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CASE STUDY

REVISED Cod, construction, and communities: Relations between fish and architectural history in Ísafjörður, Iceland

[version 3; peer review: 2 approved, 2 approved with reservations, 1 not approved]

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Abstract

Understanding the interplay between ecological processes and human-built environments is key to addressing the entangled dynamics of marine and terrestrial landscapes, yet these relationships are often studied separately. This paper addresses this issue by exploring the socioecological histories of North Atlantic fishing landscapes, with a focus on Ísafjörður, situated in the Westfjords of Iceland, a critical site in the history of cod (*Gadus morhua*) fisheries.

It presents the outcomes of a weeklong workshop that explored the connections between urban development and cod populations through three thematic lenses: 1) the urban development of Ísafjörður, 2) the life cycle of cod, and 3) Icelandic fisheries. A range of interdisciplinary methods was applied, including archival photography analysis, historical mapping, cod movement pattern reconstruction, oceanographic data assessment, investigation of vessel technology, and fisheries data analysis.

Our findings reveal overlapping timelines that link fish population cycles with patterns of urban growth, highlighting points of convergence where ecological and social dynamics intersect. Visual representation was used as an integrative tool to translate between marine processes and the built environment. By reflecting on the workshop's experiments and achievements, this paper proposes strategies for future research at the intersection of ecology, fisheries, and architecture.

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REVISED **Amendments from Version 2**

In response to the reviewers' comments, the paper was revised to clarify its scope and contribution, particularly in emphasising the exploratory nature of the methodologies under discussion. The abstract was restructured as suggested, and the introduction was expanded with a paragraph addressing research gaps, while the discussion was extended to include recent references; figure files were also updated.

Any further responses from the reviewers can be found at the end of the article

Introduction

Research has acknowledged the relationship between fishing pressure and the health of fish populations, including demersal fish such as cod (Thurstan *et al.,* 2010; Thurstan, 2022). While there are several factors that determine the size of catches—including environmental conditions, the fishing gear used, and the degree of effort involved—extraction technologies require an anchor point onshore to transform marine resources into terrestrial commodities. An extensive range of facilities, such as harbors, processing plants, drying racks, and warehouses, are built manifestations of the ecological pressure on marine ecosystems (Tavares, 2024a). They allow us to trace the connections between the built environment and fish populations. Nonetheless, a methodology for estimating such impact has yet to be established.

While cod has been studied from fish species and ecological perspective (Kulatska *et al.,* 2025; Rose, 2007; Rose, 2008; Rose, 2019) and a variety of historical perspectives (Campana *et al.*, 2025), their related architectural and urban dimensions remain underexplored. Architecture and urban studies document the growth of a variety of landscapes associated with fisheries, but from cultural and sociological angles. Hence, the entanglements between built environments, fish populations, and socioecological change remain insufficiently understood. Overcoming this gap requires new research methodologies capable to bridge difference disciplines and research.

This paper presents the results of a weeklong workshop held in Ísafjörður, Iceland, organized as part of the Fishing Architecture project (Tavares, 2024b), a broader research project focused on the industrialization of fisheries along the shores of the North Atlantic exploring the interconnections between onshore fishing-related infrastructure and offshore natural resources, from 1815 to 1992. The project's methodological backbone is structured around key analytical axes: marine ecosystems, fishing technologies, food processing, politics, and consumption habits. This framework allows us to investigate the complex interrelations between marine environments and terrestrial landscapes. For instance, aligning fluctuations of fish populations with different patterns of urban expansion and technological change can display the intricated parallel transformations happening within the two systems. Our research applies this methodology across several geographically, culturally and ecologically distinct case studies. So far, research has focused on four locations: South Brittany in France, the Sado estuary in Portugal, Ísafjörður in Iceland, and Gloucester in Massachusetts. By doing so, we aim to assess the ecological impact of fishing-related built environments and the natural resources upon which they depend. Within this context, working in Ísafjörður supported the development of experimental concepts to establish a foundation for understanding the broader patterns that emerge across other study areas.

Having developed from a simple trading post into an urban center through fishery activities during the twentieth century (Þór, 1984), this town in the Westfjords peninsula is an ideal place to study cod in the assessment of the dynamics of fishing architecture. The paper focuses on the methodology employed to tackle these often-overlooked connections between the built environment and marine populations.

Context

Alongside agriculture, fisheries were the predominant economic sector throughout Iceland's history, experiencing exponential growth at the end of the nineteenth century and bolstering the numerous fishing settlements spread along its shores (Arnason, 1995). The environmental conditions provide ideal spawning grounds during the spring season for both coastal and frontal (migratory) Atlantic cod populations, as they aggregate in pockets of marine space around the country (Jónsson, 1996; Sólmundsson *et al.,* 2015). The largest of the spawning areas is in southwestern Iceland, where both migrant and coastal Atlantic cod spawn at varying depths (Grabowski *et al.,* 2011; Sólmundsson *et al.,* 2015). Outside the spawning season, the northern areas provide ideal feeding grounds for migratory mature cod (Sólmundsson *et al.,* 2015).

Ísafjörður started out as a commercial outpost that eventually took on great importance as a center of fish processing and export. The town is located on a sandbar (Eyrin) jutting out into the fjord Skutulsfjörður, which provides ideal conditions for mooring large vessels protected from the harsh conditions of the North Atlantic. From the seventeenth century onwards, this sandbar hosted a Danish trade outport which gave rise to a small community with a strong symbolic presence. In 1866, the few existing houses were granted municipal administrative status, and in 1902 the harbor welcomed its first motorized fishing boat. In the following years, Ísafjörður experienced significant urban growth, its population expanding from 830 to over 1,960 inhabitants between 1890 and 1920 (Þór, 1984, 38). Located in the neighboring waters of the Atlantic, on the underwater cliffs of the Denmark Straight, the Halinn (Halamið) fishing grounds were identified in the first decades of the 20th century and became highly productive with the establishment of bottom trawling, until today being the most productive cod fishing ground for Icelandic trawlers. In recent decades the fishing fortunes of the Westfjords have waned, following the introduction of individual transferable quotas (Edvardsson *et al.,* 2018). Despite still being the home base

for several fishing vessels, onshore processing is now only a shadow of what it once was.

This case study is promising to understand key Fishing Architecture concepts since it provides an overview of the technological transformations from pre-industrial salted fish processing to the development of freezing technologies. These can be seen in the development of special building typologies whose change impacted the urban development. Ísafjörður proximity to cod populations preferred habitats can explain the historic development of regional fisheries. The settlement being built upon a sandspit, and its urban growth being associated with the exploitation of the marine resource (relatively impervious to other concurrent economic activities), offers a unique viewpoint to access the transformations of terrestrial forms and buildings, and access to the entangled ecological shifts happening in Atlantic waters.

The relationship between architecture and marine ecosystems, particularly in the context of fisheries, remains underexplored in both architectural and environmental humanities. Traditional architectural methodologies often isolate the analysis of the built environment from its ecological and socio-economic surroundings. Conversely, environmental assessments and marine science studies typically overlook the spatial, material, and built implications of marine ecological dynamics. Our methodological innovation lies in bridging these disciplinary gaps through a comprehensive, multi-scalar approach that integrates ecological, spatiotemporal, and cultural dimensions of fishing-related architecture and urban dynamics. Setting up this transdisciplinary framework demands interdisciplinary negotiation and methodological adjustments, finetuning language and tools to achieve sound results. By doing so, we expect to capture the reciprocity and complexity of fish as drivers of urban growth processes and coastal infrastructures as ecological agents that actively shape, and are shaped by, changing marine and terrestrial dynamics.

This is relevant considering more-than-human and socio-ecological perspectives in architectural and environmental research. Socially, this research framework supports critical reflections on the sustainability of coastal communities, the material legacy of industrial fisheries, and the adaptation of infrastructures to ecological shifts. By applying this methodology across diverse geographic case studies, we can trace shared patterns as well as site-specific responses, offering valuable insights for policymakers, architects, and communities working to reimagine the future of coastal areas. The methodological innovation we aim to contribute for must enable a deeper understanding of how fish and fisheries shape and are shaped by architecture, ecology, and society – a perspective we believe is increasingly vital in the context of environmental change and evolution of the built environment of coastal areas.

Three approach angles

Three teams were established for the workshop, focusing on 1) urban development, 2) the cod life cycle, and 3) Icelandic fisheries. Each team was coordinated by one member of the Fishing Architecture research project with different disciplinary backgrounds: 1) architecture, 2) contextual design, and 3) marine biology. From the outline the methods to be experimented, materials were prepared in advance, which provided participants with a structured entry point and guidance. Teams were composed of a small group of master students from architecture traveling from Porto, Bergen and Reykjavik, as well as local master students from coastal and marine management and regional development, and a doctoral candidate on marine biology. The groups were formed to ensure multidisciplinarity, while also considering the participants' personal interests and competences.

The work ran parallel with lectures on regional development in fishing coastal communities (Kokorsch & Benediktsson, 2018); the history of the Icelandic cod fisheries and settlements (Edvardsson, 2010); Atlantic cod behavior, population structure, migrations, and management (Ólafsdóttir *et al.,* 2017); archival sources and the documentation of local history (Hreiðarsdóttir *et al.*, 2005); the distribution and movement of juvenile Atlantic cod; seascapes and geography (Benediktsson & Waage, 2015); and the urban history of neighboring communities. The lecturers, as well as the local research center community, provided critical feedback on the ongoing work and preliminary results.

While the initial outline was followed, space for creativity and exploration was intentionally left open, so that groups could adapt their approach, bring in new ideas, and pursue emerging lines of thought. With this approach, we aimed to balance between methodological preparation and openness to accommodate both rigor and innovation in the research process.

Urban development

This group based its work on archival materials, including bibliographies, maps, and photographs. A selection of objects covering an extensive period was assembled and inventoried, and the work was organized toward: a) an archival photographic survey, and b) urban development mapping.

Archival photographic survey. Two sources were scrutinized to construct a geo-tagged database of historical photographs from Ísafjörður: the online database Sarpur, and a historical book on local commerce (Halldórsson, 2007). The first task was to identify images of the main street (Aðalstræti), then expand out to the local neighborhood, and later to the entire urban area. Over 150 sources were briefly catalogued and cross-checked with a recent housing survey (Bergsson *et al.,* 2022) and the current online property register.[1] Images were mapped, revealing how buildings were transformed through time, and when such transformations occurred (Figure 1).

[1] The main sources used were the property register, https://fasteignaskra.is/ (HMS, https://hms.is/).



Figure 1. Ísafjörður, 1900 and 1907 panorama (Courtesy Safnahúsið, Ísafjörður Culture House and archives). Hafnarstræti and Silfurgata junction, 1927–1928 and circa 1940. (Courtesy Ísafjörður Regional Photo Archives).

Consolidated historical mapping. Survey plans from 1865, 1905, 1924, 1935, and 1970 were selected to depict the major urban transformations occurring within the time frame under scrutiny. After being georeferenced, it was critical to adapt their original forms to match projection systems and reference buildings and harmonize different criteria used in their original production.

The output was not a complete match: while the form and development of the Eyrin sandspit were accurate, some buildings appeared shifted (Figure 2). The setback was overcome by adopting the 1924 urban survey, the most comprehensive of the period, as a reference to be vectorized. The maps were analyzed to obtain information on construction materials (e.g., concrete versus timber in 1924) or functions (e.g., housing, warehouses, and cod drying facilities in 1905). The outcome outlined Ísafjörður's urban development from 1865 to 1970, highlighting the 1910s and 1920s as key periods of growth with the rise of fisheries (Seelow, 2011, 164–67).

Cod life cycle

The group initially selected three papers on the life cycle of Icelandic Atlantic cod (Astthorsson *et al.,* 1994; Pálsson & Thorsteinsson, 2003; Thorsteinsson *et al.,* 2012). These papers outlined spawning grounds south of Iceland, larvae dispersal, juvenile maturation in fjords, and adults inhabiting the northern continental shelf. Complementarily, the concept of the 'Codexian' was introduced to bridge the disciplines of marine biology and architecture, as discussed below.

Movement patterns. As a preliminary approach to the work, three spatial and temporal scales of Atlantic cod movement and behavior were discussed: daily, seasonal, and across their development from larvae to adult. The team decided to focus on individual cod instead of populations to grasp the dynamics of cod movement and behavior for different body sizes and ecotypes. Acoustic telemetry data for the movement and behavior of two Atlantic cod juveniles (1–3 years aged) within a nearby fjord (Dýrafjörður) across different seasons were observed.[2] The choice of the individuals was made from a sample being tracked within the framework of one of the workshop participant doctoral research, hence the choice was dictated by data availability. The team compared individual movement over time, considering water temperature as a factor likely to influence their choices (Figure 3). Although not conclusive, the data on cod movement patterns allowed to explore its relation with very different datasets, such as urban development patterns.

Data assessment. From the literature review it was possible to identify the main parameters of habitat suitability and preferences in different stages of individual cod development. Depth, water temperature, salinity, currents, and water velocity were charted, offering visual renderings of habitat suitability

[2] Data was provided from Michelle Valliant's ongoing doctoral research (University of Iceland, Research Centre of the Westfjords).

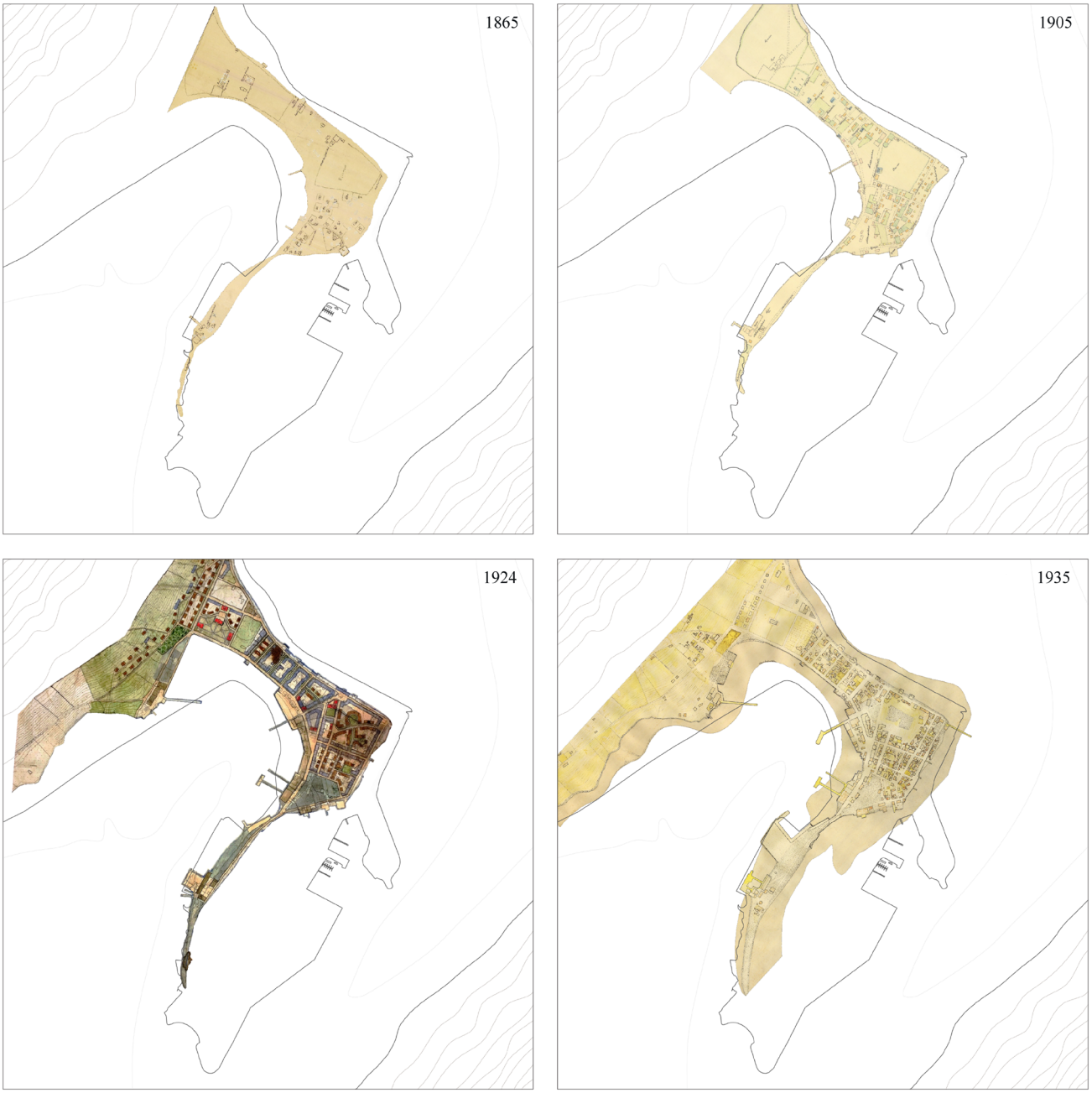


Figure 2. Historical maps showing the physical transformation of Ísafjörður between 1865 and 1970. Black line represents current (2024) coastline. Reference coordinates: 66.07° N, 23.12° W, WGS84. Base materials sourced from Ísafjörður Regional Archives.

for 2021.[3] Although inconclusive, the potential areas of interaction between the general dynamics of cod populations and their life cycle were mapped (Figure 4).

Environmental data and map illustrations from various cod studies (e.g., Pampoulie *et al.,* 2023; Thorsteinsson *et al.,* 2012) were overlaid to understand where and when the larval life stages are likely to move around Iceland, and where adult populations are likely to move or stay resident, based on environmental (e.g., temperature, currents) and biological factors (e.g., chlorophyll, plankton) resulting in a particular spatial distribution (e.g., spawning and feeding grounds).

[3] Mercator Océan International. (2024). *Global Ocean Physics Analysis and Forecast* [Dataset: cmems_mod_glo_phy-thetao_anfc_0.083deg_P1D-m]. Copernicus Marine Service. https://doi.org/10.48670/moi-00016

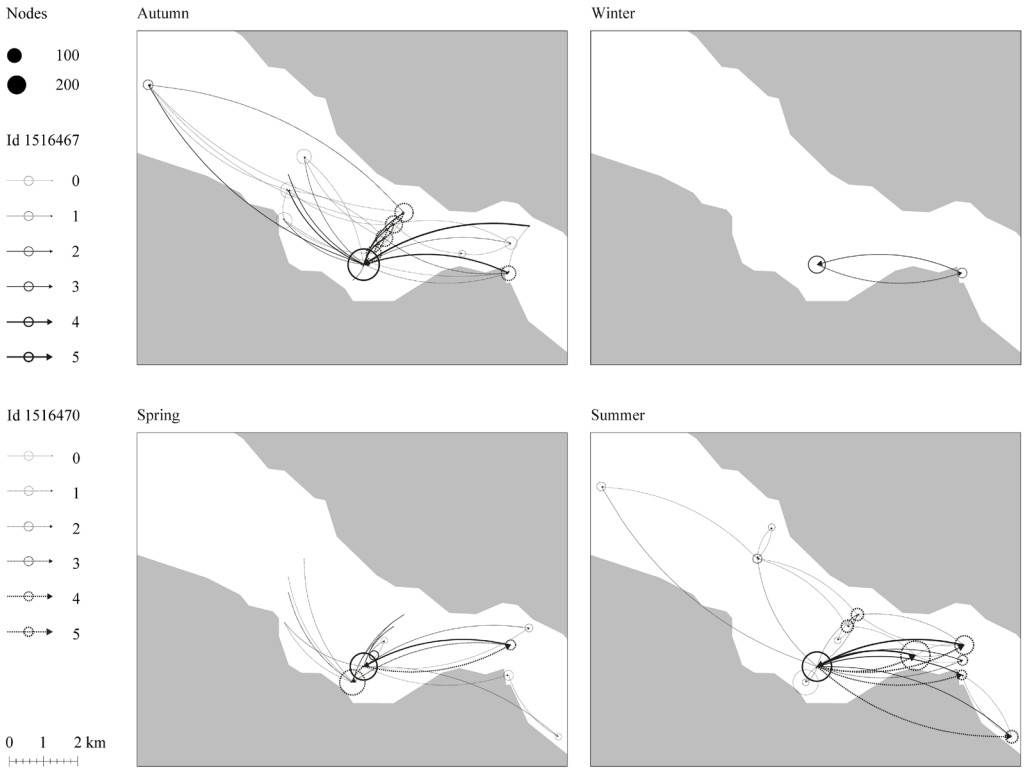


Figure 3. Movement network analysis of two juvenile Atlantic cod in Dýrafjörður's nursery ground over the seasons. Nodes size indicates the number of times a fish comes and goes close to a site while the arrows represent the direction and frequency of how often the individual fish moved between sites. The result shows possible sites within a nursery ground that are of interest to the fish throughout space and time.

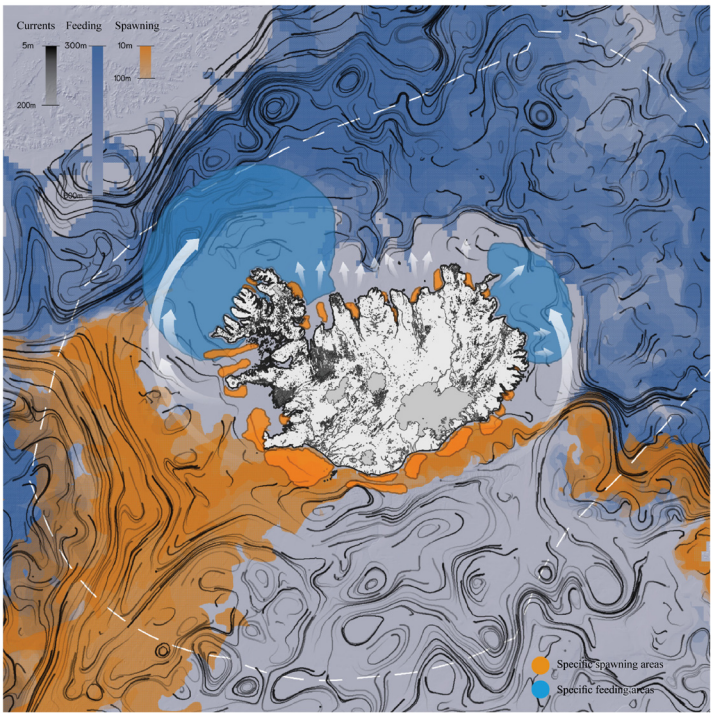


Figure 4. Movement patterns of Atlantic cod in the Icelandic region, spawning areas, and feeding grounds. Redrawn from Pampoulie *et al.* (2023) and overlaid with environmental data and biological factors to compute spawning and feeding grounds.

Codexian. The Codexian—an imaginary creature—was introduced as a creative methodological and conceptual tool. This metaphorical entity symbolizes the interconnectedness between the human and marine worlds, but it can also be viewed as an attempt to create a platform of co-exploration through notions of engagement, exploration, play, and the blending of fiction and reality. The Codexian was a creature, half-cod half-researcher, equipped with elusive powers and insights that supported the construction of a fictional narrative.

Although the Codexian emerged as a creative tool, it acted as a mediator between scientific and artistic lenses. Participants enacted their rituals, using video to integrate observation, grant respect, and develop cross-disciplinary explorations. It materialized as a performance which involved actions such as casting a line with a waterproof camera and hydrophone into the sea to observe and listen to the cod. The method was an attempt—eventually closed in its own oppacity—to grasp the variables at stake in the different working time frames, underscoring the need for experimental methodologies to address the natural environment (Hessler, 2018). More puzzling than problem-solving, the Codexian became a faithful companion to interdisciplinary research.

Icelandic fisheries

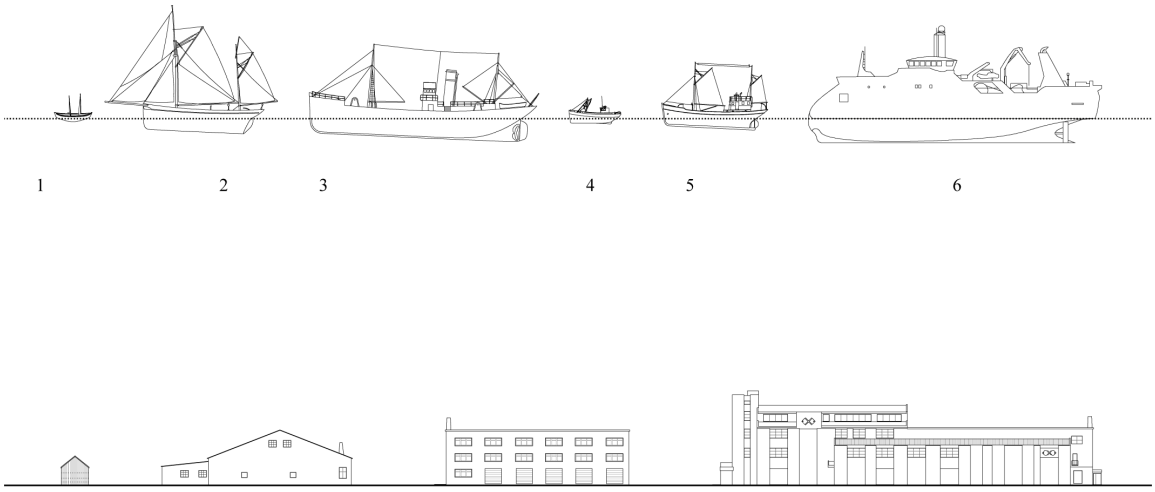
The work of this group began with a preliminary collation of Icelandic fish landings data from 1905 to 2022, creating a dashboard to track the overall fishing activities. The objective was to support the search for historical data to fill equivalent data sets to reconstruct a historical perspective in relation to Ísafjörður's urban development.

During the workshop, two lines of work provided consistent results: a) temporal tracing of vessel technology and capacity, and b) preliminary assessment of historical fisheries data. Relevant historical references to fishing grounds and sites were also discussed (Edvardsson, 2010, 317).

Vessel technology and capacity. The different vessels, their capacities, dimensions, and technological features were assessed to shed light on the major historical transformation in fishing gear and equipment used in operations based in Ísafjörður. The focus followed a historical sequence: open rowing boats; decked boats and schooners; steam and diesel motorized boats; motorized side trawlers; stern trawlers (Jónsson, 1983; Sverrisson, 2002). The vessels emerged as the inevitable link between the terrestrial and marine ecosystems, connecting the transformations occurring in both environments (Figure 5).

Historical fisheries data. The assessment of archival data on historical fisheries allowed this group to understand what kind of data is available and to which years it applies.[4] Preliminary

[4] Accessible via the www.timarit.is digital library. *Skýrslur um landshagi á Íslandi*, 1858–1875; *Stjórnartíðindi fyrir Ísland: C-deild*, 1882–1907; *Landshagsskýrslur fyrir Ísland*, 1899–1913; Ægir, a fisheries journal with monthly catches published from 1905 onwards.



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7 8 9 10

1	2	3	4	5	6
Sexæringurinn Stanley	Geir RE 8	Hávardur Ísfird. IS 451	Farsæll IS 93	Rán IS 51	Björg EA 7
Rowing boat	**Sailing cutter / smack**	**Steam trawler**	**Motorboat (small)**	**Motorboat (large)**	**Trawler**
1860-1908	1887-1912	1860-1908	1969-1994	1958-1988	2017-2024
gt 2 ton.	gt 85,60 ton.	gt 314 ton.	gt 10,30 ton.	gt 58,25 ton.	gt 2 080 ton.
7,60 m	24,0 m	45,10 m	8,23 m	21,40 m	58,50 m
Crew 5	Crew 27	Crew 20	Crew -	Crew -	Crew -

7	8	9	10
Anonymous	Íshúsfélag Ísfirðinga	Íshúsfélag Ísfirðinga	Íshúsfélag Ísfirðinga
Drying shed	**First warehouse**	**Freezing factory**	**Factory expansion**
c. 1095	1955	c. 1960	1976

Figure 5. Timeline of fishing vessels and built cod processing facilities. Examples of ships registered for Ísafjörður's cod fisheries and contemporary buildings.

data sourced from Statistics Iceland and available in spreadsheets could be promptly processed. The most relevant pattern was the increased percentage of Icelandic Atlantic cod within the world catch, rising from a 5.95% minimum in 1968 to a peak of 22.82% in 1991. Throughout the period range, Icelandic cod saw a growth in its worldwide relevance, with a steady decrease evident elsewhere, even before the 1992 Canadian moratorium on the Grand Banks cod fisheries.

A noticeable feature was the similar patterns between herring and cod Atlantic catches, particularly in the mid-1960s and mid-1970s, a coincidence that is neutralized by the increasing economic relevance of cod as compared with herring, which was of lower value. This data could be overlapped with the archival photographic survey, considering herring's relevance in Ísafjörður during the 1920s, in direct chronological relation to the Icelandic "herring adventure" (Hamilton *et al.,* 2004). The statistical findings showed how herring has a lower profile within Ísafjörður's historical narratives, which tend to emphasize cod fisheries as a major engine of its social organization.

Discussion

Assessing the relationship between fish populations and the built environment within an ecosystem requires the consideration of a multitude of variables, including biological, ecological, environmental, and social factors. The methods adopted in the workshop helped the participants to fulfill such requirements, although its limited time frame precluded intense cross-disciplinary experimentation.

The character of the results obtained underscored the significance of visual renderings. During the discussion of the multiple research threads, the juxtaposition of the visual materials produced by each team brought evidential aspects to the fore and highlighted areas of synthesis. For example, comparing the scale of fishing gear (Figure 5) with the scale of the urban features (Figure 1) revealed a continuity between the marine and terrestrial forms of human activity that coincided with the amount of cod biomass extracted from its natural environment (Figure 6).

Visual representation alone does not constitute definitive evidence of causal relationships. Instead, its exposes potential patterns, tensions, and moments of convergence that can be further interrogated through comparative analysis and future research (Bremner, 2023). Hence, it becomes a mediation tool that allows disciplinary backgrounds to work with heterogeneous data sources over a common ground. To push further research results and methods, rather than a singular method or research angle, novelty requires to bring together disparate forms of knowledge who are seldom in dialogue. And visual synthesis can propel the combination of multiple datasets and disciplinary perspectives through collaborative research. It adds that there are secure methods to combine visual outputs and quantitative data (Baxter, 2025).

When dealing with marine systems and terrestrial landscapes, representation translates concrete dynamic processes into abstract and stable forms: the specific variables of cod behavior are

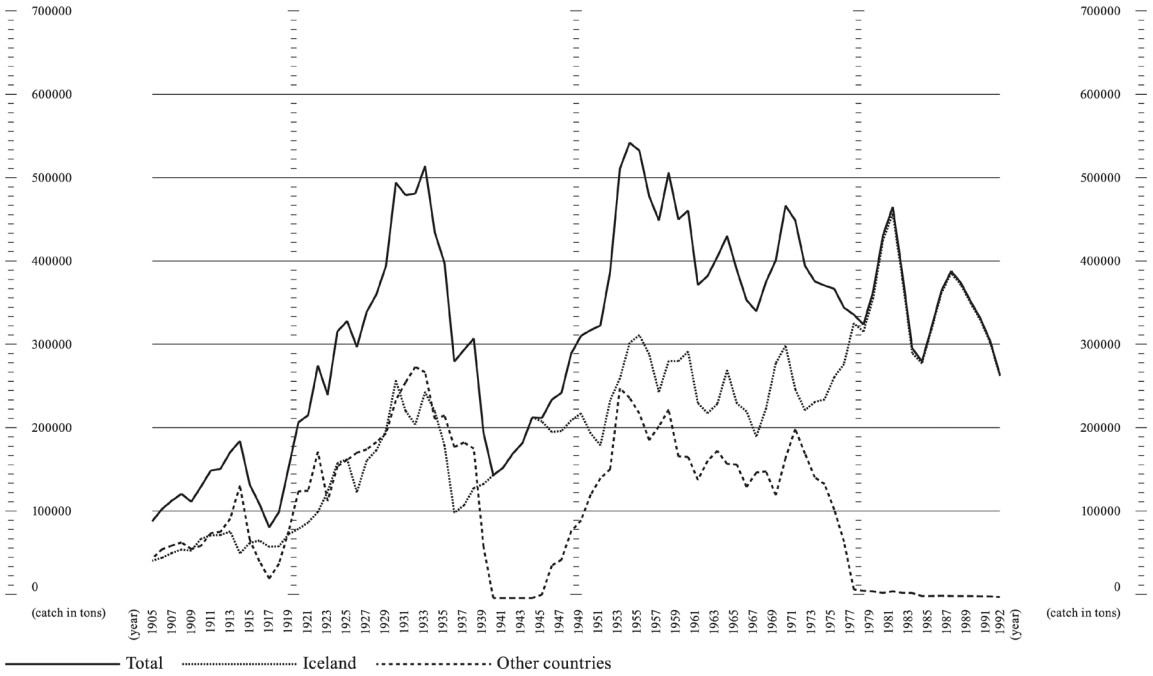

Figure 6. Graph showing Atlantic cod catches within ICES area Va (27.5.a, Iceland Grounds) between 1905 and 1992. Catch data is presented in tons. The lines represent catches by the Icelandic fleet (dotted line), other countries' fleets (dashed line), and total catches in the area (solid line).

represented as something fixed. Objective representations allow us to materialize connections and grasp possible understandings of the elusive relationship between fish populations and built environments. During the workshop, this possibility became obvious through an objectification of the sheer scale of cod spawning areas and feeding grounds in relation to Iceland's land areas.

The workshop also reinforced the idea of technology as a connector between the different lines of inquiry, environmental conditions, and ecological transformations. Based on the technology deployed in fisheries but also on the methods used to acquire knowledge, such as Automatic Identification Systems, the buoys used to triangulate, record, and transmit fish-tagging devices, or access to fish-landing statistics, technology explains many of the interconnections we want to highlight and understand. Nonetheless, the fact that the prior relations persist beyond major technological shifts makes it clear that technology is no more than a link within a more complex chain of factors and events.

One inconclusive question was how to address the relationships between individual cod behaviors and population patterns. The history of urban dynamics is parallel to the economic data of fish landings, yet it is seldom sufficient to enable us to grasp a coherent picture of fish at sea. The cod life cycle is regular, but variations do exist in age and size at maturity between different groups and regions, influenced by environmental conditions. There are both abiotic (e.g. temperature) and biotic (e.g. prey availability) factors that influence fish distribution and the timing of movement events, contributing to life-history stages, spawning grounds, foraging areas, and nursery habitats (Buchan *et al.*, 2020; Harley *et al.*, 2006; Rezek *et al.*, 2020; Robichaud & Rose, 2004). Moreover, the genetic diversity among cod ecotypes is complex where the differentiation of coastal and frontal cod in Iceland is under continued investigation, suggesting differences in movement and behaviour among ecotypes and linked with genetics (e.g., Arnason *et al.*, 2009; Beukeboom *et al.*, 2022; Beukeboom *et al.*, 2023; Pampoulie *et al.*, 2008; Pampoulie *et al.*, 2023).

The workshop results suggested a temporal mismatch in the linkage between sea and land. Ísafjörður illustrates how the spatial overlapping of urban dynamics, marine ecosystems, and cod populations does not coincide with their chronological coincidences. Its physical location is close to cod feeding grounds and to the highly productive Halinn grounds, where the continental shelf slopes steeply down into the deep ocean of the Denmark Strait. Although it was a historic trading post, Ísafjörður's urban growth was due to motorized fisheries and the cod economy that developed in the early twentieth century. As one can see in the chronology of urban development (Figure 2), transformations on land took time, and in decades past, urban visions were adjusted, abandoned, and redefined. Yet, the cod life cycle remained stable, from the larval to juvenile stages and on to maturity and senescence (Figure 4). The cod's rhythms do not match the architectural, social, and terrestrial transformation cycles. Further research following the preliminary results that came out can be tracing such chronological matches and mismatches within a specific chronological time frame. Within the framework of the Fishing Architecture research such hypothesis was further researched in the Brittany case study (Tavares & Nouvet, 2025).

Further data acquisition and integration is required. Yet, at this stage of the research, our focus has been on establishing a robust methodological framework and clearly presenting the distinct layers of data that will feed into future synthesis. The Icelandic case study presented here is a foundational project to future integration of data and cross-case comparison with other Fishing Architecture case studies. The patterns, tensions, and convergences identified so far will serve as critical points for a broader socioecological research endeavor.

Conclusions

While operating with fragmented data retrieved from existing literature, the workshop clearly revealed the potential that visual representations have for addressing the dynamic relationship between cod, construction, and communities. It allowed to assess the availability of data on a) fish landings and the national economy, b) the environment and physio-chemical conditions in the ocean, c) urban development, and d) the local economy. Our experimentation with different representation methods yielded approaches to e) mapping, f) statistics, and g) ecosystems. The workshop generated a local historical outline and references to further studies on the existing background. With respect to fish biology and behavior, it provided general descriptions of cod at the levels of species, population, ecotype, and individual, suggesting strategies that can be used in representing and tracking the multiple scales involved. With respect to the chronological framework of the research, which runs from 1815 to 1992, it allowed us to narrow down the time frame of the Ísafjörður case study to the period between 1897 and 1942.

The main outtake of the Cod, Construction and Communities workshop was the need to further integrate data and knowledge between disciplines and research methods. Narrowing both the timeframe and the ambition of research can be a positive strategy, although it risks blurring the perception of interconnected historical sources. Ísafjörður was consolidated as a case study and further research will be developed, focusing on the assessment of cod population dynamics, urban development patterns and building typologies.

Ethics and consent

Ethical approval and consent were not required.

Data availability

The data used for Figure 3 represents a small subset of acoustic telemetry tracking data collected from two individual fish within a fjord system equipped with an acoustic receiver array. This subset includes date and timestamps, fish IDs, station IDs, and corresponding latitude and longitude coordinates.

The full dataset is not currently available via online open access, as it is part of a larger ongoing tracking project. Once data collection is complete, the full dataset will be made available through the Ocean Tracking Network Data Portal.

In the meantime, readers or reviewers who wish to access the subset data may contact Michelle Valliant, PhD Candidate at the University of Iceland, via email at miv1@hi.is.

The data used for Figure 6 is based on the dataset Catches of Atlantic cod in Icelandic waters in the 5a area, 1905–2019, available at https://doi.org/10.5281/zenodo.15168429 (Directorate of Fisheries, 2025).

This dataset was derived from the database of the Icelandic Directorate of Fisheries (https://statice.is/statistics/business-sectors/fisheries/), accessed on March 20, 2024.

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Acknowledgements

The paper presents the results of a teamwork comprised by many more than its authors. We want to acknowledge the enthusiastic participation of Sadie Ainsworth (University Centre of the Westfjords), Liliano Ferreira (University of Porto), Anna Gehlen (University Centre of the Westfjords), Perla Gísladóttir (Iceland University of the Arts), Anna Morozova (University Centre of the Westfjords), Miguel Oliveira (University of Porto) Luna Scéau (Bergen School of Architecture), Katherine Stewart (Iceland University of the Arts), and Lena Winderen (Bergen School of Architecture). Guest lectures provided fruitful insights and initiated relevant discussions, namely Matthias Kokorsch (University Centre of the Westfjords), Ragnar Edvardsson (University of Iceland, Research Centre West Fjords), Guðfinna Hreiðarsdóttir (Safnahúsið, Ísafjörður Culture House and archives), Guðbjörg Ásta Ólafsdóttir (University of Iceland, Research Centre West Fjords) and Einar Hlér Einarsson (Sei Studio). The workshop was made possible through a collaboration with the University Centre of the Westfjords, and we want to acknowledge its staff's warm welcome and hosting. Heimabyggð carefully provided food, and the operation was successful due to the organizational care and attention granted by Claudia Soares (University of Porto). This work is part of the Fishing Architecture research project and the authors want to acknowledge the discussions and contributions of the entire team.

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Open Peer Review

Current Peer Review Status: ✔ ? ✘ ✔ ?

Version 3

Reviewer Report 25 September 2025

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✔ **Preeti Kumari**
Amity University, Ranchi, Jharkhand, India

The author has made substantial changes in the manuscript. The manuscript may be accepted for indexing.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Ecotoxicology; Bioaccumulation; Human Health Risk; Mercury; Arsenic; Cadmium; Environmental Toxicology; Metalloids; Heavy Metals; Biomonitoring; Environmental Pollution; Heavy Metal Toxicity; Biodiversity; Heavy Metal Pollution; Toxic Metals; Heavy Metals Analysis; Heavy Metal Accumulation; Bioassessment; Microplastics; Environment; Environmental Analysis; Environmental Analytical Chemistry; Environmental Impact Assessment; Environmental Monitoring; Fish toxicity; Bioaccumulation of Heavy Metals; Biotic indices; Environmental Risk Assessment; Toxicity; Ecological Risk Assessment; Environmental Exposure; Macroinvertebrates; Environmental Remediation; Ecology; Zoology; Remediation; Bioremediation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 2

Reviewer Report 22 August 2025

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Jean C.G. Ortega
[1] Environment, Soils and Land Use, The Agriculture and Food Development Authority (Teagasc), Wexford, County Wexford, Ireland
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This is an interesting and well-written study. As the authors' framework can be applied to different contexts, it is important to provide a bit more context about which stakeholders were involved in the workshops and about the development of this activity.
Were they all researchers?
Were only specialists composed in each group?
Or were they composed of stakeholders with different backgrounds?
All stakeholders participated in the research project, or were external ones involved in it?
If the latter, how were they involved?
Concerning the workshops, the authors wrote that research was done in parallel with lectures.
Was the research process conducted with any source of moderation?
Movement patterns: how were the individuals chosen to have their movement tracked?

Is the background of the case's history and progression described in sufficient detail?
Yes

Is the work clearly and accurately presented and does it cite the current literature?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full access and reuse by other researchers?
Partly

Are the conclusions drawn adequately supported by the data and analysis?
Yes

Is the case presented with sufficient detail to be useful for teaching or other practitioners?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Ecology, Fish ecology, Freshwater ecology, Agricultural ecosystems

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 02 Sep 2025

Rafael Sousa Santos

A paragraph was added to expand on the workshop development and stakeholders, addressing the relevant questions highlighted in the review.

Competing Interests: No competing interests were disclosed.

Reviewer Report 19 August 2025

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Preeti Kumari
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The manuscript entitled **"Cod, construction, and communities: Relations between fish and architectural history in Ísafjörður, Iceland"** provides the information about how urban development in Ísafjörður is intertwined with cod fisheries, using interdisciplinary and visual methods to study past and present dynamics, and suggesting approaches for future research. The research work is unique and has the potential to index in the journal. However, there are some modifications/corrections that need to be addressed:
Abstract section is incomplete. An abstract must contain a short intro, methodology, and a brief finding. Kindly modify it.
Introduction needs to be modified by adding research gaps.
Kindly add latitude, longitude, scale and direction in the figure 2 of Ísafjörður.
Kindly improve the picture quality of Figure 3 and 6. The texts are not readable.
Discussion part is weak and it need further clarifications supported by recent references.

Is the background of the case's history and progression described in sufficient detail?
Yes

Is the work clearly and accurately presented and does it cite the current literature?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full access and reuse by other researchers?
Yes

Are the conclusions drawn adequately supported by the data and analysis?
Yes

Is the case presented with sufficient detail to be useful for teaching or other practitioners?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Ecotoxicology; Bioaccumulation; Human Health Risk; Mercury; Arsenic; Cadmium; Environmental Toxicology; Metalloids; Heavy Metals; Biomonitoring; Environmental Pollution; Heavy Metal Toxicity; Biodiversity; Heavy Metal Pollution; Toxic Metals; Heavy Metals Analysis; Heavy Metal Accumulation; Bioassessment; Microplastics; Environment; Environmental Analysis; Environmental Analytical Chemistry; Environmental Impact Assessment; Environmental Monitoring; Fish toxicity; Bioaccumulation of Heavy Metals; Biotic indices; Environmental Risk Assessment; Toxicity; Ecological Risk Assessment; Environmental Exposure; Macroinvertebrates; Environmental Remediation; Ecology; Zoology; Remediation; Bioremediation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 02 Sep 2025

Rafael Sousa Santos

The abstract was updated to comply with the suggested structure. A paragraph was included in the introduction to further address research gaps. New files for figures were provided expecting better compression to be achieved in publication. Discussion was extended including recent references.

Competing Interests: No competing interests were disclosed.

Reviewer Report 12 August 2025

https://doi.org/10.21956/openreseurope.22620.r57145

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Piatã Marques
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I have now read the paper titled “Cod, construction, and communities: Relations between fish and

architectural history in Ísafjörður, Iceland". While I believe that understanding the dynamics between landscape, technology, and fish stocks is of increasing interest. While I acknowledge that interdisciplinary approaches are specially challenging to implement. I believe this paper has major flaws in the main goals, methodological approach, data obtained, data processing. Because of that I could hardly assess the strength of the discussion and conclusions. Please find specific comments below.

Major broad comments
The main goal of this paper is confusing to me. The focus here is to describe the workshop and the process of knowledge building OR it is to propose a new methodology for integrating social and ecological data? I believe the paper falls very short on either case.

The workshop activities and processes are poorly described. There is not enough information for the reader to understand what tools (e.g. group discussion, breakout groups) where used during the workshop to build knowledge (a flowchart would be key here). It is fundamental to explain how each tool builds onto another to integrate knowledge production (e.g. what is the role of the codexian as a tool? How was it built? How it integrates with the other knowledge brought by different teams?) Also, it is impossible to know how the different players were involved in the process. What is the professional/knowledge holder make up in each focus team (i.e. how many fishers, researchers, industry / community members were involved in each team and how)? When a literature review was performed, authors must include the methodology for such review. Which keywords were used? How boolean operators were used? What were the criteria for inclusion/exclusion of papers? Without this information I cannot assess the scope or the depth of information produced in the workshop (e.g. is this an academic/expert perspective only or it involves local knowledge of non-academics?). It is also impossible to assess the transdisciplinary extent of the information produced. I suggest that, if the main goal of the paper is to report on the workshop, authors put considerably more effort into detailing the processes of knowledge production.

I am very skeptical this paper presents any "methodological innovation". It seems to me that the paper proposes the readers to eyeball and guess relationships based on visual representations of three datasets (urban development, cod life cycle and fisheries). Whether this can be considered a "methodological innovation" or "robust methodological framework" is very obscure to me. I am an advocate for qualitative research, but I am very skeptical that a visual approach is nearly enough to be used as a tool to link landscape and marine processes, as proposed here. This raises concerns about: 1-visual assessments being misleading and open to readers interpretation, 2- the approach incites the reader to visualize linear relationships between fishing technology, processing facilities, and fish stocks which may or may not be the case. I strongly suggest that, if the actual objective of the paper is to advance understanding on the dynamics between landscape, technology and fish stock dynamics, the authors use a quantitative approach and explore predictive models. Quantitative data on the number of cod processing facilities, area of urbanization, number of vessels, extent of fish movement and location should be straightforward to obtain and can be used to feed those models. That would be a much stronger approach than visual evaluations.

Major specific comments
Introduction
There is an overall lack of references. Multiple strong statements are made throughout the paper,

without proper references. This leaves me wondering the extent to which the case for this paper is built on actual evidence supported by other studies. Some examples are:

- "An extensive range of facilities, such as harbors, processing plants, drying racks, and warehouses, are built manifestations of the ecological pressure on marine ecosystems."
- "The relationship between architecture and marine ecosystems, particularly in the context of fisheries, remains underexplored in both architectural and environmental humanities."
- Traditional architectural methodologies often isolate the analysis of the built environment from its ecological and socio-economic surroundings.
- "environmental assessments and marine science studies typically overlook the spatial, material, and built implications of marine ecological dynamics."

Please provide more details as to how "This framework allows us to investigate the complex interrelations between marine environments and terrestrial landscapes".

Methodology

An n=2 can hardly help understand cod movement dynamics. Also, how this data was integrated with the landscape and vessel data is very unclear.

Figure 4 is very confusing because it shows movement dynamics for the whole Iceland, while the paper focus on Ísafjörður. Please zoom in or circle the area of interest. Also, how his data is integrated with the landscape and vessel data is unclear to me.

Discussion

Overall, I believe the discussion is vague and falls very short on referencing other studies. I also believe the paper does not show enough data (from its own research) to support the following statements:

"The workshop also reinforced the idea of technology as a connector between the different lines of inquiry, environmental conditions, and ecological transformations". What specific piece of information links technology, environmental conditions (what are they specifically?) and "ecological transformations" (what are these?).

"One inconclusive question was how to address the relationships between individual cod behaviors and population patterns." It is very hard to find conclusive relationships with sample size =2.

"The cod life cycle is regular, but variations do exist in age and size at maturity between different groups and regions, influenced by environmental conditions." How exactly the age/ size difference and influence of environmental conditions was assessed? I am assuming this is from the literature, but no references provided? What is the discussion regarding the data you collected and processed

Conclusion

I am very concerned and profoundly disagree with the conclusions outlined in this paper. More specifically, I oppose the ideas that:

"Our experimentation with different representation methods yielded approaches to e) mapping, f) statistics, and g) ecosystem modelling". What are the specific contributions to "mapping' (e.g. geoprocessing analysis, predictive spatial analysis, shape files produced)? What is the statistical approach when most of the data is qualitative? What is the ecosystem modelling approach when data on ecosystem processes is nonexistent?

"With respect to fish biology and behavior, it provided general descriptions of cod at the levels of species, population, ecotype, and individual, suggesting strategies that can be used in representing and tracking the multiple scales involved." Except for the two tagged cods, all fish biology data (behavior, population dynamics etc) were obtained from the literature. Also, It is not clear to me what sort of species level or ecotype data were presented in the paper.

Is the background of the case's history and progression described in sufficient detail?
No

Is the work clearly and accurately presented and does it cite the current literature?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full access and reuse by other researchers?
Yes

Are the conclusions drawn adequately supported by the data and analysis?
No

Is the case presented with sufficient detail to be useful for teaching or other practitioners?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Urban Ecology, Fish Ecology, Socio-Ecological Dynamics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 02 Sep 2025

Rafael Sousa Santos

The purpose of the paper is to report and discuss ongoing work challenging methodology standards to develop interdisciplinary research. The reviewer's questions point to established and long-term research practices, whereas the point of the workshop was to experiment on short-term untamed methodologies. There are certainly flaws, and more important, limitations to the outcomes—this paper does not aim to accurately describe the "the ecological impact of fishing-related built environments and the natural resources upon which they depend" but to expose how to imagine, test, discuss and expose unconventional methods to address the question. The methods used are not yet fully articulated, hence their assessment in systematic opposition to conventional and established research

strategies is a relevant contribution to their continuous development. Hence, we do believe it is relevant to publish—and discuss—ongoing research. We are grateful for the thorough assessment of the paper and the workshop open ends. The flaws raised will indeed be valuable to further developments and will be taken up in future publications.

Competing Interests: No competing interests were disclosed.

Version 1

Reviewer Report 13 June 2025

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Wiebren Johannes Boonstra
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The article "Cod, construction, and communities: Relations between fish and architectural history in Isafjodur, Iceland" provides a description of ongoing methodological innovation to capture the interlinkages between terrestrial development and use of ocean resources. The article provides a clear description and makes the plausible argument that the integration and juxtaposition of (sometimes unconventional) visualisations of data can help draw unexpected interrelations between terrestrial and marine phenomena.

I find that the paper can be strengthened with a greater substantial discussion of the problem that the authors intend to address. Why is methodological innovation needed? Which scientific puzzle or social problem can it address?

More explanation is needed on the "Codexian". What is this exactly? How was it constructed?

More effort can be paid to integrating and synthesising the different sources of data. At it currently stands they are described and explained too much on their own account. I believe that linking their social and environmental dynamics in time can reveal can reveal useful information. The suggestion of a mismatch is somewhat superficial and indicates to me that the authors might need to consider more and more different data to understand how the terrestrial is linked (not mismatched) with the maritime.

Is the background of the case's history and progression described in sufficient detail?

Partly

Is the work clearly and accurately presented and does it cite the current literature?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full access and reuse by other researchers?
No source data required

Are the conclusions drawn adequately supported by the data and analysis?
Yes

Is the case presented with sufficient detail to be useful for teaching or other practitioners?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Environmental sociology; Rural sociology; Sustainability science

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 07 Jul 2025

Rafael Sousa Santos

We are very grateful for the feedback received, whose comments contributed to clarify aspects of the paper. Paragraphs in Introduction and Context sections were added to expand the information provided and respond to the main questions raised. Due to the length of the paper, the explanation of the need for methodological innovation and the scientific and social challenges addressed were kept synthetic, since a proper answer would diverge the focus of the paper from the explanation of the experimented methodology. A more detailed reference to the research project that was added offers access to the ongoing research production where the topics of relevance are fully addressed. More explanation on the Codexian was added. Minor adjustments were made to captions to Figure 4 and section 3.2.b. A paragraph was added in the discussion to address the question on data integration and synthesis. The comments on the superficial quality of the temporal mismatch were also addressed, simplifying the discussion and referencing further work. Conclusions were expanded to identify lessons learnt and next steps.

Competing Interests: No competing interests were disclosed.

Reviewer Report 09 June 2025

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The Architecture Follows Fish project is a pathbreaking and promising attempt to build a dialogue between architecture and fish biology, drawing on relevant historical data, including town and harbour plans and visual information. The case study is a concise and instructive example of how such a dialogue is being built. As such this is a valuable and publishable report.
The paper is written from a perspective that is clearly coming from within the project. To an outside perspective, it is hard to understand exactly what is being attempted and achieved in the case study. I suggest that the authors expand the Context by introducing in a paragraph the wider project and how this case study fits the overall project design. The Conclusion may identify lessons learnt and next steps.
It is important that the data underlying the results be published within the timeframe suggested in the paper.

Is the background of the case's history and progression described in sufficient detail?
Partly

Is the work clearly and accurately presented and does it cite the current literature?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full access and reuse by other researchers?
Partly

Are the conclusions drawn adequately supported by the data and analysis?
Yes

Is the case presented with sufficient detail to be useful for teaching or other practitioners?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: marine environmental history

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 07 Jul 2025

Rafael Sousa Santos

We are much grateful for the feedback. The manuscript was revised to improve clarity and address key points raised. The Introduction and Context sections were expanded, and a reference to the broader research project was added to contextualize the scientific and methodological challenges discussed. A new paragraph in the Discussion addresses data integration and synthesis, and the issue of temporal mismatch was clarified and linked to ongoing work. The Conclusions were updated to highlight lessons learned and outline future steps.

Competing Interests: No competing interests were disclosed.