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中文题名	河湖水生态系统多维评价研究
英文题名	Multidimensional assessment of freshwater ecosystem based on biogeochemical simulation
中文关键词	水生态系统,耦合模型,多维评价,鄱阳湖,三峡水库
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中文文摘	水生态系统是自然生态系统的重要组成部分，受人类活动和气候变化等影响，多呈现生境破碎化、生物多样性受损、生态功能退化等特征。开展全面有效的水生态系统评价，对水生态系统演变分析及管理至关重要。现有的水生态系统评价，多采用健康与完整性评价，涉及物理、化学、生物元素的完整性等，着重于水生态系统元素的静态特征；但缺乏水生态系统元素之间的联系（如网络特征）、元素的动态变化（如稳定性和瞬变征兆）等分析，可能导致评价结果的片面性、以及对水生态系统的系统性和动态性问题的遗漏。同时，受原位监测点位和监测频次等影响，数据获取通常是限制水生态系统评价的重要因素；开展水生态系统模拟，可完善和扩展水生态数据集，但现有模型大多缺乏水沙与水生态的相互耦合，难以提供复杂水沙条件下的完整水生态数据。本文从水沙与水生态耦合的系统模拟出发，突出水沙输移与河床演变对水生态元素的影响，提高复杂水沙条件下的水生态系统模拟效果，为水生态系统评价提供高密度和高精度的数据支持。在此基础上，构建多维度水生态系统评价体系，涵盖水生态系统健康与完整性评价、网络评价、以及稳定性和瞬变评价，实现对大时空尺度的水生态系统元素、元素之间联系、元素动态特征的多维度分析，以弥补现有水生态系统评价方法的局限。上述耦合模型及多维度评价体系，被应用到典型湖泊、水库生态系统的评价实践中，分析人类活动与气候变化影响下鄱阳湖、三峡水库的水生态系统演变规律。结果表明，在人类活动与气候变化影响下，鄱阳湖水体生态系统遭到破坏，鄱阳湖水利枢纽工程能够缓解这种影响，主要体现在提升秋冬季的湖容从而为水生生物提供更多的栖息地，但会带来新的潜在风险，如鱼类的洄游受阻以及秋冬季湖泊的高氮磷浓度。三峡水库建成后形成了独特的河流型水库生态系统，其过渡带处于相对脆弱的状态，需要合适的捕鱼控制政策以缓解这种脆弱性，对于不同的区域采用不同的管理办法。构建的水沙与水生态耦合的系统模型及多维度水生态系统评价体系，能够较好地分析评价鄱阳湖和三峡水库等水生态系统在气候变化和人类扰动下的演变规律，为水生态系统管理和修复提供新的分析视角。
外文文摘	Aquatic ecosystems are an important part of natural ecosystems, which are affected by human activities and climate change, and often show the characteristics of habitat fragmentation, biodiversity damage, and ecological function degradation. Comprehensive and effective aquatic ecosystem assessment is essential for aquatic ecosystem evolution analysis and management. The existing aquatic ecosystem assessment mostly adopts health and integrity assessment, involving the integrity of physical, chemical and biological elements, focusing on the static characteristics of aquatic ecosystem elements; However, the lack of analysis of the connections between aquatic ecosystem elements (such as network characteristics) and the dynamic changes of elements (such as stability and early warning signals of regime shifts) may lead to one-sided evaluation results and omission of systemic and dynamic problems in aquatic ecosystems. At the same time, due to the influence of in-situ monitoring points and monitoring frequency, data acquisition is usually an important factor limiting the evaluation of aquatic ecosystems. Aquatic ecosystem modelling can improve and expand the aquatic ecosystem dataset, but most of the existing models lack the coupling of water, sediment and aquatic ecosystem, and it is difficult to provide comprehensive aquatic ecosystem data under complex water and sediment conditions.Starting from the systemic modelling of the coupling of water, sediment and aquatic ecosystem, this

	paper highlights the influence of water and sediment transport and riverbed evolution on aquatic ecosystem elements, improves the simulation effect of aquatic ecosystem under complex water and sediment conditions, and provides high-density and high-precision data support for aquatic ecosystem assessment. On this basis, a multi-dimensional aquatic ecosystem assessment system is constructed, covering aquatic ecosystem health and integrity assessment, network assessment and stability and regime shift assessment, and realizes multi-dimensional analysis of aquatic ecosystem elements, the connections between elements, and the dynamic characteristics of elements at large temporal and spatial scales, so as to make up for the limitations of existing aquatic ecosystem assessment methods.The above coupled model and multi-dimensional assessment system are applied to the assessment practice of typical lake and reservoir ecosystems, and the evolutions of aquatic ecosystems in Poyang Lake and Three Gorges Reservoir under the influence of human activities are analyzed. The results show that the Poyang Lake water conservancy project can mitigate the destruction of the aquatic ecosystem of Poyang Lake under the influence of human activities, mainly in the form of improving the lake water level in autumn and winter to provide more habitat for aquatic life, but bringing new potential risks, such as hindered fish migration and high nitrogen and phosphorus concentrations in autumn and winter. After the construction of the Three Gorges Reservoir, a unique riverine reservoir ecosystem has been formed, and its transition zone is in a relatively fragile state, which requires appropriate fisheries control policies to alleviate this vulnerability, and different management methods are applied for different regions. The systemic model coupling of water, sediment and aquatic ecosystem and the multi-dimensional aquatic ecosystem assessment system can better analyze and assess the evolution of aquatic ecosystems such as Poyang Lake and Three Gorges Reservoir under climate change and human disturbance, and provide a new analytical perspective for aquatic ecosystem management and restoration.
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