The direction of river environment research

1. Outline of Studies and Activities

	研究の背景・経緯・概要	
出来事・社会の変化	○1993年 ・環境基本法 ○1997年 ・河川法改正（河川環境の整備と保全） ・環境影響評価法 ○2002年 ・自然再生推進法 ○2004年 ・景観法	○2007年 ・IPCC第4次評価報告書 ○2010年 ・COP10（生物多様性条約第10回締約国会議） ○2011年 ・環境影響評価法改正
国土交通省の動き	○1994年 ・環境政策大綱（環境政策の理念、推進方策、推進体制） ○2002年 ・自然再生事業の創設 ○2003年 ・美しい国土づくり政策大綱 ・審議会答申（美しい国土づくり） ① 河川等を活かした地域づくり等への支援 ② 自然再生への取組み ③ 水環境の改善を通じた川らしさの確保 ④ 環境学習等への支援 ⑤ 適正な河川利用の支援 ○2005年 ・かわまちづくりの推進 ・多自然川づくりアドバイザー制度	○2016年 ・審議会提言（多自然川づくりへの展開） ① 既往知見のとりまとめ、技術的支援の実施 ② 評価体制の構築、実施体制の見直し ③ 市民参画、普及、人材育成 ④ モニタリングと目標設定 ・審議会提言（安全・安心が持続可能な河川管理） ① 河川環境管理のための目標 ② 管理基準の設定 ○2013年 ・河川協力団体制度
	2001年～2006年頃	2007年頃～2013年
自然環境に係る取組み	ダムの環境アセスメント手法に関する研究 河川環境の予測評価技術、モニタリングに関する研究	多自然川づくり、保全・再生 流砂・河床環境の変動特性に関する研究 汽水域の保全と再生に関する研究 河川植生の管理に関する研究 水温・流況が河川環境に与える影響に関する研究 主な研究成果 ダムと下流河川の物理環境との関係についての捉え方 魚類及び底生動物の水温・水質への依存性評価
社会環境に係る取組み	ダム貯水池の水質に関する研究 都市の再生・川まちづくりに関する研究 自然共生型流域圏に関する研究（東京湾・霞ヶ浦）	自然共生型流域圏に関する研究（伊勢湾） 流域環境と河川特性が河川水質に与える影響に関する研究 主な研究成果 伊勢湾流域圏の自然共生型環境管理技術開発
河川環境関連情報の集積と配信	環境教育に関する研究	市民連携に向けた河川環境情報共有手法に関する調査 河川環境データサービス及びナレッジデータベース 主な研究成果 市民との連携・協働を促進する河川環境情報共有システムの提案

[Up to about 2006: Progress toward ecological and environmental conservation for riverine environments]

In response to the growing social awareness of environmental issues, the Basic Environment Law was enacted in 1993, and in 1994, the Ministry of Construction formulated the Outline of Environmental Policy based on the principles of "creation and inheritance of a beautiful environment that is comfortable and pleasant" and "conservation of a healthy and bountiful environment," etc. In 1997, "development and conservation of river environments" was added to the objectives of the River Law. In the midst of the change from pollution control measures to an era of environmental conservation, there has been a continuous search for ways to preserve the river environment and how to assess the environmental impact of dams and other projects.

The research themes included studies on the environment of dams, such as "environmental assessment methods for dams" and "water quality of dam reservoirs," studies on environmental assessment technology, such as "forecasting assessment technology and monitoring of river environments," studies on living circumstances, such as "urban landscapes and waterfront use," and research on the measurement of educational, welfare, and medical effects of riverside waterfront areas.

While the concept of "symbiosis between nature and humans" has been spreading socially, we have also improved the technologies for observation, diagnosis, and assessment of urban environmental conditions and watershed ecosystems to create nature-symbiosis-oriented cities, and developed watershed area management models for Tokyo Bay and Kasumigaura basin.

[Up to 2013: Expansion of spatiotemporal perspective and progress toward viewing rivers in landscape important for activating ecosystems]

In 2006, the River Subcommittee of the Council for Social Infrastructure Development recommended the "compilation of existing knowledge and implementation of technical support," "establishment of an evaluation system and review of the implementation system," "citizen participation, dissemination, and human resource development," and "monitoring and target setting" as a transformation from "nature-figured river works" to "nature-oriented river works." The report also suggested "establishment of a system to ensure that safety and security are sustainable." In addition, "goals for river environment management" and "establishment of management standards" were proposed.

During this period, we shifted our research focus on nature-oriented river works, which had been targeted at the local work-site level, to a view in the context of entire water connection within watersheds. We conducted research on major themes such as "Sediment dynamics and riverbed transformation," which have a significant impact on river environments along with water flow; "Conservation and restoration of brackish water regions," which continuously link river and marine environments; "Management of riverine vegetation," which is important for waterbodies connected to land areas; and "Impact of water temperature and flow regime on riverine environments" in response to advancing global warming.

As for the watershed area, we aimed to develop a technical system from the viewpoint of environmental management, and developed our research on the Ise Bay watershed area so that ecosystem services can be quantitatively grasped mainly in terms of material circulation aspects.

In addition, for the accumulation and distribution of river environment related information, we worked on research to share information, such as "Research on river environment information sharing methods for citizen collaboration on river themes," and "River environment data service and knowledge database" to release the results of censuses and other surveys of river waterfront areas.

As described above, we decided to take a bird's-eye view of not only the direct impact added to rivers, but also various changes that have occurred in the watersheds over time.

[After 2013]

We have been promoting the river environment research to be inclusive from the work-site level to the watershed level in terms of space, from a long-period trend before the high economic growth to short-term impacts such as floods in terms of time, and also focusing on the interrelationship between flow, sediment, and organisms in terms of ecosystem. As a result, research and technological development has progressed to consider river management and the environment in a more integrated manner, and river environment studies are now encompassed within total river research. Research on “rivers” is conducted by the River Research Laboratory and the Public Works Research Institute (PWRI) as “Nature-Oriented River Works” linked to river channel planning (see “Toward Flood Control Planning in View of Climate Change” in this issue). Research on “reservoirs and lakes” is handled by the Water Cycle Laboratory and PWRI. Currently, the Water Environment Research Officer is in charge of the overall coordination of research on the water environment of rivers and coasts, including liaison with administrative agencies such as the Ministry of Land, Infrastructure, Transport and Tourism and its Regional Development Bureaus, institutions conducting environmental research such as the PWRI, and universities and other academic societies.

2. Main Research Results

◆How to explain the impacts of dams on the physical environment of downstream rivers - Toward understanding the relationship between dams and the biological and ecological systems of downstream rivers[1)]

This report provided a comprehensive and technical overview of the basic approach to examining the impacts of dams on the physical environment of downstream rivers. The contents consist of surveys, analyses, and predictions to understand the relationship between dams and the physical environment and organisms in downstream rivers.

As an example, a method for estimating sediment fluxes from watershed area ratios is shown in Figure-1. This analysis method based on only a plan view of the watershed is easy to use, and provides a first-order approximation by creating a simple map of the sediment dynamics in the water system. It has become the basis for physical environmental impact assessments of the downstream of dams. By collecting, organizing, and analyzing information on a mountainous river channel, for example, dam-induced “changes in the flow regime” and “changes in sediment transport” could classify characteristic features of each river section (See Figure-2) to affect the responses of both the physical environment and the organisms in the water system including the influence of tributary rivers. It is expected that the perspective of the entire water system for diagnosing the current status of the river environment will take shape and take root.

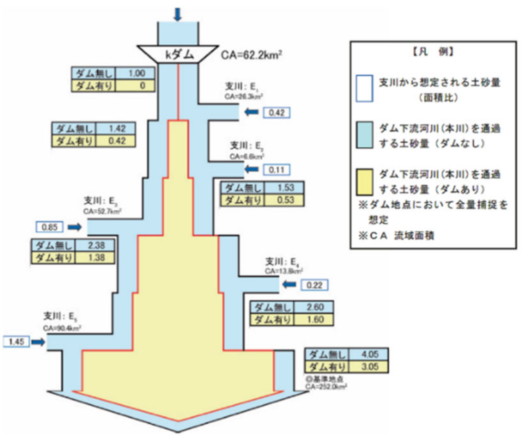

Figure-1 Image of sediment dynamics map

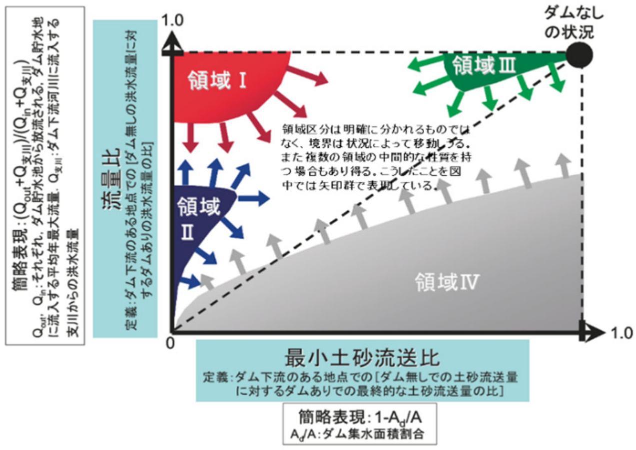

Figure-2: Classification on Dam-Downstream Relationship Map

◆Assessing the dependency of fish and benthic fauna on the water temperature and quality using the National Census

on the River Nature Environment[2]

In order to evaluate the habitable environment for aquatic species under global warming, combining the data on the water quality and the National Census on the River Nature Environment for 109 first-class water systems throughout Japan, we selected five frequently appearing fish species, five benthic animal species, six narrow-temperate cold water fish species, and nine benthic animal species in major orders to compile with the distribution of the water temperature, pH, DO, BOD, COD, and SS at the sites where these species were observed. The distribution of the water temperature and pH was also compared with all monitoring data in Japan to examine the dependency of the individual species. As a result, the water temperature frequency distribution at the points of yamame, which is landlocked salmon considered to be a narrow-temperate cold water species, was unevenly distributed toward lower water temperatures among all the measurement points, indicating that these fish species could live in areas with lower water temperatures (see Figure-3). In a case study of yamame, the average annual maximum water temperature of 26°C was evaluated as their habitatable limit. Other nationwide comparisons with estimated water temperature distributions showed that a 1°C increase of the highest water temperature due to global warming had the possibility of decreasing suitable habitats by 10%.

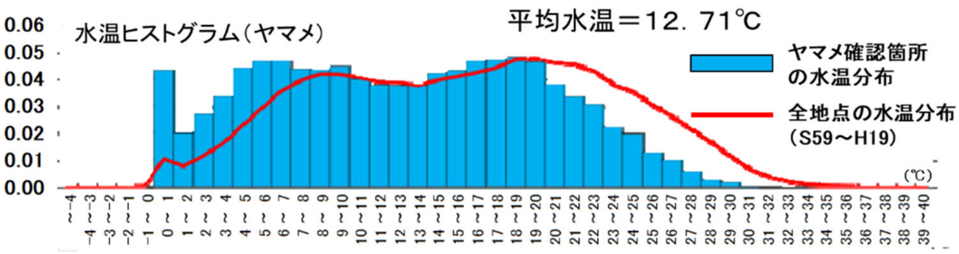

Figure-3 Comparison of water temperature frequency distribution between confirmed yamame and all water quality survey sites

◆Development of environmental management technology for natural symbiosis in the Ise Bay watershed area[3)]

Aiming to develop a technological system that maximizes the function to circulate material of the natural environment, minimizes the impact on the surrounding environment due to human activity spreading in the basin, and creates watersheds to maintain the functionality and sustainability of the ecosystem, we developed an environmental information database for the Ise Bay watershed area. Geographical and spatial information is interlocked in the database by using versatile software such as GIS with natural classification, population, land use, riparian and coastal topography, substantial discharge into water circulation and the sea, river flow, and sediment dynamics, etc.

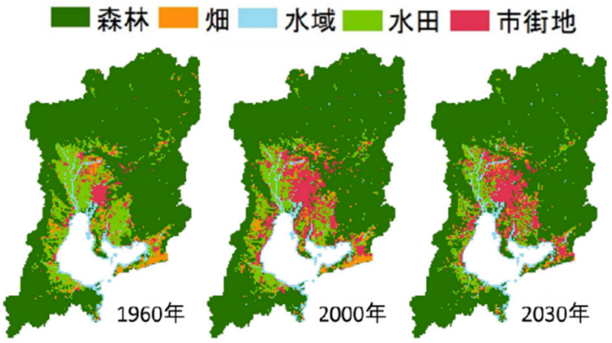

Figure-4 Trends in land use distribution in the Ise Bay watershed area

Through a bird's-eye view analysis interrelating the information of each item, the environmental transition of the watershed was structurally grasped. The period of analysis was based on 50 years from 1950 to 2000 as well as the years up to 2030 (see Figure-4) to examine future conditions. In addition, for the purpose of water quality improvement, we calculated the water cycle and ecosystem services under the following setup scenarios: "α-type, conventional and continuous behavior steered mainly by infrastructure improvement," "β-type, cooperative approach involving enlightened residents through individual voluntary and subsidies," "γ-type, ecosystem enhancement directory improving the ecological functions of the typology landscape," and "a combination of each feasible typology from the perspective of nature coexistence." Through this study, it became possible to comprehensively compare measures of different policies with multiple indicators taking into account ecological services and social feasibility.

◆Proposal for a river environment information sharing system to promote cooperation and collaboration with citizens[4)]

With the aim of proposing effective information provision and sharing methods that promote cooperation and collaboration between river environment administration and citizens, we surveyed the actual status and issues of information sharing. While citizen groups want information on river water quality, organisms, and other data, as well as the direction and implementation status of river environment policies, they also pointed out the lack of information and fewer contact points from river administrators.

As a radical improvement to facilitate information sharing, we considered a Web-based information sharing system and proposed its practical application. The system was positioned as a "river portal site for citizens that provides various information related to the river environment in an easy-to-understand format," and aims to introduce river organisms, water quality and discharge, river administrators, materials to study rivers, websites of citizen groups active in rivers, and search functions using WebGIS and other tools.

Through the study, we compiled "Points for exchanging and sharing information on the river environment with citizens" and "Examples of river environment management in cooperation and collaboration with citizens." These results promoted the activities of the River Cooperation Groups, which were institutionalized in 2017.

(https://www.mlit.go.jp/river/kankyo/rcg/01.html)

3. List of Related Reports and Technical Documents

1) A fundamental approach for assessing the downstream effects of a high dam on river characteristics: In order to recognize the change in aquatic organisms and stream ecosystem, NILIM Technical Note No. 521
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0521.htm

2) Interim report on climate change adaptation studies, NILIM Technical Note No. 749
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0749.htm

3) Development of Environment Impact Assessment Technique for Eco-Compatible River-Basin Management In and Around Ise Bay, NILIM Annual Report (2010)
http://www.nilim.go.jp/lab/dbg/pdf/kn22_81-82.pdf

4) Proposal on River Environment Information Sharing System to Promote Cooperation with Residents in the Basin for River Management, NILIM Technical Note No. 793
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0793.htm