

論文 / 著書情報
Article / Book Information

題目(和文)	トンレサップ湖洪水氾濫原の生態系サービスと水文学的变化へのその 応答
Title(English)	Ecosystem Services of Tonle Sap Lake-Floodplain and Their Responses to Hydrological Change
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論文要旨

THESIS SUMMARY

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

The tropical river-lake floodplain system is one of the most diverse and significant ecosystems for wildlife and humans. Such a system is fundamentally characterized by the flood pulse, principally affecting the biota (e.g., aquatic life and flooded plants) and humans through its hydrological process. However, our understanding of the ecosystem services (ES) of tropical floodplain systems concerning the economic value, social importance, and perception of local communities of ES remains scarce and fragmented. Further, due to the recent hydrological change, it is required to identify suitable ecohydrological conditions to maintain the provisional service of the floodplain (e.g., fish production). Therefore, this study aimed to comprehensively elucidate the ES of a floodplain and its response to changing hydrological regimes in a large tropical lake-floodplain system, with Tonle Sap Lake (TSL) in Cambodia as an internationally important ecosystem (Chapters 1 and 2).

In Chapter 3, the empirical model of fish biomass was developed to investigate the response of migratory fishes to shifting hydrological regimes. The model is based on the integration of life cycle and seasonal habitat conditions, employing the biomass of 74 migratory fishes in the floodplain of the Lower Mekong Basin, including TSL during the hydrological years 2000 – 2015. Then, generalized linear, generalized additive, and random forest models were applied to the collected data with and without life cycle information. As a result, the models and their performance indicate that the integration of the life cycle and seasonal habitat conditions in modeling biomass is significantly important for migratory fishes. The results further showed that changing ecohydrological indices in the feeding and refuge seasons negatively affected fish biomass. Those indices were hydrological factors (i.e., maximum water level, mean water level, the start date of the flood, and the end date of the flood), and climate factors (water temperature). Interestingly, the models indicated that the total area of inundated forests negatively influences the biomass of planktivorous fishes while it positively affects the biomass of piscivores. These results clearly showed the importance of the natural flow regime to ensure the fish life cycle and biomass production in the Lower Mekong Basin. The findings of this study enhance our understanding of the effects of shifting ecohydrological conditions on the fish life cycle and biomass production, which are critically important for fish conservation and management.

In Chapter 4, the ES of TSL was evaluated by an intensive site investigation and detailed analysis of ninety-seven surveyed households, randomly selected from 22 villages in nine communes. The study further adopted the local market value approach for provisioning services, the double-bounded dichotomous choice for cultural services on willingness to pay, and structural equation modeling for

regulating services and supporting services. Consequently, provisioning service was estimated to be US\$655/person/year on average. The majority of cultural service was ecotourism, followed by social relations, religious, aesthetic, cultural heritage, and inspirational services. The estimates of the willingness to pay for these services were heavily influenced by the community characteristics, namely distance, sex, household size, and age. The regulating service comprised air temperature regulation, water purification, storm regulation, flood control, and carbon fixation, whereas the supporting service included fish spawning grounds and waterbird habitats. This study for the first time elucidated the importance of the four main ES categories of the flooded forests of the tropical floodplain system to the local communities. However, those services have been deteriorated by the ecohydrological change and anthropogenic activities. The applied and developed approaches provide scientific-based evidence for policymakers to incorporate ES in the conservation and management of flooded forests of tropical floodplains.

In Chapter 5, the fish biomass model was applied to define the conditions for sustaining the ES of TSL identified in Chapter 4 and other services of the Lower Mekong Basin floodplain system. This model application utilized the fish biomass determinants, namely, the maximum water level, total area of inundated forests, and water temperature in the MR refuges of the previous hydrological year. By fixing the water temperature in the MR refuges (i.e., using its average during the study period, 26.6°C), the sustainable conditions for the fish biomass were identified as the maximum water level of approximately 9.5 m or higher at Kampong Luong station, while the total area of inundated forests should be around 550,000 hectares in TSL. The relatively high maximum water level (≥ 9.5 m) propels a large reverse flow into the TSL ≥ 48.7 km³, which was the average flow during the pre-dam period in 1962 – 1972. This reverse flow to the lake is fundamental to maintaining the functions and services of the floodplain.

In conclusion (Chapter 6), the tropical floodplains provide important services to support human and wildlife ecosystems. However, those services have been gradually degraded due to shifting ecohydrological regimes, in particular the changes in the maximum water levels and total area of inundated forests. The findings suggest that a natural flow regime is fundamental for maintaining the ES of the floodplain, specifically fish production. The presented approach can be applied to evaluate the ES in other tropical lake-floodplain systems, in particular, to model those ES in spatially connected and changing environments.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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