鱼类人工培植放流站，进行野生亲本捕捞、运输和驯养。要在库区及支流放流叉尾鲌、丝尾鳢等受影响鱼类，并对增殖放流结果进行跟踪监测。

此外，云南省环境保护厅还要求建设方应建立人工产卵场，建立鱼类栖息地保护区，开展澜沧江支流保护生态补偿机制研究。

而上述鱼类学专家告诉科技日报记者：“如果这些措施能严格执行的话，在一定程度上会减少建设对鱼类生态环境的影响——这是最理想的情况，但仍不能完全消除影响。”

据该专家了解，在其他一些电站也有类似措施，但有的执行几年后就不再执行；有的虽然年年进行增殖放流，但放流的并非根据野生亲本捕捞和驯养的鱼苗，种类也难以齐全，还有的放流的是常见鱼种……因此加大对运营者的有效监管，成为各地、各级环保部门的一项重要工作。

“在监管全流程中，应有水生生物专家介入，进行鱼类种苗的培养鉴别，提供最优化的建议，将建设与开发对生态环境的影响降低到最小程度。”该专家说：“从长远来看，这些生态补偿措施的效果还有待观察。”

（来源：科技日报 2017-11-27）

## 南水北调通水 3 年受益人数逾 1 亿

12月12日科技日报记者从国务院南水北调办获悉，南水北调东、中线一期工程全面通水3年来，工程安全平稳运行，输水水质全线达标，东、中线受益人口超过1亿人，工程基础性、战略性地位与作用日益显现。



截至2017年12月12日，中线工程不间断通水，安全供水1096天，累计调入干渠114亿立方米，累计分水量108亿立方米。中线一期工程通水，使得沿线受水区北京、天津、石家庄、郑州等18座大中城市的供水保障能力得到有效改善，惠及北京、天津、河北、河南4省市达5320万人。

国务院南水北调办综合司司长、新闻发言人耿六成介绍，东线一期工程建成以来，累计向山东调水21亿立方米，山东省受益人口超过4000万人，极大缓解了胶东半岛等地水资源短缺状况；完善了江苏省原有江水北调工程体系，增强了受水区的供水保障能力，提高了扬州、淮安、徐州等7市50个区县共计4500多万亩农田的灌溉保证率。

南水北调成败在水质。耿六成表示，东线一期工程在加强工程建设的同时，大力加强水污染治理和生态环境建设。经过江苏、山东两省地方政府十几年不懈努力，在水利、环保、城建、交通等多部门的协同配合下，提前实现了输水干线水质全部达标的庄严承诺，并稳定达到了地表水Ⅲ类标准，沿线生态环境显著改善。中线水源区及沿线地区采取强有力的治污环保措施，中线一期工程通水之后，水质保持稳定。特别是丹江口水库，水质一直保持在Ⅱ类及以上。

（来源：科技日报 2017-12-13）

## 水处理新技术助力节水环保

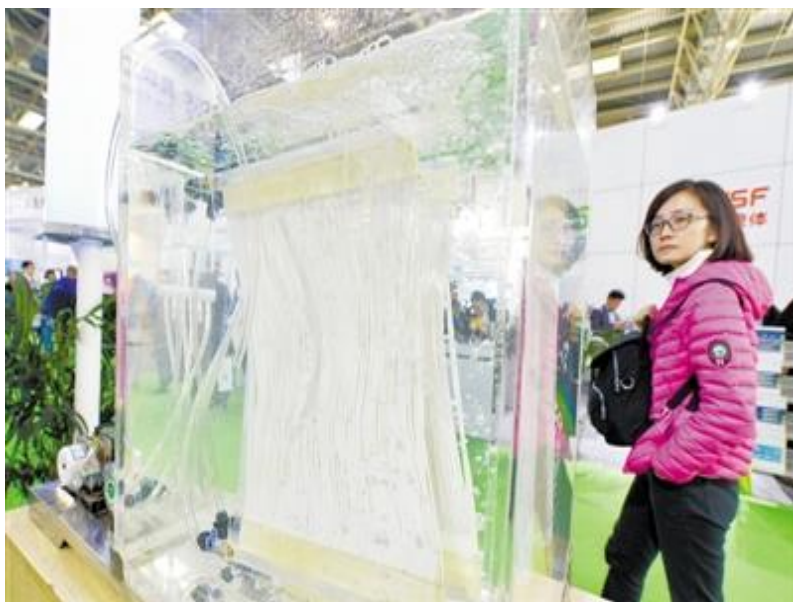


图 参展商展示的污水处理站过滤膜

10月14日，科技日报记者在2017第八届中国国际水技术展览会暨膜与水处理技术及装备展览会上看到，展览设有“污水处理区”“净水区”“膜区”“泵管阀区”“空气新风专区”五大主题展区，展览集中展示了膜与膜组件、过滤设备、污

水及污泥处理设备、水处理药剂、臭氧杀菌等方面的最新技术和产品，助力城市节水环保。

(来源：科技日报 2017-10-16)

## 长荡湖转型再次走在全国湖泊可持续发展前列

金坛长荡湖拆除所有网围，结束34年网围养殖“湖史”后，“长荡湖转型”取得新进展。中国水产科学院淡水渔业研究中心、江苏省长荡湖旅游度假区管委会、长荡湖管委会管理处26日签署合作协议，共同推进该湖从生产功能向生态功能转型。

据长荡湖旅游度假区管委会副主任、长荡湖湖管会管理处主任周建立介绍，上世纪80年代之前，长荡湖渔民一直以捕捞为生，渔业生产主要以自然增殖和人工放流为主。其后，长荡湖率先开展和研制了网围养鱼技术，全国第一块网围养殖就诞生在此，填补了国内网围养殖的空白，致富了一方百姓，为全省乃至全国湖泊渔业发展作出了示范。但一度时期，长荡湖网围养殖规模发展到6.8万亩，严重影响了长荡湖生态环境的承载力和渔业的可持续发展。

以网围养殖为主的湖泊渔业发展方式转变势在必行，金坛区分多轮进行网围整治，至本月12日彻底拆除所有网围，养殖、捕捞渔民全部离水上岸、转产转业，同时规划建设了长荡湖湿地公园、长荡湖国家级水产种质资源保护区。目前，包括退田还湖、生态清淤等系列“救湖工程”正有序实施，长荡湖生态环境和生物多样性得到了明显恢复。

此次三方合作，中水院淡水渔业研究中心在已对长荡湖水生生物资源摸底调查的基础上，将为长荡湖提供5方面科技合作服务：参与长荡湖资源养护战略研究和相关规划制定工作，提高长荡湖渔业资源养护和管理水平；协助推动长荡湖渔业资源环境公报的发布，持续开展长荡湖渔业资源环境监测工作，为长荡湖科学实施渔业资源增殖放流和捕捞提供依据；支持推进长荡湖生态修复工程，开展生态浮床、人工鱼巢、净水渔业和水生植被恢复等科研工作，促进长荡湖生态环境良性发展；支持推进或共建长荡湖国家级水产种质资源保护区保种试验区、长荡湖土著渔业生物种质资源库、长荡湖水产良种繁育基地等各类产学研联合体，促进长荡湖渔业种质资源可持续利用；对长荡湖资源保护及渔业管理人员进行针对性教育和培训，提高从业人员的湖泊管理水平和学历层次。

据该中心主任徐跑称，三方合作意味着长荡湖从生产功能转向生态功能，此举再次走在了全国湖泊转型可持续发展的前列。

(来源：<http://www.changzhou.gov.cn/> 2017-12-28)

## 守护中华水塔青海主打绿色牌

在平均海拔高达4200米的青藏高原上，冰川、雪山融化的雪水从山崖上飞溅而下，汇集成小溪流入大河，或蜿蜒流过草地，进入湖泊和沼泽……这里就是青海的三江源地区。

作为“中华水塔”，三江源对保障国家生态安全具有不可替代的战略地位。但是，“随着全球气候变暖，加上乱采金矿、过度放牧等人为不合理行为的共同作用，三江源出现了冰川、雪山融化萎缩，江河、湖泊和湿地逐渐缩小等现象，荒漠化和草地退化问题日益突出，中华水塔面临严重的生态之忧。”在第二届“寻找中国好水”环保考察行动中，青海省环境保护厅副厅长齐铭告诉科技日报记者。

长江总水量的25%、黄河总水量的49%、澜沧江总水量的15%都来自三江源地区，这里每年有600多亿立方米的优质清洁水输出；三江源保护区是我国面积最大的自然保护区，也是我国生态系统最丰富、最敏感和最脆弱的地区之一，现存生态系统价值约14万亿元。

党中央、国务院高度重视三江源的生态环境保护和建设，2005年审议批准《青海三江源自然保护区生态保护和建设总体规划》，一期工程2005年至2013年实施。为将生态保护和建设深入开展下去，2013年，《青海三江源生态保护和建设二期工程规划》审议通过，治理范围从一期的15.23万平方公里扩大至39.5万平方公里。

齐铭说，目前三江源区域生态环境总体表现出“初步遏制，局部好转”的态势。

据一期工程监测和评估结果表明，三江源林草植被覆盖度增长地区的面积达79.18%，长江、黄河流域平均年径流量分别增加39.2、36.9亿立方米，生物多样性明显恢复，农牧民纯收入年均增长10%左右。

白扎林场位于澜沧江上游，三江源国家级自然保护区的核心区。囊谦县环保林业局局长西尕说，县里统筹考虑生态环保、群众生产生活和地区经济发展，实施了以野生动植物保护、中央生态效益林补偿基金等为主的生态环保项目。

为算好“绿色账”，走好“绿色路”，打好“绿色牌”，2017年8月1日，我国首部国家公园条例——《三江源国家公园条例(试行)》开始施行。该条例对发生重大生态环境破坏、重大环境污染事件的地区和单位责任人，“一票否决”。

环保部华南环境科学研究所副所长刘晓文研究员说，在三江源开展国家公园体制试点，对实现三江源的重要自然资源国家所有、全民共享、世代传承，促进自然资源的持久保育和永续利用，具有十分重要的意义。

目前，三江源地区的环境科技水平也在不断提升。玉树州环保局局长多加说，先后实施的玉树州环境监测、监察、信息达标建设工程，环境应急能力建设与恢复工程、专项环境监测能力建设与恢复工程和生态监测体系建设与恢复工程等环保能力建设项目，给国家和省、州在生态环保方面的科学决策提供了强有力的科学数据保障。



## 保护洱海就一定要驱赶红嘴鸥?

近日曝出云南大理“驱赶洱海沿岸红嘴鸥、禁止游客投食”事件,大理市洱海保护管理局通过“@大理在线”官方微博表示,在洱海人工喂食红嘴鸥存在三个方面的问题:潜在增加洱海污染负荷、改变野生动物自然习性将不利于野生动物的种群生存和繁衍、大量红嘴鸥与人群密切接触存在传播疾病的潜在危害。

### 官方:红嘴鸥对公共卫生安全有威胁

大理市洱海保护管理局表示,大理洱海与昆明大量红嘴鸥所栖息的滇池不同,洱海水一直是大理市民饮用水源,红嘴鸥每年冬天到大理越冬,会吸引较多游人观赏。如果红嘴鸥携带致病或条件致病性微生物,那粪便就可通过水源污染,或者通过密切接触而导致人群的感染,引起公共卫生问题。以往因为来大理越冬的野鸟数量不多,相关检测、监测工作基本没有开展过,对于公共卫生安全有较大威胁。

### 专家:暂未监测到红嘴鸥传染疾病的数据

随后,科技日报记者采访了长期关注红嘴鸥迁徙与保护的昆明鸟类协会秘书长赵雪冰。他认为,客观地说,野生鸟类都存在携带病原体的风险,但根据他们多年来不间断的监测与观察,目前还没有接到相关的报告。以今年为例,云南昆明聚集了3万—4万只红嘴鸥,但没有数据和事例证明,红嘴鸥与禽流感或相关传染性疾病有关联。

此前,云南省卫计委12月2日发布通告称,云南11月30日确诊1例H7N9病例。“禽流感”再次成为热词。据了解,就在11月30日当天,昆明市林业局、云南农业大学、昆明鸟类协会等多家单位联合开展了红嘴鸥疫源疫病监测工作,对红嘴鸥进行了抽样“体检”。工作人员主要对红嘴鸥进行抽血化验,以及粪便采集、唾液采集等系列疫源疫病监测,一方面是为了监测红嘴鸥自身是否健康,另一方面也监控是否携带对人类有害的病毒。

### 公众:保护洱海和爱护红嘴鸥并不矛盾

昆明是红嘴鸥越冬最为集中的地方,大理的种群数量要少得多。从历年对红嘴鸥的监测来看,没有关于环境污染和公共卫生安全方面的评估——因为从红嘴鸥种群数量、所携带病原体的情况来看,做这样评估的意义不大,完全达不到所谓“对公共卫生安全有较大威胁”的级别,这点必须予以澄清。一旦监测到相关疫情,相关部门和各级政府会第一时间做出预警。

红嘴鸥到云南已有三十多年了,事实证明,人工投放鸥粮是对自然食物的必要补充。近年来通过政府和相关协会的引导,现在大家都投放专门的鸥粮,海鸥吃饱了就飞走了;海鸥飞走了,人们当然也就不再投放——鸥粮投放本身不会对湖水造

成明显的污染。但“保护”与“爱护”不应该成为矛盾体，而是应该能从彼此之间找到平衡点。

(来源：科技日报 2017-12-22)

## 湿地好生态候鸟如约归

据进入冬季，大批候鸟陆续飞抵江苏中部的盱眙县境内。近年来，盱眙县加大环境治理和生态功能修复力度，使得辖区内的猫耳湖、龙庙湖、七里湖等湿地成为天鹅、大雁、赤麻鸭等众多鸟类迁徙中转站和栖息地，每年到此越冬的候鸟种类和数量逐年增多。



图 一群天鹅在江苏省盱眙县猫耳湖休憩、飞翔

(来源：<http://news.xinhuanet.com> 2017-12-05)

## 巴西召开国际会议研讨城市水资源管理

随着城市化进程加速，全球将面临水资源供需平衡、饮用水安全与水卫生、极端气候条件下的水灾害等相关问题的严峻挑战。绿色、低碳、人水和谐的城市水资源可持续管理已成当务之急。11月17日，为期三天的城市水务发展国际研讨会在巴西圣保罗市召开，会议主题为“提高用水效率，治理水体污染，确保用水安全”，集中展示行业发展成果，探讨城市水务发展趋势。

研讨会邀请来自巴西国内水行业的管理人员、专家学者，以及来自美国、葡萄牙、阿根廷等国的专业技术人员，就应对气候变化的城市水资源一体化管理、“海绵城市”建设与创新、城市水资源开发利用等议题展开讨论。与会嘉宾和专家充分

交流, 分享“海绵城市”建设、城市生活污水处理技术、污水处置技术等方面的解决方案。

来自巴西环境部的特纳德里奥在接受科技日报记者采访时称, 城市化进程加快带来城市水规划缺失, 城市水安全与水环境问题日益严峻, 导致“逢雨必涝”、黑臭水体、水资源严重不足、饮用水安全等严重问题。事实上, 水安全风险、水生态破坏、水资源短缺、水环境污染是相互关联、相互影响的, 决不能分而治之, 都应纳入到“海绵城市”建设中去, 要把“海绵城市”的建设看成一个系统工程来推动。

特纳德里奥表示, “海绵城市”应该像海绵一样, 在适应环境变化和应对自然灾害等方面, 具有良好的弹性。目前应重点解决好城市涝灾与城市水环境恶化等问题, 要充分利用城市水体的生态净化功能, 再加上“海绵城市”设施对雨水的收集与利用, 实现地表水资源、污水资源、生态用水、自然降水、地下水等统筹管理、保护及利用, 确保城市水循环能够与自然水循环相互贯通, 减轻城市“逢雨必涝”等水安全问题。

“流得太快、排得太慢、存得太少, 这是造成城市内涝的主要原因。”圣保罗市城市规划司工程师佩德罗在研讨会上指出。他表示, 雨水综合利用系统用途广泛, 可用于土地入渗、场地喷灌、景观补水、洗车、绿化、卫生间冲厕、道路冲洗等。雨水资源化利用, 对于缓解城市用水压力、避免城市内涝灾害、促进城市可持续发展, 具有重要的现实意义。

“在城市水资源匮乏的情况下, 建设项目更需要考虑天然雨水的储蓄利用, 如收集建筑物楼顶雨水, 将其汇集到雨水收集池, 可作绿化、生活、生产用水等, 不仅有利于区域的生态维护, 也有利于缓解城市的雨洪压力。”佩德罗强调说。

(来源: 科技日报 2017-11-21)

## 北冰洋地区禁渔至少 16 年

近日, 据《科学》杂志官网 2 日报道, 欧盟与 9 个国家已达成协议——至少在未来 16 年内, 北极中部海域 (CAO) 禁止向商业渔船开放。这项协议将确保科学家能抢在渔业泛滥之前, 有足够时间了解该地区的海洋生态以及气候变化带来的潜在影响。

目前北极中部海域 40% 的水域已开放。根据国际法, 在公海捕鱼不违法, 也不受管制。上世纪 80 年代后期, 来自各国的商业渔船从白令海峡国际公共水域打捞走了数百万吨狭鳕鱼, 到上世纪 90 年代初, 这一物种的生态仍没得到修复。一些研究人员、环境团体和政策制定者认为, 这可能会损害脆弱而迅速变化的海洋生态系统。从 2012 年起, 约有 2000 名科学家呼吁, 不要让同样的悲剧在北极中部海域发生。

2015 年, 加拿大、丹麦、挪威、俄罗斯和美国等北极海岸线国家才明令禁止本

国渔船到此渔猎，但北极仍然处于对全球捕捞船队开放的状态。随后，来自日本、中国、韩国、冰岛以及欧盟的代表团也加入讨论，并进行了新的协议谈判。

美国代表大卫·保尔顿从 2015 年开始主持谈判，他说：“各代表团终于达成一致。禁渔协议每 5 年自动更新一次，至少会持续 16 年。除非协议国提出反对，或者可以有效执行科学的渔业配额规定。”

除了关闭捕捞区外，各代表团还同意实施一个科学研究和监测联合计划，以确定物种、丰度、现有捕食者与被捕食者之间的关系，以及它们面临的气候变化压力等。加拿大渔业和海洋部前副部长皮特·哈里森主张建立一个新型跨国科学组织，以决定科学考察的优先次序，分享和分析收集的数据，就北极中部海域鱼类状况提出建议。

（来源：科技日报 2017-12-05）

## 怒江流域和缅北发现多个淡水鱼新种

中国科学院昆明动物研究所日前对外发布消息称，该所东南亚野生动物多样性学科组在我国西南的怒江流域以及缅甸北部的伊洛瓦底江流域发现多个淡水鱼新种。

云南省保山市高黎贡山是我国西南地区生物多样性热点地区，研究人员最初于 2003 年至 2006 年在高黎贡山怒江水系的两条溪流里采集到一种鳊属鱼类新种，其后分别于 2007 年和 2015 年在云南省临沧市沧源县和永德县萨尔温江水系的两条支流里也采集到了标本。新种高黎贡鳊是鳊属的第 10 个物种，形态上与分布于缅甸北部伊洛瓦底江水系的长须鳊最为接近，但在腹鳍伸达肛门或不达、颌须后伸仅达或略超过胸鳍起点、躯椎数量等方面与之相区别。

此外，作为中国科学院东南亚生物多样性研究中心常驻核心团队之一，中国科学院昆明动物研究所东南亚野生动物多样性研究组与缅甸林业研究所合作，对缅甸水生生物多样性进行了多次野外考察，积累了一定数量的标本数据。

团队整理了 2014 年—2016 年在缅甸北部采集的鱼类标本，经过系统的形态学比对，认为盈江结鱼、桥街结鱼、桥街墨头鱼、双角墨头鱼和少鳞裂腹鱼 5 种鱼类为缅甸新纪录种，这 5 种鱼类的模式产地均分布于伊洛瓦底江上游的我国云南省境内。

上述两项研究成果论文发表于学术期刊《动物学研究》38 卷第 5 期上。

（来源：科技日报 2017-11-30）