

Supplementary Information:

Appendix S1: The ASIRPA Method

The ASIRPA (Analyse de l'Impact Sociétal de la Recherche) project developed a method to evaluate the socioeconomic impacts of INRAE research using an original approach (<https://asirpa.hub.inrae.fr/1-approche-asirpa>).

The ASIRPA method is designed to assess and measure the socioeconomic effects of a study using a standardised case study approach. This helps surpass the constraints of current methods, such as economic techniques that concentrate solely on this aspect or case study-based approaches that provide only fragmented views of individual cases. For the case study-based approach, the lack of a uniform initial approach for studying each case complicates the identification of consistent elements or consolidation of results.

ASIRPA aims to broaden the scope of research impact analysis beyond economic effects, considering both direct and indirect influences on policy, the environment, and health. Given that research impacts typically emerge from lengthy processes and can spread across vast areas, this approach balances scientific rigour with practical objectives. The regular application of ASIRPA has been enhanced with methodological advancements aimed at (i) recognising and gaining deeper insight into the mechanisms that produce these impacts and the lessons derived from a reverse analysis (tracing back from the observed impact to the research contributions) to optimally design systems (structures, partnerships, etc.) capable of generating impacts; (ii) demonstrating the various beneficiaries (and, if applicable, those who may be negatively affected) of the Institute's research; these actors have diverse, and at times conflicting, values, and interests. The ASIRPA approach is based on standardised case studies, which are essential for drawing generic lessons provided the number of case studies is sufficient. This approach used three complementary tools.

- 1- A timeline which identifies the beginning and end of the case and the main events between these two time points (context of action in which the case is located and inventory of the moments and forms of intervention by INRAE) (see Figure 1).
- 2- A path of impacts (Fig. S1) which graphically represents the stages of impact generation. It describes research, the journey of knowledge outside the academic sphere, its transformation, and its use by socioeconomic actors. More specifically, the impact path distinguishes and describes the characteristics of the research (inputs), its primary products (outputs), first-level impacts generated within the first sphere of beneficiaries, second-level impacts corresponding to the generalisation of the first-level impacts beyond the first circle of beneficiaries, and intermediaries involved in each stage of the impact path. This impact results from the synergistic actions of a diverse network of actors. The impact path is

essential for determining the specific contribution of INRAE within this network, analysing the role of contextual factors, and identifying the critical mechanisms underlying the generation of impact.

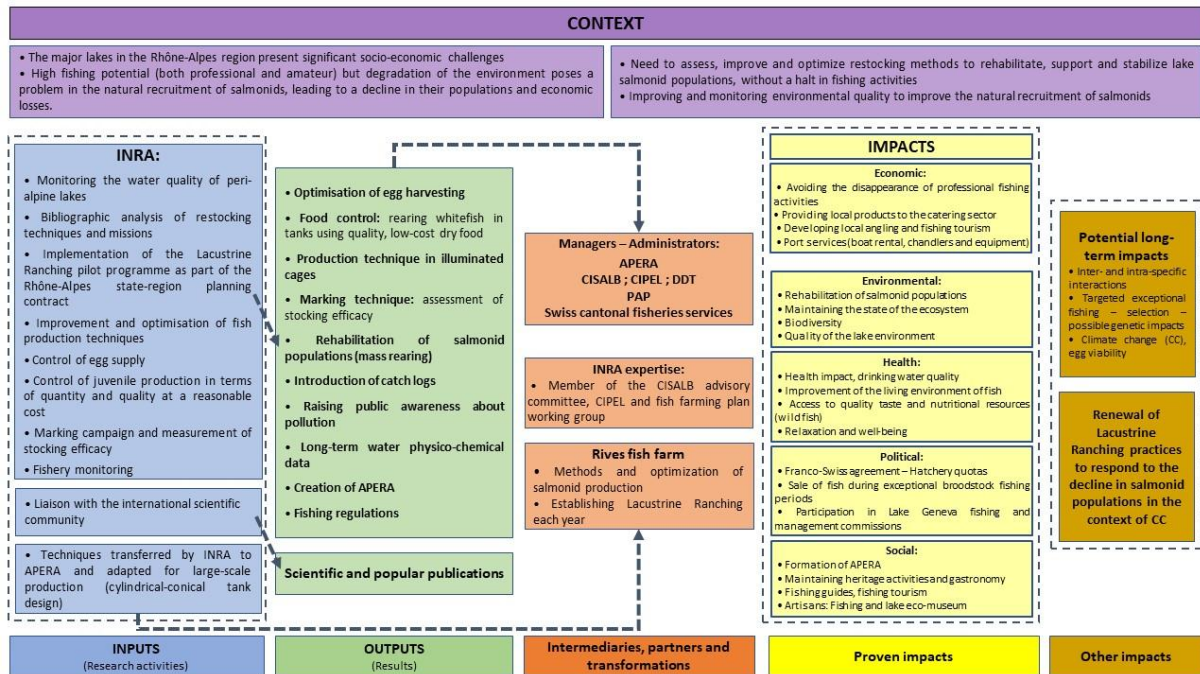


Figure S1: Impact pathway adapted from Rogissart *et al.* (2023).

- 3- A vector of impacts was synthesised in the form of a table (Table S1) and illustrated by a radar (Fig. S2), which describes the impacts generated on five dimensions, namely, (1) economic, (2) environmental, (3) health and sanitation, (4) political, and (5) social and territorial. For each dimension, the intensity of impact was graded on a scale of 1 (very weak impact) to 5 (very strong impact).

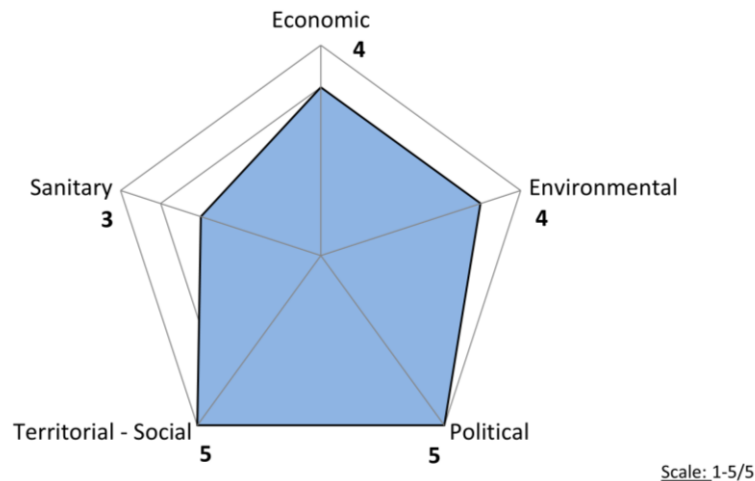


Figure S2: Radar of impacts adapted from Rogissart *et al.* (2023).

Table S1: Vector of impacts adapted from Rogissart *et al.* (2023).

Impact dimension	<i>Rating of the importance of the impacts: 1 to 5</i>	Summary of impacts
Economic	4	Dynamic of the professional and amateur fishing industry.
Environmental	4	Rehabilitation of lacustrine salmonids and maintenance of the ecosystem's state.
Health and sanitation	3	Improved water quality and well-being.
Territorial-social	5	Creation of associations, preserving heritage, eco-museum, local craftsmanship.
Political	5	Continuity of fish-farming quotas in the Franco-Swiss Agreement, participation in fishing commissions and fishing regulations.

These three tools enable the description and analysis of the mechanisms that are impactful when used in conjunction with the standardised framework of the report. In other words, they help to identify the sequences of ‘translation’ operations that link research to real world applications. To date, more than 60 cases have been studied thoroughly (<https://asirpa.hub.inrae.fr/60-cas-etudes>) and INRAE has implemented a real-time approach to analyse impact pathways at different stages of a project, with the aim of accelerating or amplifying its societal benefits.

To go further:

The complete report in French: Rogissart, H., Goulon, C., Guillard, J., 2023. *Réhabilitation des salmonidés des lacs péri-alpins : Pacage lacustre. Une recherche participative impliquant des scientifiques et des pêcheurs.* INRAE, 2023, pp. 35. (hal-03918344)

INRAE DipSO, May 11, 2023. *Réhabilitation des salmonidés des lacs péri-alpins : pacage lacustre - version longue* [Movie]. Youtube. <https://www.youtube.com/watch?v=C36SvuFARww>

Joly, P.B., Gaunand, A., Colinet, L., Larédo, P., Lemarié, S., Matt, M., 2015. ASIRPA: A comprehensive theory-based approach to assessing the societal impacts of a research organization. *Res. Eval.*, 24, 440-453. <https://doi.org/10.1093/reseval/rvv015>

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Appendix S2:

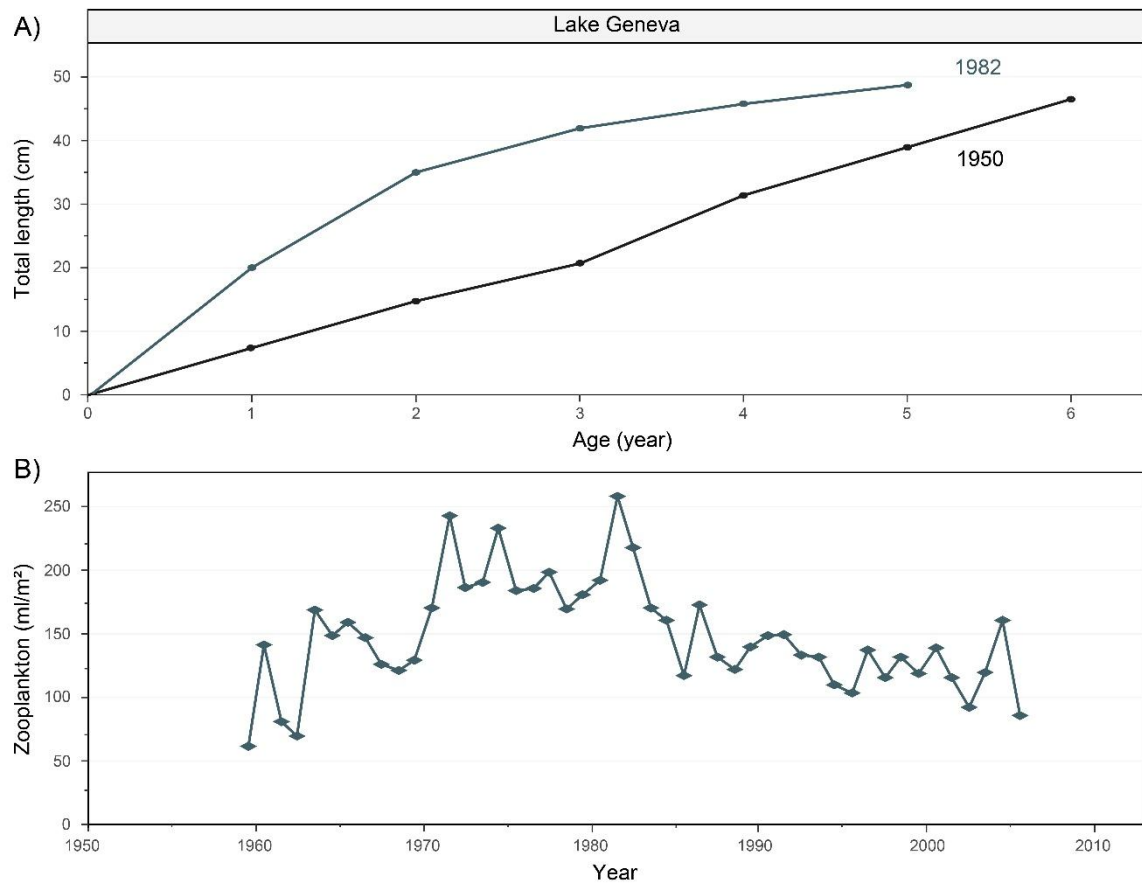


Figure S3: A) Total size-at-age (cm; year) of whitefish from Lake Geneva in 1950 and 1982 (Dottrens, 1950; Champigneulle *et al.*, 1983). B) Evolution of zooplankton biovolume (ml/m²) in Lake Geneva (adapted from Champigneulle and Caudron, 2013; data from SOERE SI-OLA; Rimet *et al.*, 2020).

Table S2: Whitefish stocking and assessment of 'Pacage lacustre' contributions in Lake Geneva and Lake Bourget using marking methods by cauterising the adipose fin (ad. fin.) and fluoromarking with Alizarin Red S (ARS) (Champigneulle and Gerdeaux, 1992; Champigneulle and Cachera, 2003, 2008).

Lake	Marking method	Cohort	Stage	Marked (n)	Recapture (n)	Contribution % (IC95%)	kg recaptured/1000 fingerlings (IC95%)
Lake Geneva	Cauterising ad. fin.	1983	Spring-prefed fry	26 000	1 041	5.4 (1.9)	27 (18-37)
Lake Geneva	Cauterising ad. fin.	1984	Spring-prefed fry	17 000	2 506	4.4 (1.5)	23 (15-26)
Lake Geneva	Cauterising ad. fin.	1985	Spring-prefed fry	63 000	3 347	4.2 (0.9)	22 (17-26)
Lake Bourget	Cauterising ad. fin.	1987	Spring-prefed fry	44 000	1298	12.9-15.8	14.5
Lake Bourget	Cauterising ad. fin.	1989	Spring-prefed fry	11 500	987	4.7-12.6	16.5
Lake Bourget	Cauterising ad. fin.	1990	Spring-prefed fry	11 050	603	80	-
Lake Bourget	Fluoromarking: ARS	2004	Larvae started	180 000	259	10.8 (7.8-16.2)	7.8
Lake Bourget	Fluoromarking: ARS	2005	Larvae started	100 000	186	9.1 (5.9-15.3)	2.3
Lake Bourget	Fluoromarking: ARS	2006	Larvae started	320 000	468	7.1 (4.9-10.9)	-

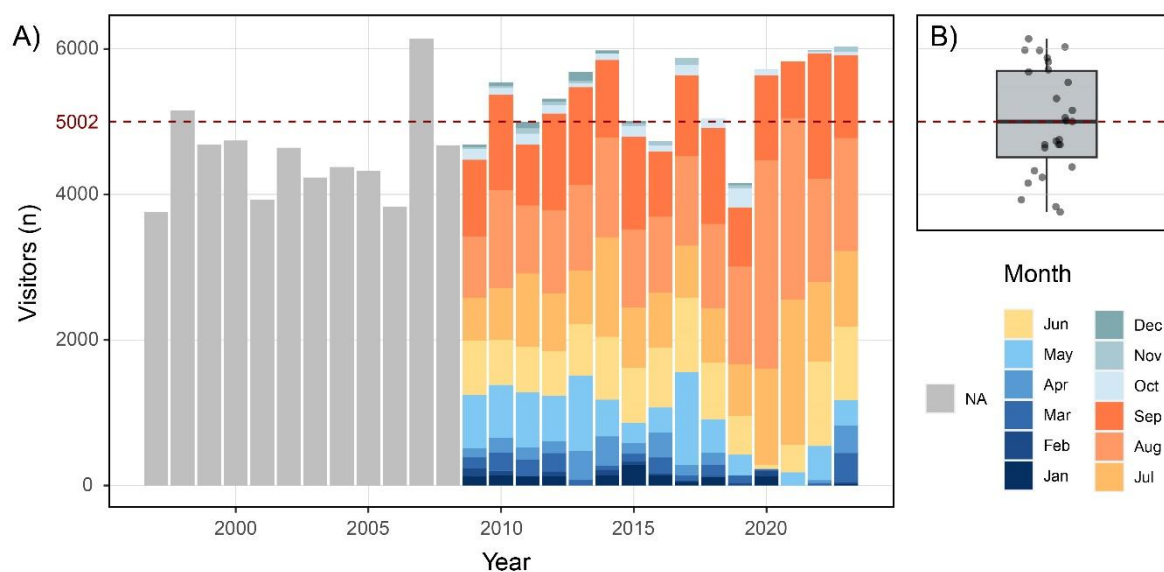


Figure S4: A) Number of annual and monthly visitors to Thonon's Fishing and Lake Ecomuseum (Ecomusée de la pêche et du lac) in Thonon-les-Bains, France, dedicated to preserving the memory and historical heritage of fishing. The dashed line represents the annual average from 1997 to 2023. B) Boxplot shows the number of visitors from 1997 to 2023 (data from Thonon-les-Bains, France, town hall). The museum welcomes both individual visitors and groups with limited individual access during the summer season, from June to the end of September.

References

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