様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９　（共通）

科学研究費助成事業　　研究成果報告書

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研究種目：基盤研究(C)（一般）
研究期間：2020～2023
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研究課題名（和文）Enclosing Salmon: Social-Ecological Resilience and Salmon Aquaculture in Japan

研究課題名（英文）Enclosing Salmon: Social-Ecological Resilience and Salmon Aquaculture in Japan

研究代表者
伊藤　毅（Ito, Takeshi）

上智大学・国際教養学部・教授

研究者番号：１０６４６８６３

交付決定額（研究期間全体）：（直接経費）　　3,300,000円

研究成果の概要（和文）：本研究は、サケの家畜化が社会生態学的関係のレジリエンスにどのような影響をもたらすかを探ることを目的とした。サケの（再）生産、小売、消費の場におけるプロセスと関係に焦点を当て、政治生態学的分析を行った。調査の結果、サケとその生息地は争われ、交渉され、囲い込まれてきたことが明らかになった。歴史上、経済活動は乱獲と生息地の喪失を招き、魚資源の枯渇をもたらした。このような状況下で、孵化場や陸上養殖は資源不足問題に有効であるとされてきたが、基幹種としてのサケを生態系から切り離す結果となった。 私たちの研究成果は、雑誌記事、書籍の章、ブログ、ビデオなど、さまざまな形式で社会に還元することを努めた。

研究成果の学術的意義や社会的意義
Our research recognizes that it is ethically important to understand the wider social and ecological consequences of this new salmon aquaculture technology, as salmon, along with maize, pigs, and chicken, will be the next major species to be domesticated for the industrial production of human food.

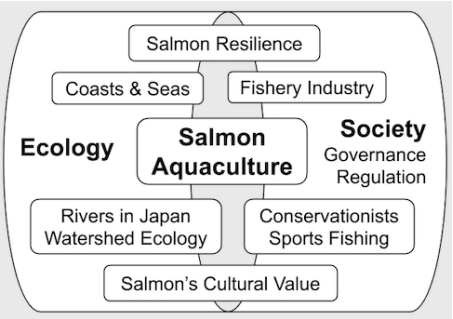
研究成果の概要（英文）：This research set out to explore how the enclosure of salmon shapes the resilience of social-ecological relations. We conducted a political ecology analysis focused on processes and relations at places of (re)production, retail, and consumption of salmon. Our research reveals that salmon and its habitat have been contested, negotiated, and enclosed as they have become a source of subsistence and a commodity of trade. In history, economic activity has led to overfishing and habitat loss, and thus produced fish stock depletion. Under such conditions, while hatcheries and land-based aquaculture have been regarded as viable solutions to resource scarcity, might be less impactful for the environment, it alienates salmon from the local ecosystems in which they connect with other species as a keystone species. We tried to disseminate and convey our findings in different formats including journal articles, book chapters, blogs, and videos.

研究分野：Political Ecology

キーワード：Ecology and society　Salmon aquaculture　Socionatures　Social institutions　Climate change　Adaptation

１．研究開始当初の背景

This research examines the emerging salmon aquaculture industry in Japan and its implication for the resilience of social-ecological systems. As capture salmon production has been decreasing every year, Japan's salmon industry is starting to augment offshore- and land-based farming to the existing hatchery system, the dominant system in Japan. While salmon aquaculture has far-reaching consequences for the fishery industry, the regulatory regime, and the ocean and river ecosystems, little social science research has been conducted to understand how this new technology is impacting the resilience of social-ecological systems. This research examines how this shift in salmon aquaculture is transforming both the existing ecosystem and the social relations around salmon. This research seeks to add the important dimensions of resilience, global food economy, and environmental ethics to the study of salmon aquaculture operating within the complex social-ecological relations.



(A) History of Salmon Aquaculture in Japan:　Salmon aquaculture is a historical culmination of the aspiration to control the reproduction of salmon through enclosures for the purpose of human consumption. In the Meiji period, the Japanese state tightened the human control over salmon by codifying laws that regulated fishery and established the modern hatchery system, which used rivers as a stock management system. In the postwar period, concerns about food security and the loss of fishery grounds led to the further development of the salmon hatchery program. The current shift to farming began due to the low salmon yield, pressure from stakeholders, and increase in imported farmed fish. The low return rate of hatchery salmon and increasing competition of imported salmon from Norway and Chile have compelled government research institutes and private companies to plan for an industry-wide shift to salmon farming. In 2018, the Japan Fisheries Research and Education Agency initiated the Innovation Platform for the Promotion of Fisheries Farming Industry, in which government agencies and research institutions, private corporations, and universities discussed this nascent industry and created policies and regulation standards. However, currently there are few rules governing salmon farming.

(B) Consequences of Salmon Aquaculture: Globally, aquaculture is on the rise. The total sale value of world fisheries and aquaculture production in 2016 was estimated at USD 362 billion, of which USD 232 billion (64%) was from aquaculture

production (FAO 2018). While capture fishery production has remained static since the late 1980s, aquaculture has seen rapid growth in the supply of fish for human consumption. In Japan, as of 2017, 58 business entities have established salmon aquaculture both offshore and on land (FRA 2018). As major food companies are now investing in salmon aquaculture, farming may soon eclipse hatcheries and coastal captures. Increased supply may bring down prices, thus forcing fishers to pursue other marine species. This in turn may trigger government subsidy programs to support hatchery salmon fishery. Farms can also have negative ecological consequences. While hatcheries produce eggs, offshore-based and land-based facilities mimic the environment where salmon fry grow into adult fish. The waste from fish and effluence from the production process, if disposed into nearby waters untreated, can cause water pollution. In Northern Europe and the Northwest Coast of North America, escaped fish from ocean-based farms have been known to cause problems, such as sea lice infestation and genetic contamination of wild species (Bolstad et al. 2017). Furthermore, salmon contribute to a healthier wetland ecosystem. Reestablishing resilient salmon populations benefits social-ecological resilience by providing adequate stream flows, clean water, functional wetlands and floodplains, intact riparian systems, productive fisheries, and other ecosystem services (Bottom et al. 2009).

	HATCHERIES	FARMS
Regulatory Law	Fishery Law	No regulation
Fishery Rights	Yes	No
Management	Salmon Propagation Association	Private companies
Capital	Fishery Cooperative Associations	Company shareholders
Purpose of Facility	Supplementing wild salmon population with artificially propagated smolts	Growing salmon from egg to adult in enclosure solely for the market
Location	Rivers	Land / Coasts
Product	Broiled Fish	Sushi / Sashimi

２．研究の目的

The purpose of the proposed research is threefold: i) to investigate the current situation of the salmon industry (hatchery and farms); ii) to identify the key drivers and consequences of salmon aquaculture; iii) to offer policy-oriented suggestions based on the above findings.

３．研究の方法

Our research will employ mixed methods of fieldwork, interviews, archival research, and policy analysis.　This project will use the following two sets of methods.

(i) Field-Based Case Studies: We will investigate salmon hatcheries and farms as case studies to understand the multi-scalar dynamics of the surrounding political and economic forces. Case study sites will be selected by considering the history of salmon aquaculture, new technology to overcome environmental problems, and types of salmon being reared. We will visit these facilities and the connected river and coastal systems to conduct interviews with key stakeholders, gather published and unpublished fishery data, and engage in hands-on field observations by

participating in the aquaculture procedures and public meetings and events. We will also investigate related activities such as recreational fishing, cultural and community-wide events, capturing salmon for Ainu ceremonies, and environmental education programs. Hatcheries: We will focus on chum salmon hatcheries in Eastern Hokkaido, primarily in the Kushiro River (Hokkaido) where our previous research has evaluated the feasibility of restoring the Kushiro Wetland by protecting natural reproduction of salmon in coexistence with hatchery salmon. We will also focus on Churui River (Hokkaido), which is a hatchery river that also allows for recreational fishing. Farms: We will first make preliminary visits to four salmon farms: Miyagi Salmon (coho salmon, Miyagi), FRD On-Land Farm (salmon trout, Chiba), Sakaiminato Salmon (coho salmon, Tottori), and Uwajima Mikan Salmon (coho salmon, Ehime). Out of these, one or two will be selected for further intensive study.

(ii) Environmental Governance and Industry: To understand the current government regulations and industrial trends, we will gather existing historical documents via archival research and policy documents from government agencies and industry headquarters. To examine today's shift in salmon aquaculture, it is important to understand past policies of salmon propagation and the prognoses for the industry's future. In our historical survey, we will focus on the shifting discourse in salmon fishery science and management literature, including the concept of scarcity and stock depletion, and the emergence of an ecologically holistic perspective. We will also frame Japan's shifts in the global economy by investigating Japan's connections to salmon aquaculture industries in other countries. We will do so by documenting technology transfers, movement of capital investment, international institution-building, and both the natural and anthropogenic spread of salmonid genetics.

４．研究成果

Journal Article:

Watanabe, T. and Ito, T. Forthcoming. "River of Fire and Ice: Infrastructure, Territoriality, and the Colonization of Eastern Hokkaido, Japan, 1600s-1900s." International Journal of Asian Studies.

Book Chapter:

Ito, T. Under review. "Socionatures: Rivers, Salmon, and People in the Kushiro River Basin, Eastern Hokkaido" in an edited volume.

Blog: to be published on kasasustainability.org

Interview with FRD

Interview with Soul of Japan

Video: to be published on kasasustainability.org
Interview with the Wild Salmon Center

５．主な発表論文等

〔雑誌論文〕　計1件（うち査読付論文　1件／うち国際共著　0件／うちオープンアクセス　1件）

１．著者名 Watanabe, T. and Ito, T.	４．巻 -
２．論文標題 River of Fire and Ice: Infrastructure, Territoriality, and the Colonization of Eastern Hokkaido, Japan, 1600s-1900s	５．発行年 2025年
３．雑誌名 International Journal of Asian Studies	６．最初と最後の頁 -
掲載論文のDOI（デジタルオブジェクト識別子） なし	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 －

〔学会発表〕　計0件

〔図書〕　計0件

〔産業財産権〕

〔その他〕

This research started in April 2020 amidst the turmoil caused by COVID-19. Our research was significantly disrupted by this pandemic and we were forced to make changes in some parts of the plan.

６．研究組織

	氏名 （ローマ字氏名） （研究者番号）	所属研究機関・部局・職 （機関番号）	備考
研究分担者	渡邉　剛弘 (Watanabe Takehiro) (50439337)	上智大学・国際教養学部・准教授 (32621)	

７．科研費を使用して開催した国際研究集会

〔国際研究集会〕　計0件

８．本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関