論文 / 著書情報
Article / Book Information

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著者(和文)	梁政寛
Author(English)	Masahiro Ryo
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論 文 要 旨

THESIS SUMMARY

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学生氏名： Student's Name	梁　政寛	指導教員（主）： Academic Advisor(main)	Oliver C. Saavedra V.
		指導教員（副）： Academic Advisor(sub)	吉村千洋

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

River environmental conditions have been seriously degraded by multiple human impacts, and therefore development of feasible countermeasures are required for sustaining river healthiness. This study aimed to propose a feasible approach for conservation of fish in rivers, based on a spatio-temporally distributed modeling of various streamflow characteristics in the context of flow regime. Flow regime represents comprehensive facets of flow variability including flood and drought as well as normal condition in terms of the magnitude, timing, duration, frequency, and flashiness.

First of all, existing environmental issues related with this study were discussed. Freshwater biodiversity has been considerably threatened by alteration of flow regimes as well as that of land covers and water quality. To measure the entire ecological healthiness, fish fauna can a good indicator; although little is known about how such environmental factors interactively influences on the population dynamics of fish in rivers (Chapter 1).

To organize existing findings of empirical relationships between flow regimes and fish fauna, literature review was conducted with a special attention to the periodical responses of fish fauna to streamflow variability such as seasonal cycle. This study defines this intra-annual periodicity as rhythm. Fish behaviors are stimulated by predictable streamflow events such as high flow pulses. It was found that the fish species richness of a river can be partially dependent on degree of decadal stability of flow regime. Regarding the flow-fish relationships, there still remains a strong need to analyze population dynamics following temporal sequence of hydrologic conditions because few study examined (Chapter 2).

The following studies (Chapter 3–5) were conducted in the Sagami River in Japan.

Flow regime is intricately altered by multiple water control facilities in the lowland section of the target area. A distributed hydrological model was applied to simulate 20-year daily streamflow (1990–2009) along the river network and to calculate a set of hydrologic indices which represent various aspects of the flow regime. The model was tuned using Nash-Sutcliffe model efficiency coefficient as the first priority, allowing the magnitude and timing of high flows to be effectively simulated (Chapter 3).

The distributed hydrological model was then used to assess spatial patterns of altered flow regime in the area. Estimation of the spatial patterns readily identified locations where streamflow aspects have been strongly altered. For example, median flow volume in August was decreased by 70% on the mainstream due to severe water withdrawal, and the occurrence of high flow pulses was decreased by 70% on the Nakatsu tributary due to peak cut operation of the Miyagase dam. It was demonstrated that the strongest alterations in different hydrological aspects did not occur at the same location. It implies that the evaluation only at discharge gauges is insufficient to capture alteration in the flow characteristics over the river network. In addition, it was found that the streamflow on the Nakatsu tributary partly mitigated the degree of alteration of flow regimes on the mainstream of Sagami River, by interfering each other at the confluence point (Chapter 4).

After confirming the accuracy and applicability of the hydrological model to simulate hydrological condition of the river, fish population variability was spatio-temporally analyzed for existing freshwater species. Random Forest was applied to detect key environmental factors influencing the population variability. Simulated hydrologic indices were used as predictor variables as well as geo-topological features at landscape- and local-scales, water quality, and sampling effort. As a result, 30 out of 42 species were modeled, having positive pseudo-R^2. Hydrologic indices not only in sampling year but also in the previous year were selected as important predictor variables, especially for swimming and land-rocked fish species in comparison to benthic and diadromous fish species. The median flow in August and maximum flow (August–October) in a previous year were commonly selected, indicating that population variability can be influenced by flow conditions during specific period of many fish species. In addition, some species which are listed as near-threatened species in the Kanagawa-prefecture Red Data Book, such as *Tribolodon hakonensis* and *Rhynchocypris logowskii steindachneri*, were successfully modeled (pseudo-$R^2 > 0.5$) with highlighting important environmental variables (Chapter 5).

Overall, this study confirmed high applicability of the combination of a physically-based hydrological model and an empirically-based machine-learning model for detection of key hydrologic aspects in order to sustain healthy fish community in a river.

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).