Consortium Agreement

IMPACT

Version 2 – 19 December 2023

Based on DESCA – Model Consortium Agreement for Horizon Europe

AP Version 1

July 2022

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CONSORTIUM AGREEMENT

THIS CONSORTIUM AGREEMENT is based upon Regulation (EU) No 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation (2021-2027), laying down its rules for participation and dissemination (hereinafter referred to as "Horizon Europe Regulation"), and on the European Commission's General Model Grant Agreement and its Annexes, and is made on 1 January 2024, hereinafter referred to as the Effective Date

BETWEEN:

STIFTELSEN NORSK INSTITUTT FOR NATURFORSKNING, NINA, Høgskoleringen 9, Postboks 5685 Torgarden, 7485 Trondheim, Norway, the Coordinator,

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ATLANTIC TECHNOLOGICAL UNIVERSITY, ATU, Old Dublin Road, H91 T8NW Galway, Ireland,

NWO I - ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH, NIOZ, Landsdiep 4, 1797 SZ Den Hoorn, The Netherlands,

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INSTITUTE OF GEOGRAPHY AND SUSTAINABILITY, UNIVERSITY OF LAUSANNE, IGD, Geopolis, 1015 Lausanne, Switzerland

UIT THE ARCTIC UNIVERSITY OF NORWAY, UiT, Hansine Hansens veg, PO Box 6050, 9037 Tromsø, Norway

hereinafter jointly referred to as "Beneficiaries"

hereinafter the Coordinator and the Beneficiaries, individually, referred to as "Parties"

relating to the Action entitled

INTEGRATED MONITORING OF PARASITES IN CHANGING ENVIRONMENTS

in short

IMPACT

hereinafter referred to as "Project"

WHEREAS:

The Parties, having considerable experience in the field concerned, have submitted a proposal for the Project to the Granting Authority as part of the European Biodiversity Partnership (Biodiversa+) – call BiodivMon (2022-2023).

The Parties wish to specify or supplement binding commitments among themselves in addition to the provisions of the specific Research plan (Attachment 1) to be signed by the Parties and the Granting Authority (hereinafter "Grant Agreement").

The Parties are aware that this Consortium Agreement is based upon the DESCA model consortium agreement.

NOW, THEREFORE, IT IS HEREBY AGREED AS FOLLOWS:

1 Definitions

1.1 Definitions

Words beginning with a capital letter shall have the meaning defined either herein or in the Horizon Europe Regulation or in the Grant Agreement including its Annexes.

1.2 Additional Definitions

"Background"

Background means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that is: (a) held by the Beneficiaries before they acceded to the Agreement and (b) needed to implement the action or exploit the results.

"Consortium Body"

Consortium Body means any management body described in Section 6 (Governance Structure) of this Consortium Agreement.

"Consortium Plan"

Consortium Plan means the description of the Action and the related agreed budget as first defined in the Grant Agreement and which may be updated by the General Assembly.

"Granting Authority"

means the body awarding the grant for the Project (Biodiversa+).

"Defaulting Party"

Defaulting Party means a Party which the General Assembly has declared to be in breach of this Consortium Agreement and/or the Grant Agreement as specified in Section 4.3 of this Consortium Agreement.

"National Funding Organisation/s"

National Funding Organisation/s means the national funding organisation/s participating in the Biodiversa+ BIODIVMON call.

"Needed"

means:

For the implementation of the Project:

Access Rights are Needed if, without the grant of such Access Rights, carrying out the tasks assigned to the recipient Party would be technically or legally impossible, significantly delayed, or require significant additional financial or human resources.

For Exploitation of own Results:

Access Rights are Needed if, without the grant of such Access Rights, the Exploitation of own Results would be technically or legally impossible.

"Results"

Results means any tangible or intangible effect of the action, such as data, know-how or information, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.

2 Purpose

The purpose of this Consortium Agreement is to specify with respect to the Project the relationship among the Parties, in particular concerning the organisation of the work between the Parties, the management of the Project and the rights and obligations of the Parties concerning inter alia liability, Access Rights and dispute resolution.

3 Entry into force, duration and termination

3.1 Entry into force

An entity becomes a Party to this Consortium Agreement upon signature of this Consortium Agreement by a duly authorised representative.

This Consortium Agreement shall have effect from the Effective Date identified at the beginning of this Consortium Agreement.

An entity becomes a new Party to the Consortium Agreement upon signature of the accession document (Attachment 2) by the new Party and the Coordinator. Such accession shall have effect from the date identified in the accession document.

3.2 Duration and termination

This Consortium Agreement shall continue in full force and effect until complete fulfilment of all obligations undertaken by the Parties under the Grant Agreement and under this Consortium Agreement.

However, this Consortium Agreement or the participation of one or more Parties to it may be terminated in accordance with the terms of this Consortium Agreement.

If

- the Grant Agreement is not signed by the Granting Authority or a Beneficiary, or

- the Grant Agreement is terminated, or
- a Beneficiary's participation in the Grant Agreement is terminated,

this Consortium Agreement shall automatically terminate in respect of the affected Party/ies, subject to the provisions surviving the expiration or termination under Section 3.3 of this Consortium Agreement.

If an Associated Partner´s participation in the Project is terminated, its participation in this Consortium Agreement may be terminated subject to the provisions surviving the expiration or termination under this Consortium Agreement (Section 4.2 and Section 3.3).

3.3 Survival of rights and obligations

The provisions relating to Access Rights, Dissemination and confidentiality, for the time period mentioned therein, as well as for liability, applicable law and settlement of disputes shall survive the expiration or termination of this Consortium Agreement.

Termination shall not affect any rights or obligations of a Party leaving the Project incurred prior to the date of termination, unless otherwise agreed between the General Assembly and the leaving Party. This includes the obligation to provide all necessary input, deliverables and documents for the period of its participation.

4 Responsibilities of Parties

4.1 General principles

Each Party undertakes to take part in the efficient implementation of the Project, and to cooperate, perform and fulfil, promptly and on time, all of its obligations under the Grant Agreement and this Consortium Agreement as may be reasonably required from it and in a manner of good faith as prescribed by Belgian law.

Each Party undertakes to notify promptly the Granting Authority and the other Parties, in accordance with the governance structure of the Project, of any significant information, fact, problem or delay likely to affect the Project.

Each Party shall promptly provide all information reasonably required by a Consortium Body or by the Coordinator to carry out its tasks and shall responsibly manage the access of its employees to the EU Funding & Tenders Portal.

Each Party shall take reasonable measures to ensure the accuracy of any information or materials it supplies to the other Parties.

4.2 Breach

In the event that the General Assembly identifies a breach by a Party of its obligations under this Consortium Agreement or the Grant Agreement (e.g. improper implementation of the Project), the Coordinator or, if the Coordinator is in breach of its obligations, the Party appointed by the General Assembly, will give formal notice to such Party requiring that such breach will be remedied within 30 calendar days from the date of receipt of the written notice by the Party.

If such breach is substantial and is not remedied within that period or is not capable of remedy, the General Assembly may decide to declare the Party to be a Defaulting Party and to decide on the consequences thereof which may include termination of its participation.

4.3 Involvement of third parties

A Party that enters into a subcontract or otherwise involves third parties (including but not limited to Affiliated Entities or other Participants) in the Project remains responsible for carrying out its relevant part of the Project and for such third party's compliance with the provisions of this Consortium Agreement and of the Grant Agreement. Such Party has to ensure that the involvement of third parties does not affect the rights and obligations of the other Parties under this Consortium Agreement and the Grant Agreement.

4.4 Specific responsibilities regarding data protection

Where necessary, the Parties shall cooperate in order to enable one another to fulfil legal obligations arising under applicable data protection laws (the *Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data* and relevant national data protection law applicable to said Party) within the scope of the performance and administration of the Project and of this Consortium Agreement.

In particular, the Parties shall, where necessary, conclude a separate data processing, data sharing and/or joint controller agreement before any data processing or data sharing takes place.

5 Liability towards each other

5.1 No warranties

In respect of any information or materials (incl. Results and Background) supplied by one Party to another under the Project, no warranty or representation of any kind is made, given or implied as to the sufficiency or fitness for purpose nor as to the absence of any infringement of any proprietary rights of third parties.

Therefore,

- the recipient Party shall in all cases be entirely and solely liable for the use to which it puts such information and materials, and
- no Party granting Access Rights shall be liable in case of infringement of proprietary rights of a third party resulting from any other Party (or its entities under the same control) exercising its Access Rights.

5.2 Limitations of contractual liability

No Party shall be responsible to any other Party for any indirect or consequential loss or similar damage such as, but not limited to, loss of profit, loss of revenue or loss of contracts, except in case of breach of confidentiality.

A Party's general aggregate liability towards the other Parties collectively shall be limited to once the Beneficiary's share of the total costs of the Project as identified in Annex 2 of the Grant Agreement.

A Party's liability shall not be limited under either of the two foregoing paragraphs to the extent such damage was caused by a wilful act or gross negligence or to the extent that such limitation is not permitted by law.

5.3 Damage caused to third parties

Each Party shall be solely liable for any loss, damage or injury to third parties resulting from the performance of the said Party's obligations by it or on its behalf under this Consortium Agreement or from its use of Results or Background.

5.4 Force Majeure

No Party shall be considered to be in breach of this Consortium Agreement if it is prevented from fulfilling its obligations under the Consortium Agreement by Force Majeure.

Each Party will notify the General Assembly of any Force Majeure without undue delay. If the consequences of Force Majeure for the Project are not overcome within 6 weeks after such notice, the transfer of tasks - if any - shall be decided by the General Assembly.

5.5 Export control

No Party shall be considered to be in breach of this Consortium Agreement if it is prevented from fulfilling its obligations under the Consortium Agreement due to a restriction resulting from import or export laws and regulations and/or any delay of the granting or extension of the import or export license or any other governmental authorisation, provided that the Party has used its reasonable efforts to fulfil its tasks and to apply for any necessary license or authorisation properly and in time.

Each Party will notify the General Assembly of any such restriction without undue delay. If the consequences of such restriction for the Project are not overcome within 6 weeks after such notice, the transfer of tasks - if any - shall be decided by the General Assembly.

6 Governance structure

6.1 General structure

The organisational structure of the consortium shall comprise the following Consortium Bodies:

The **General Assembly** is the decision-making body of the consortium.

The **Coordinator** is the legal entity acting as the intermediary between the Parties and the Granting Authority. The Coordinator shall, in addition to its responsibilities as a Party, perform the tasks assigned to it as described in the Grant Agreement and this Consortium Agreement.

6.2 Members

The General Assembly shall consist of one representative of each Party (hereinafter referred to as "Member").

Each Member shall be deemed to be duly authorised to deliberate, negotiate and decide on all matters listed in Section 6.3.7 of this Consortium Agreement.

The Coordinator shall chair all meetings of the General Assembly, unless decided otherwise by the General Assembly.

The Parties agree to abide by all decisions of the General Assembly.

This does not prevent the Parties from exercising their veto rights, according to Section 6.3.5, or from submitting a dispute for resolution in accordance with the provisions of settlement of disputes in Section 11.8 of this Consortium Agreement.

Regarding unanimity or majority decisions, only Members with voting rights regarding the item are taken into account (e.g. Section 6.3.2.5).

6.3 Operational procedures for the General Assembly:

6.3.1 Representation in meetings

Any Member:

- should be present or represented at any meeting;
- may appoint a substitute or a proxy to attend and vote at any meeting;
- and shall participate in a cooperative manner in the meetings.

6.3.2 Preparation and organisation of meetings

6.3.2.1 Convening meetings:

The chairperson shall convene ordinary meetings of the General Assembly at least once every six months and shall also convene extraordinary meetings at any time upon written request of any Member.

6.3.2.2 Notice of a meeting

The chairperson shall give written notice of a meeting to each Member as soon as possible and no later than 14 calendar days preceding an ordinary meeting and 7 calendar days preceding an extraordinary meeting.

6.3.2.3 Sending the agenda:

The chairperson shall prepare and send each Member an agenda no later than 14 calendar days preceding the meeting, or 7 calendar days before an extraordinary meeting.

6.3.2.4 Adding agenda items:

Any agenda item requiring a decision by the Members must be identified as such on the agenda.

Any Member may add an item to the original agenda by written notice to all of the other Members no later than 7 calendar days preceding the meeting and 2 days preceding an extraordinary meeting.

6.3.2.5

During a meeting of the General Assembly the Members present or represented can unanimously agree to add a new item to the original agenda.

6.3.2.6

Meetings of the General Assembly may also be held by tele- or videoconference or other telecommunication means.

6.3.2.7

Decisions will only be binding once the relevant part of the minutes has been accepted according to Section 6.3.6.2.

6.3.3 Decisions without a meeting

Any decision may also be taken without a meeting if

a) the Coordinator circulates to all Members of the General Assembly a suggested decision with a deadline for responses of at least 10 calendar days after receipt by a Party and

b) the decision is agreed by 51 % of all Parties.

The Coordinator shall inform all the Members of the outcome of the vote.

A veto according to Section 6.3.5 may be submitted up to 15 calendar days after receipt of this information.

The decision will be binding after the Coordinator sends a notification to all Members. The Coordinator will keep records of the votes and make them available to the Parties on request.

6.3.4 Voting rules and quorum

6.3.4.1

The General Assembly shall not deliberate and decide validly in meetings unless two-thirds (2/3) of its Members are present or represented (quorum).

If the quorum is not reached, the chairperson of the General Assembly shall convene another ordinary meeting within 15 calendar days. If in this meeting the quorum is not reached once more, the chairperson shall convene an extraordinary meeting which shall be entitled to decide even if less than the quorum of Members is present or represented.

6.3.4.2

Each Member present or represented in the meeting shall have one vote. Associated Partners are excluded from certain decisions of the General Assembly according to Section 6.2.

A Party which the General Assembly has declared according to Section 4.3 to be a Defaulting Party may not vote.

6.3.4.3

Decisions shall be taken by a majority of two-thirds (2/3) of the votes cast.

6.3.5 Veto rights

6.3.5.1

A Party which can show that its own work, time for performance, costs, liabilities, intellectual property rights or other legitimate interests would be severely affected by a decision of the General Assembly may exercise a veto with respect to the corresponding decision or relevant part of the decision.

6.3.5.2

When the decision is foreseen on the original agenda, a Party may only veto such a decision during the meeting.

6.3.5.3

When a decision has been taken on a new item added to the agenda before or during the meeting, a Party may veto such decision during the meeting or within 15 calendar days after receipt of the draft minutes of the meeting.

6.3.5.4

When a decision has been taken without a meeting a Party may veto such decision within 15 calendar days after receipt of the written notice by the chairperson of the outcome of the vote.

6.3.5.5

In case of exercise of veto, the Parties shall make every effort to resolve the matter which occasioned the veto to the general satisfaction of all Parties.

6.3.5.6

A Party may neither veto decisions relating to its identification to be in breach of its obligations nor to its identification as a Defaulting Party. The Defaulting Party may not veto decisions relating to its participation and termination in the consortium or the consequences of them.

6.3.5.7

A Party requesting to leave the consortium may not veto decisions relating thereto.

6.3.6 Minutes of meetings

6.3.6.1

The chairperson shall produce minutes of each meeting which shall be the formal record of all decisions taken. He/she shall send draft minutes to all Members within 10 calendar days of the meeting.

6.3.6.2

The minutes shall be considered as accepted if, within 15 calendar days from receipt, no Party has sent an objection to the chairperson with respect to the accuracy of the draft minutes by written notice.

6.3.6.3

The chairperson shall send the accepted minutes to all the Members, and to the Coordinator, who shall retain copies of them.

6.3.7 Decisions of the General Assembly

The General Assembly, shall be free to act on its own initiative to formulate proposals and take decisions in accordance with the procedures set out herein.

The following decisions shall be taken by the General Assembly:

Content, finances and intellectual property rights

- Proposals for changes to Annexes 1 and 2 of the Grant Agreement to be agreed by the Granting Authority
- Changes to the Consortium Plan
- Modifications or withdrawal of Background in Attachment 2 (Background Included)

Evolution of the consortium

- Entry of a new Party to the Project and approval of the settlement on the conditions of the accession of such a new Party
- Withdrawal of a Party from the Project and the approval of the settlement on the conditions of the withdrawal
- Proposal to the Granting Authority for a change of the Coordinator
- Proposal to the Granting Authority for suspension of all or part of the Project
- Proposal to the Granting Authority for termination of the Project and the Consortium Agreement

Breach, defaulting party status and litigation

- Identification of a breach by a Party of its obligations under this Consortium Agreement or the Grant Agreement
- Declaration of a Party to be a Defaulting Party
- Remedies to be performed by a Defaulting Party
- Termination of a Defaulting Party's participation in the consortium and measures relating thereto
- Steps to be taken for litigation purposes and the coverage of litigation costs in case of joint claims of the parties of the consortium against a Party (Section 4.2, Section 7.1.4)

6.4 Coordinator

6.4.1

The Coordinator shall be the intermediary between the Parties and the Granting Authority and shall perform all tasks assigned to it as described in the Grant Agreement and in this Consortium Agreement.

6.4.2

In particular, the Coordinator shall be responsible for:

- monitoring compliance by the Parties with their obligations under this Consortium Agreement and the Grant Agreement
- keeping the address list of Members and other contact persons updated and available
- collecting, reviewing to verify consistency and submitting reports, other deliverables (including financial statements and related certification) and specific requested documents to the Granting Authority
- preparing the meetings, proposing decisions and preparing the agenda of General Assembly meetings, chairing the meetings, preparing the minutes of the meetings and monitoring the implementation of decisions taken at meetings
- transmitting promptly documents and information connected with the Project to any other Party concerned
- administering the financial contribution of the Granting Authority and fulfilling the financial tasks described in Section 7.2

- providing, upon request, the Parties with official copies or originals of documents that are in the sole possession of the Coordinator when such copies or originals are necessary for the Parties to present claims

If one or more of the Parties is late in submission of any Project deliverable, the Coordinator may nevertheless submit the other Parties' Project deliverables and all other documents required by the Grant Agreement to the Granting Authority in time.

6.4.3

If the Coordinator fails in its coordination tasks, the General Assembly may propose to the Granting Authority to change the Coordinator.

6.4.4

The Coordinator shall not be entitled to act or to make legally binding declarations on behalf of any other Party or of the consortium, unless explicitly stated otherwise in the Grant Agreement or this Consortium Agreement.

6.4.5

The Coordinator shall not enlarge its role beyond the tasks specified in this Consortium Agreement and in the Grant Agreement.

7 Financial provisions

7.1 General Principles

7.1.1 Justifying Costs

In accordance with its own usual accounting and management principles and practices, each Beneficiary shall be solely responsible for justifying its costs (and those of its Affiliated Entities, if any) with respect to the Project towards the National Funding Organisation and Granting Authority. Neither the Coordinator nor any of the other Beneficiaries shall be in any way liable or responsible for such justification of costs towards the National Funding Organisation and Granting Authority.

7.1.2 Funding Principles

Each Beneficiary will adhere to their national Funding Organisations' funding regulations.

7.2 Payments

7.2.1 Payments to Beneficiaries

Beneficiaries will inform the Coordinator upon receival of project funds from their Funding Organisation.

8 Results

8.1 Ownership of Results

Results are owned by the Party that generates them in agreement with the rules of the National Funding Organisation.

8.2 Joint ownership

Joint ownership is governed by Grant Agreement Article 16.4 and its Annex 5, Section Ownership of results, with the following additions:

Unless otherwise agreed:

- each of the joint owners shall be entitled to use their jointly owned Results for non-commercial research and teaching activities on a royalty-free basis, and without requiring the prior consent of the other joint owner(s).
- each of the joint owners shall be entitled to otherwise Exploit the jointly owned Results and to grant non-exclusive licenses to third parties (without any right to sub-license), if the other joint owners are given at least 45 calendar days advance notice.

The joint owners shall agree on all protection measures and the division of related cost in advance.

8.3 Dissemination

8.3.1 General dissemination

For the avoidance of doubt, the confidentiality obligations set out in Section 10 apply to all dissemination activities described in this Section 8.3 as far as Confidential Information is involved. The Parties are allowed to disseminate general information about the scope of the project (i.e. aims) with the goal of providing project visibility to the general public. Specific information on project work packages, and tasks within, should not be disclosed without prior approval from all Parties involved in each work package and the Coordinator.

8.3.2 Dissemination of own (including jointly owned) Results

8.3.2.1

During the Project and for a period of 2 year after the end of the Project, the dissemination of own Results by one or several Parties including but not restricted to publications and presentations, shall be governed by the procedure of Article 17.4 of the Grant Agreement and its Annex 5, Section Dissemination, subject to the following provisions.

Prior notice of any planned publication shall be given to the other Parties at least 45 calendar days before the publication. Any objection to the planned publication shall be made in accordance with the Grant Agreement by written notice to the Coordinator and to the Party or Parties proposing the dissemination within 30 calendar days after receipt of the notice. If no objection is made within the time limit stated above, the publication is permitted.

8.3.2.2

An objection is justified if

a) the protection of the objecting Party's Results or Background would be adversely affected, or

b) the objecting Party's legitimate interests in relation to its Results or Background would be significantly harmed, or

c) the proposed publication includes Confidential Information of the objecting Party.

The objection has to include a precise request for necessary modifications.

8.3.2.3

If an objection has been raised the involved Parties shall discuss how to overcome the justified grounds for the objection on a timely basis (for example by amendment to the planned publication and/or by protecting information before publication) and the objecting Party shall not unreasonably continue the opposition if appropriate measures are taken following the discussion.

8.3.2.4

The objecting Party can request a publication delay of not more than 90 calendar days from the time it raises such an objection. After 90 calendar days the publication is permitted, provided that the objections of the objecting Party have been addressed.

8.3.3 Dissemination of another Party's unpublished Results or Background

A Party shall not include in any dissemination activity another Party's Results or Background without obtaining the owning Party's prior written approval, unless they are already published.

8.3.4 Cooperation obligations

The Parties undertake to cooperate to allow the timely submission, examination, publication and defense of any dissertation or thesis for a degree that includes their Results or Background subject to the confidentiality and publication provisions agreed in this Consortium Agreement.

8.3.5 Use of names, logos or trademarks

Nothing in this Consortium Agreement shall be construed as conferring rights to use in advertising, publicity or otherwise the name of the Parties or any of their logos or trademarks without their prior written approval.

9 Access Rights

9.1 Background included

9.1.1

In Attachment 2, the Parties have identified and agreed on the Background for the Project and have also, where relevant, informed each other that Access to specific Background is subject to legal restrictions or limits.

Anything not identified in Attachment 2 shall not be the object of Access Right obligations regarding Background.

9.1.2

Any Party may add additional Background to Attachment 2 during the Project provided they give written notice to the other Parties. However, approval of the General Assembly is needed should a Party wish to modify or withdraw its Background in Attachment 2.

9.2 General Principles

9.2.1

Each Party shall implement its tasks in accordance with the Consortium Plan and shall bear sole responsibility for ensuring that its acts within the Project do not knowingly infringe third party property rights.

9.2.2

Any Access Rights granted exclude any rights to sublicense unless expressly stated otherwise.

9.2.3

Access Rights shall be free of any administrative transfer costs.

9.2.4

Access Rights are granted on a non-exclusive basis.

9.2.5

Results and Background shall be used only for the purposes for which Access Rights to it have been granted.

9.2.6

All requests for Access Rights shall be made in writing. The granting of Access Rights may be made conditional on the acceptance of specific conditions aimed at ensuring that these rights will be used only for the intended purpose and that appropriate confidentiality obligations are in place.

9.2.7

The requesting Party must show that the Access Rights are Needed.

9.3 Access Rights for implementation

Access Rights to Results and Background Needed for the performance of the own work of a Party under the Project shall be granted on a royalty-free basis, unless otherwise agreed for Background in Attachment 2.

9.4 Access Rights for Exploitation

9.4.1 Access Rights to Results

Access Rights to Results if Needed for Exploitation of a Party's own Results shall be granted on Fair and Reasonable conditions.

Access rights to Results for internal research and for teaching activities shall be granted on a royalty-free basis.

9.4.2

Access Rights to Background if Needed for Exploitation of a Party's own Results, shall be granted on Fair and Reasonable conditions.

9.4.3

A request for Access Rights may be made up to twelve months after the end of the Project or, in the case of Section 9.7.2.1.2, after the termination of the requesting Party's participation in the Project.

9.5 Access Rights for entities under the same control

Entities under the same control have Access Rights under the conditions of the Grant Agreement Article 16.4 and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for entities under the same control".

Such Access Rights must be requested by the entity under the same control from the Party that holds the Background or Results. Alternatively, the Party granting the Access Rights may individually agree with the Beneficiary / Party requesting the Access Rights to have the Access Rights include the right to sublicense to the latter's entity under the same control. Access Rights to an entity under the same control shall be granted on Fair and Reasonable conditions and upon written bilateral agreement.

Entities under the same control which obtain Access Rights in return fulfil all confidentiality obligations accepted by the Parties under the Grant Agreement or this Consortium Agreement as if such entities were Parties.

Access Rights may be refused to entities under the same control if such granting is contrary to the legitimate interests of the Party which owns the Background or the Results.

Access Rights granted to any entity under the same control are subject to the continuation of the Access Rights of the Beneficiary / Party with whom it is under the same control, and shall automatically terminate upon termination of the Access Rights granted to such Beneficiary / Party.

Upon cessation of the status as an entity under the same control, any Access Rights granted to such former entity under the same control shall lapse.

Further arrangements with entities under the same control may be negotiated in separate agreements.

9.6 Additional Access Rights

For the avoidance of doubt any grant of Access Rights not covered by the Grant Agreement or this Consortium Agreement shall be at the absolute discretion of the owning Party and subject to such terms and conditions as may be agreed between the owning and receiving Parties.

9.7 Access Rights for Parties entering or leaving the consortium

9.7.1 New Parties entering the consortium

As regards Results developed before the accession of the new Party, the new Party will be granted Access Rights on the conditions applying for Access Rights to Background.

9.7.2 Parties leaving the consortium

9.7.2.1 Access Rights granted to a leaving Party

9.7.2.1.1 Defaulting Party

Access Rights granted to a Defaulting Party and such Party's right to request Access Rights shall cease immediately upon receipt by the Defaulting Party of the formal notice of the decision of the General Assembly to terminate its participation in the consortium.

9.7.2.1.2 Non-defaulting Party

A non-defaulting Party leaving voluntarily and with the other Parties' consent shall have Access Rights to the Results developed until the date of the termination of its participation.

It may request Access Rights within the period of time specified in Section 9.4.3.

9.7.2.2 Access Rights to be granted by any leaving Party

Any Party leaving the Project shall continue to grant Access Rights pursuant to the Grant Agreement and this Consortium Agreement as if it had remained a Party for the whole duration of the Project.

10 Non-disclosure of information

10.1

All information in whatever form or mode of communication, which is disclosed by a Party (the “Disclosing Party”) to any other Party (the “Recipient”) in connection with the Project during its implementation and which has been explicitly marked as “confidential” at the time of disclosure, or when disclosed orally has been identified as confidential at the time of disclosure and has been confirmed and designated in writing within 15 calendar days from oral disclosure at the latest as confidential information by the Disclosing Party, is “Confidential Information”.

10.2

The Recipient hereby undertakes in addition and without prejudice to any commitment on non-disclosure under the Grant Agreement, for a period of 5 years after the final payment of the Granting Authority:

- not to use Confidential Information otherwise than for the purpose for which it was disclosed;
- not to disclose Confidential Information without the prior written consent by the Disclosing Party;
- to ensure that internal distribution of Confidential Information by a Recipient shall take place on a strict need-to-know basis; and
- to return to the Disclosing Party, or destroy, on request all Confidential Information that has been disclosed to the Recipients including all copies thereof and to delete all information stored in a machine-readable form to the extent practically possible. The Recipients may keep a copy to the extent it is required to keep, archive or store such Confidential Information because of compliance with applicable laws and regulations or for the proof of on-going obligations provided that the Recipient complies with the confidentiality obligations herein contained with respect to such copy.

10.3

The Recipient shall be responsible for the fulfilment of the above obligations on the part of its employees or third parties involved in the Project and shall ensure that they remain so obliged, as far as legally possible, during and after the end of the Project and/or after the termination of the contractual relationship with the employee or third party.

10.4

The above shall not apply for disclosure or use of Confidential Information, if and in so far as the Recipient can show that:

- the Confidential Information has become or becomes publicly available by means other than a breach of the Recipient's confidentiality obligations;
- the Disclosing Party subsequently informs the Recipient that the Confidential Information is no longer confidential;
- the Confidential Information is communicated to the Recipient without any obligation of confidentiality by a third party who is to the best knowledge of the Recipient in lawful possession thereof and under no obligation of confidentiality to the Disclosing Party;
- the disclosure or communication of the Confidential Information is foreseen by provisions of the Grant Agreement;
- the Confidential Information, at any time, was developed by the Recipient completely independently of any such disclosure by the Disclosing Party;
- the Confidential Information was already known to the Recipient prior to disclosure, or
- the Recipient is required to disclose the Confidential Information in order to comply with applicable laws or regulations or with a court or administrative order, subject to the provision Section 10.7 hereunder.

10.5

The Recipient shall apply the same degree of care with regard to the Confidential Information disclosed within the scope of the Project as with its own confidential and/or proprietary information, but in no case less than reasonable care

10.6

Each Recipient shall promptly inform the relevant Disclosing Party by written notice of any unauthorised disclosure, misappropriation or misuse of Confidential Information after it becomes aware of such unauthorised disclosure, misappropriation or misuse.

10.7

If any Recipient becomes aware that it will be required, or is likely to be required, to disclose Confidential Information in order to comply with applicable laws or regulations or with a court or administrative order or - in the case of an Associated Partner - with a reporting requirement from its National Funding Organisation, it shall, to the extent it is lawfully able to do so, prior to any such disclosure

- notify the Disclosing Party, and
- comply with the Disclosing Party's reasonable instructions to protect the confidentiality of the information.

11 Miscellaneous

11.1 Attachments, inconsistencies and severability

This Consortium Agreement consists of this core text and:

- Attachment 1 (Research plan)
- Attachment 2 (Background included)

In case the terms of this Consortium Agreement are in conflict with the terms of the Grant Agreement, the terms of the latter shall prevail. In case of conflicts between the attachments and the core text of this Consortium Agreement, the latter shall prevail.

Should any provision of this Consortium Agreement become invalid, illegal or unenforceable, it shall not affect the validity of the remaining provisions of this Consortium Agreement. In such a case, the Parties concerned shall be entitled to request that a valid and practicable provision be negotiated that fulfils the purpose of the original provision.

11.2 No representation, partnership or agency

Except as otherwise provided in Section 6.4.4, no Party shall be entitled to act or to make legally binding declarations on behalf of any other Party or of the consortium. Nothing in this Consortium Agreement shall be deemed to constitute a joint venture, agency, partnership, interest grouping or any other kind of formal business grouping or entity between the Parties.

11.3 Formal and written notices

Any notice to be given under this Consortium Agreement shall be addressed to the recipients as listed in the most current address list kept by the Coordinator.

Any change of persons or contact details shall be immediately communicated to the Coordinator by written notice. The address list shall be accessible to all Parties.

Formal notices:

If it is required in this Consortium Agreement (Sections 4.3, 9.7.2.1.1, and 11.4) that a formal notice, consent or approval shall be given, such notice shall be signed by an authorised representative of a Party and shall either be served personally or sent by mail with recorded delivery with acknowledgement of receipt.

Written notice:

Where written notice is required by this Consortium Agreement, this is fulfilled also by other means of communication such as e-mail with acknowledgement of receipt.

11.4 Assignment and amendments

Except as set out in Section 8.3, no rights or obligations of the Parties arising from this Consortium Agreement may be assigned or transferred, in whole or in part, to any third party without the other Parties' prior formal approval.

Amendments and modifications to the text of this Consortium Agreement not explicitly listed in 6.3.7 require a separate written agreement to be signed between all Parties.

11.5 Mandatory national law

Nothing in this Consortium Agreement shall be deemed to require a Party to breach any mandatory statutory law under which the Party is operating.

11.6 Language

This Consortium Agreement is drawn up in English, which language shall govern all documents, notices, meetings, arbitral proceedings and processes relative thereto.

11.7 Applicable law

This Consortium Agreement shall be construed in accordance with and governed by the laws of Belgium excluding its conflict of law provisions.

11.8 Settlement of disputes

The Parties shall endeavour to settle their disputes amicably.

Any dispute, controversy or claim arising under, out of or relating to this contract and any subsequent amendments of this contract, including, without limitation, its formation, validity, binding effect, interpretation, performance, breach or termination, as well as non-contractual claims, shall be submitted to mediation in accordance with the WIPO Mediation Rules. The place of mediation shall be Brussels unless otherwise agreed upon. The language to be used in the mediation shall be English unless otherwise agreed upon.

If, and to the extent that, any such dispute, controversy or claim has not been settled pursuant to the mediation within 60 calendar days of the commencement of the mediation, it shall, upon the filing of a Request for Arbitration by either Party, be referred to and finally determined by arbitration in accordance with the WIPO Expedited Arbitration Rules. Alternatively, if, before the expiration of the said period of 60 calendar days, either Party fails to participate or to continue to participate in the mediation, the dispute, controversy or claim shall, upon the filing of a Request for Arbitration by the other Party, be referred to and finally determined by arbitration in accordance with the WIPO Expedited Arbitration Rules. The place of arbitration shall be Brussels unless otherwise agreed upon. The language to be used in the arbitral proceedings shall be English unless otherwise agreed upon.

The award of the arbitration will be final and binding upon the Parties.

Nothing in this Consortium Agreement shall limit the Parties' right to seek injunctive relief in any applicable competent court.

12 Signatures

AS WITNESS:

The Parties have caused this Consortium Agreement to be duly signed by the undersigned authorised representatives in separate signature pages the day and year first above written.

STIFTELSEN NORSK INSTITUTT FOR NATURFORSKNING

Signature

Name Anne Kristin Jøranlid

Title Head of Department, Department of Salmonid Fishes, Norwegian Institute for Nature Research (Norsk Institutt for Naturforskning)

Date

MUSÉUM D'HISTOIRE NATURELLE DE LA VILLE DE GENÈVE

Signature

Name Dr Arnaud Maeder

Title Director of the Muséum d'histoire naturelle de la Ville de Genève

Date

ATLANTIC TECHNOLOGICAL UNIVERSITY

Signature

Name Dr Des Foley

Title Vice President for Research and Innovation Atlantic Technological University, ATU

Date

NWO I - ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH

Signature

Name Prof. Dr. A.J. Dolman

Title Institute Director

Date

UNIVERSITAT DE VALÈNCIA - ESTUDI GENERAL

Signature

Name Rosa María Donat Beneito

Title Vice-rector for Innovation & Transfer, Universitat de València - Estudi General

Date

BIOLOGY CENTRE OF THE CZECH ACADEMY OF SCIENCES

Signature

Name prof. RNDr. Libor Grubhoffer, CSc., dr. h. c. mult.

Title BC Director

Date

UNIVERSITY OF DUISBURG-ESSEN

Signature

Name Astrid Hilker

Title Ms., Head of Department, Department of Economics and Finance (Dezernat Wirtschaft & Finanzen)

Date

INSTITUTE OF GEOGRAPHY AND SUSTAINABILITY, UNIVERSITY OF LAUSANNE

Signature

Name Jean Ruegg

Title Head of the Institute of Geography and Sustainability

Date

UIT THE ARCTIC UNIVERSITY OF NORWAY

Signature

Name Terje M Aspen

Title Faculty Director, Faculty of Biosciences, Fisheries and Economics, UiT

Date

Attachment 1: Research plan

Integrated **M**onitoring of **PA**rasites in **C**hanging Environmen**T**s (IMPACT)

Fit to the Biodiversa+ call and thematic priorities. Parasites are typecast as biological villains due to their threats to human health and wildlife conservation, despite most metazoan parasites having no zoonotic potential[1], and constituting an overwhelming proportion of current biodiversity (~40%[2]). Unsurprisingly, parasites remain the most neglected components of biodiversity monitoring and management strategies, and completely absent from conservation discussions. Our project will provide new knowledge to address three themes of the current Biodiversa+ call: i) ***innovation of tools for assessing biodiversity*** through the critical evaluation of eDNA for parasite biodiversity monitoring, ii) ***addressing knowledge gaps on biodiversity status and trends*** for a broad range of parasite taxonomic groups that serve as biological indicators, and iii) ***using existing biodiversity data*** to understand the current status and long-term trends in European fish parasite biodiversity. New assessments of fish parasite biodiversity status are desperately needed at a time when both parasites and their fish hosts face the impacts of global change and invasive species[3,4]. By merging traditional monitoring techniques with eDNA technologies, our project will provide a new framework for supporting widespread parasite biodiversity monitoring in aquatic ecosystems. Our focus on helminth parasite biodiversity, which encompasses five taxonomic groups (Monogenea, Trematoda, Cestoda, Nematoda, Acanthocephala), will overcome knowledge biases toward more charismatic groups of free-living species. IMPACT will provide the foundation to break down key barriers to parasites in transnational biodiversity and ecosystem change monitoring, and provide tools to facilitate the explicit inclusion of parasites into international conservation strategies. Our multidisciplinary consortium includes scientists from nine European research institutions across seven countries (Czech Republic, Germany, Ireland, Netherlands, Norway, Spain, Switzerland; Fig. 1a) with track records of high-quality scientific work (see CVs of PIs) relevant to the present call, namely parasite ecology & taxonomy, biogeography, macroecology, molecular ecology, aquatic biodiversity monitoring and social anthropology, and builds on the EU collaborations EuroFresh and DNAquaNet.

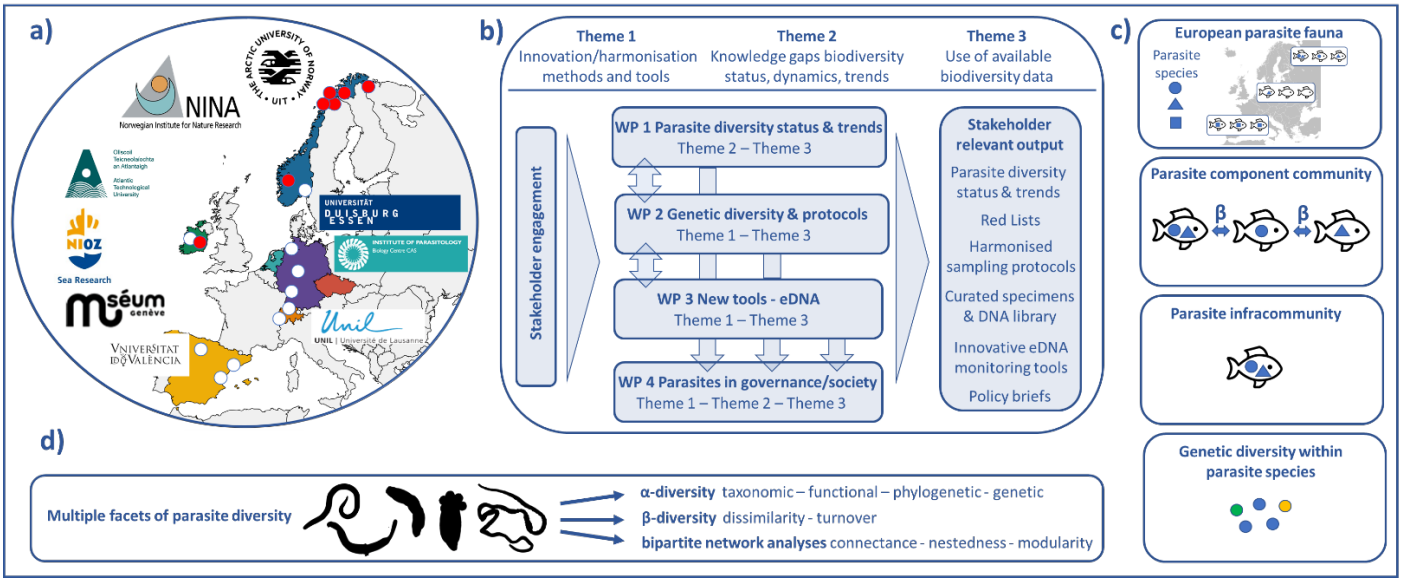


Fig. 1. a) Distribution of historical (white) and long-term (red) European freshwater fish-parasite monitoring localities, b) general approach and work packages, c) organisational levels of parasite diversity, and d) multiple facets of parasitic helminth diversity explored by IMPACT.

Scientific objectives and research questions. Global parasite biodiversity is facing an extinction crisis, with up to 30% of species in each major parasite group predicted to be extinct by 2070; a risk that only escalates when host coextinctions are considered[5]. Although parasites can serve as integrative biological indicators of ecosystem responses to global change[7], unlike their more charismatic free-living hosts, their decline and disappearance are seldom a focus in long-term or distribution monitoring programs[8,9], despite recent indications that parasites have experienced dramatic climate-driven declines[10]. Their value as integrative indicators remains under-exploited due to the lack of cost-effective monitoring tools for detecting broad-scale changes. Whilst deliberate management actions may be needed to eradicate a small number of invasive parasitic trouble-makers responsible for host declines or local extinctions, in general parasite loss is celebrated by those failing to recognise parasites as essential components of healthy and resilient ecosystems[11], and fundamental ecological and evolutionary drivers of biodiversity and ecosystem processes[12,13]. As a consequence, parasites lack formal protection (see[8] for rare exceptions) and are not explicitly included in biodiversity policy or monitoring strategies, despite calls for a global parasite conservation plan[1]. This policy is highly questionable because parasites can in fact inform major threats to

global biodiversity[14] and contribute decisively to stabilize and reinforce ecosystem structure and biodiversity[15].

The IMPACT project examines the multiple facets of parasitic helminth diversity (taxonomic, functional, phylogenetic and genetic[16]) in European freshwater fish, including species that migrate to estuarine and coastal habitats which are most threatened by global change[17]. We will explore existing and develop new European fish parasite diversity datasets, test novel molecular methods for parasite diversity monitoring, and elucidate the role of parasites in environmental governance to address the overall goal of providing evidence-based knowledge to support the integration of parasites into biodiversity monitoring directives and environmental decision making. ***Our scientific objectives are****:* i) to assess the spatial-temporal status and long-term trends of European freshwater fish parasite biodiversity; ii) to explore different facets of diversity, and establish a curated reference library of specimens and molecular barcodes to facilitate identification of freshwater fish parasites; iii) to critically evaluate eDNA as an integrative tool for assessing fish parasite diversity in aquatic biodiversity monitoring; and iv) to gain knowledge about stakeholders' perceptions of parasites, understand the role of parasites in environmental governance, and provide an evidence-based approach for integrating the functional role of parasites in conservation management and policies. ***Our research questions are***: i) What is the current status of European freshwater fish parasite diversity and where should future monitoring efforts be focused?; ii) What are the ecological and environmental correlates of parasite community diversity in fish host populations?; iii) What are the long-term trends in parasite community diversity and are certain parasites in need of conservation measures?; iv) Does genetic diversity uncover cryptic parasite species or confirm previously described parasites based on morphological diversity?; v) Is eDNA an effective replacement or complementary tool to traditional fish parasite monitoring for detecting changes in parasite biodiversity?; and vi) What limits the inclusion of parasite biodiversity monitoring and governance in environmental decision making? All scientific objectives and research questions were **developed in consultation with key stakeholder groups**, namely local communities, environmental NGOs, and nature management advisors and policy makers, with the goal of ensuring IMPACT delivers actionable-science outcomes of relevance to biodiversity monitoring and conservation. Our coordinating institute, NINA, a world-leader in delivering research-based biodiversity and societal solutions relevant to national and international management needs, will be the central hub for disseminating IMPACT outcomes, including Red List assessments, best practice guidelines, innovative diversity monitoring tools, and co-developed policy briefs. In doing so, IMPACT will provide the first steps towards establishing national and pan-European biodiversity strategies inclusive of parasites.

General approach and work packages. IMPACT has been organised in four integrated Work Packages (WP) led by Paterson & supported by Blasco-Costa (Fig. 1b). IMPACT uses a transnational multidisciplinary approach that harnesses WPs synergies to deliver stakeholder-centred research. Our research questions are addressed at different organisational levels (Fig. 1c), ranging from the total parasite species diversity in Europe and in different regions, to parasite component community diversity in local fish populations, fish infracommunity diversity in individual hosts, and to genetic diversity within parasite species. Depending on the organisational level and research question, we will assess four major facets of parasite α-diversity (Fig. 1d): taxonomic diversity (TD, richness and abundance of taxonomic entities in a community), functional diversity (FD, richness and abundance of functional traits in a community) and phylogenetic diversity (PD, richness and abundance of genetically different entities in a community) at the level of parasite faunas and communities, and genetic (GD) diversity within individual parasite species. Traditionally, ecologists have considered TD as the single measure of species and community diversity. However, this results in a loss of ecological (FD) and evolutionary (PD) information since TD considers all species in a community to be equally similar. In contrast, considering FD and PD allows the contribution of species turnovers to functional and phylogenetic diversity in each community to be assessed. At the parasite community level, we will also investigate β-diversity patterns (Fig. 1c, d) as another facet of biodiversity in the form of compositional differences in parasite communities among individual fish and among sampling events over time. In addition, we will explore compositional changes in parasite communities using ecological network analysis (Fig. 1d). This multi-pronged approach of various diversity measures will allow us to gain unprecedented insight into the patterns and process of parasite diversity in European freshwater fish.

WP1 will assess the spatial-temporal status and long-term trends of European freshwater fish parasite biodiversity by using existing databases and literature as well as by re-sampling locations with historical records. Ecological and environmental correlates of parasite community diversity and of diversity trends in fish hosts will be identified and Red Lists of parasite species with conservation needs compiled. In **WP2**, guidelines for collection and vouchering parasite specimens will be created to harmonise monitoring practices and foster biobanking. Collected specimens will serve for (i) reassessing taxonomic species concepts and unravel cryptic species, (ii) characterise genetic diversity at the species and intraspecific level, and (iii) provide state-of-the-art molecular resources for future implementation of eDNA monitoring of parasite

biodiversity. A novel curated reference library linking molecular data and voucher specimens will be made openly available and feed to the Global Biodiversity Information Facility (GBIF) to allow the most needed scientific cross-validation of information in poorly studied organisms. In **WP3**, parasite inclusive biodiversity monitoring will be achieved through standardisation of an eDNA approach for rapid, non-destructive detection of all major helminth groups that can be harmonised with existing aquatic monitoring programs. Finally, in **WP4** we take a qualitative social sciences approach to understand the diversity of perceptions, values, knowledge, and risk evaluations of parasites held by key stakeholders. In doing so, we identify the potential barriers and find feasible solutions for effective integration of parasite biodiversity monitoring and conservation into environmental governance.

WP1. Assessing the spatial-temporal status and long-term trends of European freshwater fish parasite biodiversity *(R Paterson, D Thieltges & JA Balbuena, with C Selbach, R Primicerio, K O'Dwyer, B Sures & I Blasco-Costa)*

Unlike more charismatic organisms such as birds and mammals, spatially comprehensive, long-term fish parasite monitoring is rare, to the extent that general patterns and processes regarding the diversity of parasites supported by European freshwater fish are poorly understood. Apart from a few exceptions[18], monitoring efforts have focused on single parasite species or sampling events, from which extensive distribution datasets are available (e.g. Host-Parasite database NHM London, Limnofauna Europaea) that enable regional, host-parasite taxonomic group assemblage patterns and knowledge gaps to be identified. However, these databases do not provide quantitative information on parasite abundance, and we have little understanding of the general patterns and drivers of parasite diversity at the level of local fish populations (parasite component communities; Fig. 1c) in Europe, the scale most relevant for freshwater biodiversity monitoring efforts. In addition, reassessments of European fish parasite diversity status from historically sampled localities are urgently needed to identify how global change has shifted parasite dynamics for fish communities (e.g. increased parasite loads, invasion of novel parasites), and whether the loss of parasite species, and their inherent functional roles in aquatic ecosystems, should be considered conservation targets themselves[1,19]. We predict to identify large gaps in our current knowledge of fish parasite diversity on a European as well as regional scale. On a local scale, we expect to identify several correlates of parasite community diversity such as specific host traits and environmental factors. We also expect to quantify temporal changes in parasite diversity and compositional turnover at this scale, and to link those to global change drivers.

Task 1.1. Assess the known European fish parasite diversity and identify knowledge gaps. To inform future monitoring strategies, we will quantify the known diversity of the fish parasites in Europe, and predict the number of fish parasite species yet to be described, in addition to identifying diversity hotspots and regional knowledge gaps. The known diversity of parasites in Europe will be estimated from fish parasite occurrence data from existing databases. We will focus on the Host-Parasite database from the Natural History Museum (NHM) in London[20], arguably the most comprehensive parasite database globally, which has been used for macroecological studies in the past[21,22]. Using existing code[23], we will extract the known number of parasite species in the different major helminth groups, both for Europe and for each country. Based on taxonomic diversity (TD; richness), we will quantify the known total and regional parasite species diversity and identify regional differences for each of the major helminth groups. For each group and country, we will then predict the number of parasite species yet to be described using established approaches[22,24], which will identify the taxonomic and geographic distribution of knowledge gaps. In addition to these diversity analyses, for each parasite species, we will extract the geographic range (no. of countries) and the host range/specificity (no. of recorded host species as well as host species identities) which will inform the Red List assessments in Task 1.4. **Milestone (M) 1.1** Assessment of known and predicted total and regional fish parasite diversity in Europe. **Deliverable (D) 1.1.1** Publish parasite richness data (known and predicted) per region and major helminth group. **D1.1.2** Provide geographic and host range data for each known parasite species for Task 1.4.

Task 1.2. Establish a European fish parasite community database and determine correlates of parasite community diversity. To provide insights into the parasite diversity to be expected at the level of local fish populations, where biodiversity monitoring is conducted, and to understand ecological and environmental correlates of the observed patterns, we will compile a new parasite component community database. For this, we will extract data from published literature, stakeholder reports (e.g. veterinary and fisheries institutes), and unpublished datasets from project partners. All WP1 partners will contribute to the literature collection and data entry. We will only include studies that investigated the entire helminth community of single or multiple fish host species at a respective location (i.e. excluding studies that only looked at single parasite species). For each fish species and location, we will record the presence and infection levels (prevalence, abundance, intensity) of each parasite species in the sampled local parasite

community (respective sampling effort will be noted as it can affect richness and infection level data[25,26]). In addition, for each host species and location we will extract data on host traits (e.g. body size, migration behaviour) and environment (e.g. lentic or lotic habitat, latitude) from the source publication and existing databases[27,28]. We will then determine the parasite community diversity in different hosts based on functional (FD, richness and quantitative infection level-based indices) and phylogenetic diversity (PD, in absence of complete phylogenies, we will estimate a proxy from the length of the path connecting two species traced through a Linnaean classification of the full set of species in the community[16]) and identify ecological and environmental correlates of parasite community diversity using established analytical approaches from comparative parasite ecology and macroecology[29,30]. A strength of our analyses is to not only investigate taxonomic richness but to also include abundance-based, and functional and phylogenetic diversity estimates. In addition to these analyses of parasite community diversity, the new database will provide presence-absence and quantitative infection level data for specific parasite species (after checking for synonyms) which will inform Task 1.4. The completed database will be archived in Zenodo. **M1.2** EU fish parasite community database and analyses of correlates of parasite community diversity; **D1.2.1** New openly accessible fish parasite community database; **D1.2.2** Publish diversity analyses of correlates of parasite community diversity in fish.

Task 1.3. Assess long-term trends in European fish parasite diversity. To quantify temporal changes in parasite diversity and to identify possible links to global change drivers, we will investigate existing long-term parasite time series of project partners and re-sample parasite communities at locations that have been sampled in the past. The existing time series from seven locations span over 54 years and include six fish species (Fig. 1a). The re-sampling locations will include 31 fish species from 10 locations across the partner network (last sampled >20 y.; Fig.1a; e.g. NO[31], IR[32], ES[33]; CR excluded by funding rules). The re-sampling will be conducted in Spring/Summer 2024 as a project team effort in combination with WP2 tasks, with all sampling procedures adhering to strict ethical procedures of partner institutions, and guidelines for minimum host sample size for estimating infection[25,26] and specimen vouchering (Task 2.1). Species identification will be confirmed by morphological and molecular assessments (Task 2.2). For all existing time series, and most historical datasets, raw data on parasite species occurrence and infection levels are available, which allows for unprecedented analyses not only at the level of parasite component communities, but also at the parasite infracommunity level. In turn, this enables us to evaluate location-specific evidence of temporal parasite diversity trends at two organizational levels: α diversity or diversity at the level of the sampling unit (i.e. the fish individual or population) and β diversity or the extent of dissimilarity and turnover[35,36] of parasite communities, both within fish hosts (β1 diversity), and between higher levels of an organisational scale, e.g. surveys (β2 diversity). Regardless of the level considered, diversity will be assessed under three facets: taxonomic diversity (TD), functional diversity (FD) and phylogenetic diversity (PD)[36]. To compute FD indices a dataset of parasite functional traits will be compiled according to [37] using existing parasite trait databases[38] and the primary literature. We will estimate PD from the length of the path connecting two species traced through a Linnaean classification of the full set of species in the community[16], since no complete helminth phylogeny is available. In addition, temporal changes in the structure of host-parasite interactions will be evaluated with bipartite network analysis. Previous studies[39,40] have shown that this approach can provide relevant information about alterations in parasite-host interactions. We will use host individual-based network analyses to compute three indices of network structure (connectance, weighted nestedness and modularity). These indices are deeply affected when a disturbance occurs in the system and have been widely used as indicators of network properties. In addition, changes in the roles played by each parasite species will be assessed using the betweenness centrality index and the numbers of within-module and among-module links. Finally, to identify possible links to global change drivers, we will evaluate whether parasite diversity trends are correlated with the local average annual temperature (data from local monitoring stations or online databases) and local invasive parasite species (e.g. swim bladder nematode of European eel), as well as with other locally available environmental data (e.g. eutrophication, pH, alkalinity). **M1.3** Assessment of long-term trends in parasite community diversity; **D1.3.1** Fish individuals x parasite species abundance matrices; **D1.3.2** Publish comparison between historical and current diversity (TD, FD, PD) of parasite communities; **D1.3.3** Publish comparison between historical and current host-parasite network structure.

Task 1.4. Develop Red List Assessments for Helminth Parasites of European Fish. Effective parasite biodiversity conservation action requires parasite representation in the IUCN Red List (RL)[1]. Whilst the recent establishment of the IUCN SSC Specialist Parasite Group (Blasco-Costa is member) is an essential step towards this goal, coordinators of national RLs (who provision global RLs) reveal that expert panels tasked with Red List Assessments (RLA) have not been established for helminth parasites. We will take the first step towards the inclusion of parasites in RLs by critically evaluating the national-level extinction risk for a pilot group of up to 10 parasite species across taxonomic groups from Germany, Ireland, Norway, Spain and

Switzerland (excluding zoonotic, invasive and highly pathogenic parasite species) informed from Task 1.1-1.3 datasets and national RL coordinators. Red List Assessments (RLA) will follow the best-practice 'Guidelines for Application of IUCN Red List Criteria at Regional and National Levels'[41], with participants attending the IUCN Red List Assessor training course for regional assessors to ensure scientifically rigorous IUCN RLAs adhering to standards for taxonomy (informed from Task 2.2), freshwater species mapping, and supporting information are conducted. Whilst each parasite will be evaluated against all five available IUCN RLA criteria, pre-project consultation with national RL assessors suggests *Criteria B: Geographic range (B1: extent of occurrence* and/or *B2: area of occupancy)* is most appropriate for parasites (akin to criteria for other aquatic invertebrates), whereas other criteria may be more suited to free-living species (e.g. A: population size reduction over three generations; C,D: number of mature individuals). Pilot group RLAs will be refined in consultation with national RL coordinators (e.g. Norwegian Biodiversity Information Centre; The German Red List Centre; National Biodiversity Data Centre (IR); Federal Office for the Environment (CH)) and the IUCN SSC Parasite Specialist Group, to guide the implementation of RLAs for other parasite species. Congruence between RLAs and function trait-based parasite vulnerability assessments[8] will be tested. By providing the first critical evaluation of EU freshwater fish parasites that meet IUCN RLA criteria, and by sharing our knowledge and experiences of conducting RLAs with RL coordinators in all partner countries, the European Environment Agency (European RL), and the IUCN SSC Parasite Specialist Group (knowledge exchange seminar in Task 4.3), our final assessments (accessible on Zenodo) will enable the first integration of parasites into national RLs across Europe, a vital step towards global RLs inclusive of parasite biodiversity. **M1.4** Red List assessments; **D1.4.1** Pilot Red List Assessments of European freshwater fish parasites; **D1.4.2** Final Red List Assessments of European freshwater fish parasites.

Expected outcomes in WP1:

- Assessment of known and predicted total and regional freshwater fish parasite diversity in Europe
- New European freshwater fish parasite community database and identification of diversity correlates
- Quantification of temporal trends in parasite diversity and possible links to global change drivers
- First Red List Assessments of European freshwater fish parasites

Synergies and Added value in WP1:

- Joint re-sampling campaign with WP2
- Integration of taxonomic and molecular data from WP2 to forecast remaining species to be discovered
- Fish sampled in WP1 inform infection probabilities for WP3 experiments
- National Red List Assessments experiences will inform WP4 knowledge exchange seminar

WP2. Exploring different facets of diversity and establishing a curated reference library of molecular barcodes and voucher specimens* of *freshwater fish parasites *(I Blasco-Costa & T Scholz)*

Re-evaluation of European freshwater fish diversity has led to an increase in recognised fish diversity, often linked to the discovery of local endemism[42,43]. Conversely, surveys of their associated parasites, despite been studied from the 18th century, have been slow to follow and their diversity is likely underestimated due to morphological identification forming the basis for exploring taxonomic diversity in the pre-molecular era. We predict cryptic species, only distinguishable by molecular data, are highly probable[44], but genetic data for most parasites are scarce in reference sequence platforms like GenBank or BOLD. DNA-based approaches to identification, like DNA barcoding, are attracting interest in multiple applications from CITES species tracing, to forensics and lately eDNA approaches. The capacity of DNA barcodes to assign newly encountered specimens to a species relies on the comparison of new sequences to the libraries of reference sequence platforms. However, these platforms contain many sequences wrongly assigned to species, often wildlife parasites are identified only to high taxonomic levels[45] and the lack of voucher specimens associated to the sequences impedes validation of the initial identifications. Preparing a morphological voucher requires the availability of fresh specimens and selecting a worm that will serve as reference, from which a small piece of tissue is excised to provide material for genetic characterisation (e.g. hologenophores sensu[46]). With the ongoing loss of taxonomic expertise[47] producing accurate identifications will become eventually unattainable. Thus, WP2 takes action to test and harmonise collection protocols for matching voucher specimens to genomic data in WP1 and encourage biobanking in monitoring poorly studied organisms, like parasites, to ensure scientific cross-validation. Existing species concepts based on morphology will be revisited using newly generated molecular data and an integrative approach to taxonomy to set the foundations for future monitoring by providing genetic diversity estimates and accurate species identifications. The resources developed will be made publicly accessible as a curated reference library of voucher specimens from which molecular sequences have been obtained to improve the urgently needed reliability of molecular resources in reference databases.

Task 2.1 Create guidelines for vouchering specimens of helminth parasite taxa. Parasitological examination, *i.e.*, dissection or necropsy, is the basic procedure required to obtain parasites, but different methods are used to examine and preserve different groups of helminths. An illustrated, easy-to-use methodological guide (manual) will be provided (i) to achieve a higher degree of standardisation (see[48]); (ii) to share expert advice broadly; (iii) to ensure appropriate processing of specimens; and (iv) to facilitate learning. The guidelines will include instructions on how to collect helminth parasites, prepare voucher specimens, and preserve them (using the adequate chemicals and techniques to store the specimens for different downstream purposes), with short demonstration videos also available through the project website (multi-language closed captioning available). WP co-leader Scholz previously developed similar guidelines for parasites of African freshwater fishes[49]. The innovation here is that these guidelines are intended for capacity building of ecologists, consultants, stakeholders and non-specialists, to make the most of valuable fish parasite material so that it is suitable for reliable taxonomic identification and genotyping applications. WP1 partners will test the guidelines during re-sampling (Task 1.3) and feedback from stakeholders and WP1 tests will inform its publication as a standardised guide for the study of helminth parasites in freshwater fish. **M2.1** Distribution of guidelines for testing to WP1 partners and relevant stakeholders; **D2.1** Publication of the standardised guide for the study of helminth parasites in freshwater fish.

Task 2.2 Re-assess European fish parasite species taxonomic diversity. Consortium partners have revealed current parasite diversity of freshwater fish is underestimated for multiple groups. For instance, new species of trematode genera *Crepidostomum* and *Diplostomum* have been discovered in salmonids and cyprinoids[50,51] for which more species are expected to be found. Recent studies distinguished a new *Caryophyllaeus* tapeworm in cyprinoids[52], and restored the validity of two *Proteocephalus* tapeworms in whitefish, and at least two other molecularly distinct species await formal morphological description/redescription[53]. Monogeneans also show obvious hidden species diversity in the Diplozoidae, gill parasites of cyprinoid fishes[54]. The same likely applies to acanthocephalans and nematodes that have been less investigated lately. Taxonomic diversity will be reassessed, based on examination of voucher specimens (Task 1.3) from re-sampling campaigns using best practices in the field (Task 2.1), with an integrative approach combining distinct lines of evidence[55], including morphology, host specificity, geographical distribution, and genetic differentiation. The latter will be generated in Task 2.3, whilst host specificity and spatial distribution will be obtained from WP1. Morphological features in voucher specimens and other collected specimens will be examined using light, scanning electron microscopy, and histology, by our teams of taxonomists and current collaborators with expertise for the relevant groups (e.g. acanthocephalans, nematodes). Priority for taxonomic descriptions/redescriptions will be given to target taxa mentioned above, followed by taxa-host combinations with widespread distributions as they could hide unrecognised cryptic species (putative local endemism). We anticipate the discovery of cryptic species or rediscovery of previously synonymised species[55] parasitic of native freshwater fish, because taxonomic status and validity of most parasite species have not been tested using molecular data yet. Taxonomic publications for the targeted taxa will be delivered within the project timeframe, but the taxonomic study (highly labour intense) is likely to extend well-beyond this project. The specimens will remain available in the collections of the Muséum d'Histoire Naturelle de Genève (MHNG, participating institution) as a legacy for continuing future research (see also Task 2.4). **M2.2** Process specimen whole mounts for species (re)descriptions; **D2.2.1** Publish species (re)descriptions of parasites of salmonids; **D2.2.2** Publish species (re)descriptions of parasites of other fishes by priority**.**

Task 2.3 Assess European fish parasite species genetic diversity. Genetic diversity will be assessed (1) at the species level for all species detected in WP1, and (2) among sub-populations from different hosts/localities for broadly distributed (morphology-based) species (unique parasite-host-site combinations) after establishing priorities with local stakeholders (e.g. zoonotic parasites like tapeworm *Dibothriocephalus latus* widely distributed in European perch). A representative of each taxon (1) will be selected and the tissue for molecular analysis of voucher specimens analysed in a pool of 20 samples of different taxa for low coverage whole genome sequencing with the goal of obtaining the whole mitogenomes and the entire ribosomal operons for all species, following standard practices[56,57]. Up to 25 platyhelminth specimens have been pooled and successfully sequenced by Blasco-Costa (unpublished) given their relatively small genomes (50-1500 Mb), as is the case for most helminths[58]. For priority species, genetic data for their unique parasite-host-site combinations (2) at the continental scale will be generated using a multiplex library kit suitable for low DNA inputs and scalable to hundreds of samples[59], and low-depth whole-genome sequencing to recover mitogenomes and ribosomal operons, in addition to other genome-wide data to some extent. Whole-genome approaches provide a higher wealth of data and overcome amplification problems associated to the lack of universal primers for mitochondrial genes commonly used as barcoding markers in helminths. Genetic diversity and divergence will be estimated for the entire ribosomal operon and the mitochondrial genome

(mitogenome) among parasite sub-populations, and compared across species of different taxa and with different life strategies involving different numbers of hosts, transmission stages and other characteristics that may render them more vulnerable to extinction. These molecular data linked to physical voucher specimens will form the basis of the first curated reference library of helminth parasites (Task 2.4) enabling reliable species identification and cross-validation in future surveys. Additionally, genetic data will be used for phylogenetic inference in Task 2.2 and for primer development for eDNA approaches (WP3). **M2.3.1** Assembly of mitogenomes and ribosomal operons (RO) for WP3; **M2.3.2** Assemble mitogenomes and RO for all helminth species; **M2.3.3** Evaluate EU parasite-host-site genetic diversity; **D2.3.1** Publication on comparative analysis of mitogenome architecture and genetic diversity at the species level; **D2.3.2** Publication of population genetic structure of selected species at the continental scale.

Task 2.4 Establish a reference library of molecular data associated to a curated voucher collection of European freshwater fish parasite species. Biobanking represents the only way[60] to overcome the serious problem limiting the use of parasite molecular data in GenBank by allowing cross-validation of morphological vouchers, in case of suspicious species identifications of molecular sequences. Permanent mounts of voucher specimens collected will be deposited in the MHNG, databased and linked to the molecular data generated for each specimen (Task 2.3), which will be submitted to GenBank. Additional specimens and tissue/DNA samples will be distributed to relevant museum collections of participating countries (NHM-Oslo, MNCN-Madrid, NM Ireland-NH, NHM-Berlin) therefore fulfilling the Nagoya protocol (NP) agreement on access and benefit-sharing for the *Convention on Biological Diversity*. Museum collections represent science infrastructure necessary to support society-wide solutions[61] and will ensure the availability of voucher specimens for scientific loan and further study as legacy of this project. Furthermore, the MHNG helminth collection with new links to sequence data in molecular data repositories will be publicly accessible online through GBIF, which already contains the MHNG Platyhelminthes collection. Type specimens used for species descriptions and semi-permanent mounts of nematodes and acanthocephalans will be digitized using standard protocols of an ongoing SwissCollNet project (to Blasco-Costa), with microphotographs made available through the upcoming portal of Swiss Virtual Natural History Collections, GBIF and the future Global Registry of Scientific Collections, to improve accessibility and promote its regular use. **M2.4.1** Database vouchers and make links to genetic sequences in repositories; **M2.4.2** Digitized type specimens with microphotographs; **D2.4** Curated reference collection of helminths publicly accessible and submitted to GBIF.

Expected outcomes in WP2:

- Published guidelines for vouchering specimens of helminths
- Taxonomic revisions of major helminths groups parasitising freshwater fishes in Europe
- Publications on comparative parasite species genetic diversity and population genetic structure of selected species at the continental scale
- Curated reference library of molecular data and vouchers of helminth parasites of EU freshwater fish

Synergies and Added value in WP2:

- Guidelines for parasitological examination and vouchering of WP2 will be applied in WP1
- Specimens collected in WP1 will be used for taxonomic assessment in WP2
- Molecular data for mitogenomes and ribosomal operons will be used to inform in WP3

WP3. Critically evaluate eDNA as an integrative tool for assessing fish parasite diversity in aquatic biodiversity monitoring *(B Sures & F Leese, with C Selbach & I Blasco-Costa)*

Monitoring of aquatic parasite biodiversity is hampered by inefficient tools for detecting parasites, with current methods involving the sacrifice of thousands of hosts (depending on the parasite's prevalence) to quantify parasite biodiversity, and still, parasites occurring in low prevalence may be difficult to detect. Thus, for ethical reasons and amid a potential 6th mass species extinction[62], it is necessary to develop less invasive and non-lethal monitoring methods. Environmental DNA (eDNA) offers a potential solution by allowing parasites to be monitored in environmental (ex-host) matrices without the need to sacrifice hosts[63,64], and has proven useful in the detection of single parasite species[65] or defined parasite groups[66]. Given that eDNA is increasingly used in European aquatic biodiversity monitoring[67], this technique should be harmonized to obtain parasite diversity data in existing monitoring programs. However, the effectiveness of eDNA as a replacement or complementary tool to current fish parasite biodiversity assessment needs verification. Additionally, a standardized pipeline (temporal and spatial sampling strategies, processing and analysis) for simultaneous detection of multiple parasite groups must be established to ensure the utility of this technique before it is integrated into aquatic biodiversity monitoring programs. For instance, we predict that sediment samples will be most efficient at detecting all parasite groups due to the accumulation of eDNA over time, though in general ectoparasites may be preferentially detected due to their constant exposure to the external environment.

Task 3.1 Method development and calibration. Experimental setup: Laboratory assays will be performed to standardize and optimize eDNA pipeline components for field testing (Task 3.2). For this purpose, naturally

infected European eel (*Anguilla anguilla*; obtained from national monitoring program) and three-spined stickleback (*Gasterosteus aculeatus*) from German Task 1.3 localities will be kept in the laboratory in tanks with defined volumes and sediment layers. Different volumes of water/sediment sampled after one and three days will be taken and stored until DNA-extraction. After three days, the fish will be euthanized and examined for parasites following Task 2.1 guidelines. Since DNA decay rates can differ among taxa[68], water and sediment samples will be kept at different temperatures (reflecting average summer/winter water temperatures at sampling site) for three days. Sub-samples will be collected daily, filtered and analysed using species-specific qPCRs for the three most common parasites to quantify the group-specific decrease in DNA content. Primer design: For detection, we will test and compare available primers for helminth parasites, and develop new parasite group-specific primers based on novel sequence information generated in Task 2.3. We will target Acanthocephala (no previous eDNA study), Cestoda (only few species-specific approaches), Trematoda (primers available), Monogenea (only single-species detection), and Nematoda (primers available). Previous information on primers used for eDNA detection of trematodes and nematodes will be used as a starting point[66,69]. Furthermore, we will design new primers for the remaining groups based on sequence data for ribosomal operons and whole mitogenomes from Task 2.3. DNA extraction and library generation: DNA will be extracted from the filters and sediment samples[70,71]. Library preparation will be performed following an Illumina two-step PCR assay with dual indexing[72]. The specific volumes and thermocycling conditions will be optimized. **M3.1** Parasite DNA detection with group-specific primers; **D3.1.1** Protocols on eDNA methodology to be applied in the field; **D3.1.2** Publication on primers and results of optimization.

Task 3.2 Field sampling of model lake and rivers. eDNA field sampling will be performed in three rivers (Rhine, Ems & Boye, DE) and one lake (Takvatn, NO) for which unparalleled host-parasite taxonomic inventories are available[18,73-75], thus providing the ideal model systems to assess novel eDNA approaches for merging parasite diversity assessments and existing aquatic monitoring programs. Monthly eDNA water and sediment samples will be collected over 12 months by local partners at four sites in the lake to account for parasite spatial heterogeneity, and one site in each stream, since water flow will allow detection of DNA from organisms present in a stretch of several hundreds of meters upstream[76] Sample processing and DNA extraction will be performed at an eDNA-dedicated laboratory at the University of Duisburg-Essen based on the methods developed and calibrated in Task 3.1, and following existing protocols[70,77] to avoid sample contamination. We will obtain lists of parasite species based on the seasonally detectable DNA in water and sediment from each model system, and will use Venn diagrams to compare detection success of a particular parasite species between eDNA and host-parasite taxonomic inventories[66], and between water and sediment matrices[78]. Results will identify optimal methodology and matrices, in addition to exposing potential detection biases linked to the parasites' transmission strategy (i.e. presence of free-living larval stages, life cycle complexity) in waterbodies of differing hydromorphological contexts. Our standardised and validated eDNA methodology will provide a tool enabling parasite identification on the basis of reliable sequence information generated in WP2. The ease to which this methodology may be integrated into current eDNA-based aquatic monitoring programs will enable parasite distributions to be mapped at an unprecedented scale, thus providing crucial knowledge for Red List assessments (WP1) and for stakeholders concerned with the management of economically relevant fish (e.g. swim bladder nematode of European eel) or zoonotic parasites (e.g. tapeworm *D. latus*, trematodes causing swimmers itch; WP4). **M3.2.1** Complete field sampling campaign; **M3.2.2** Analysis of field samples; **M3.2.3** Reconciliation of available field data with eDNA; **D3.2.1** Sequence data for parasites in lake and rivers; **D3.2.2** Species lists of detected parasites; **D3.2.3** Publication on the efficacy of eDNA as a monitoring tool for detecting changes in parasite biodiversity.

Expected outcomes in WP3:

- Development of an eDNA detection workflow for the main helminth parasite groups
- Method calibration against reference ecosystems with highly resolved parasite inventories

Synergies and Added value in WP3:

- Generated sequence information in WP2 will inform primer design in WP3
- WP2 sequence data will allow matching eDNA samples to parasite species not yet in GenBank
- Long-term host-parasite inventories in WP1 will be used to test method efficacy in WP3

WP4. The role of parasites in environmental governance and society *(S Rybråten & J Salomon Cavin, with K O'Dwyer, O Andersen, R Paterson & I Blasco Costa)*

Understanding stakeholder perceptions is essential for effective integration of parasite biodiversity monitoring and conservation into environmental governance. We hypothesise that parasites are part of what environmental ethicians call "unloved others"[79]; the disregarded, disliked and actively vilified creatures, where their associated negative values explain the lack of interest in them among the general public and conservation scientists alike[80] and their lack of representation in biodiversity policies. Insights in values and

knowledge informing stakeholders' parasite perceptions and risk evaluations[81] make it possible to reveal and address barriers towards more diverse understandings of parasites. Key stakeholders identified across Norwegian and Swiss case studies consist of 1) Local community stakeholders, 2) Environmental NGOs, 3) Nature management advisors and policy makers, and 4) Environmental scientists. These stakeholder groups are collectively responsible for parasite eradication (for economic & public health), aquatic recreation, local and national waterbody management, safeguarding natural habitats and resources, producing knowledge, advising government, implementing national climate and environmental policies, and participating in international environmental strategies.

Focal case studies & key stakeholders: I) Norway – eradication of invasive Atlantic salmon ectoparasite and the co-extinction of native parasites. *Stakeholders*: group 1) Local management board for the Fusta River (FUSAM forvaltningslag), Vefsn Hunting and Fishing Association, Vefsn municipality; group 2) NGO for anadromous river managers (Norske Lakseelver); group 3) County Governor of Nordland, Norwegian Environment Agency, Ministry of Climate and Environment; group 4) Norwegian Veterinary Institute, Norwegian Institute for Nature Research, UiT The Arctic University of Norway, NTNU Norwegian University of Science and Technology. ***II) Switzerland*** – management of wildlife parasites with zoonotic potential: native trematode responsible for swimmer's itch and the broad fish tapeworm. *Stakeholders*: group 1) Swiss Romand Association of Professional Fishermen, International Federation of Sport Fishing in Lake Geneva; group 2) NGOs for nature conservation (Pronatura, Salamandre, and Pôle-Invertebrates), WWF Geneva, Association for the Safeguard of Lake Geneva, Association for freshwater conservation (Maison de la Rivière); group 3) Geneva Department of Social Welfare and Public Health, Cantonal Offices of Geneva, Vaud and Valais (health, environment & fisheries), Swiss Centre for Wildlife Cartography, Swiss Federal Office for the Environment, Swiss Academy of Sciences, International Commission for the Protection of the Water from the Léman; group 4) University of Geneva, Lausanne, Neuchâtel, Bern and Zurich; ETH-Zurich, Cantonal Museum of Vaud, Institute for Fish and Wildlife Health. All WP4 participants have active collaborations with key stakeholders in their respective countries, with ongoing discussions informing the approach employed in this WP.

Task 4.1 Understanding stakeholders' perceptions of parasites. To gather the diversity of parasite perceptions, we will conduct semi-structured, in-depth interviews with key stakeholders, to gain insights into the values, norms, and theoretical and practical knowledge that inform perceptions of parasites and their inclusion – or lack thereof – in environmental governance. Acknowledging risk evaluations as embedded in specific practice-based social contexts, where various actors' perspectives and interpretations vary[81], we will investigate the degree to which parasites are currently considered risk objects or undesirables beings, rather than (also) being deemed central for biodiversity maintenance. To ensure comparability between countries and groups, the same questions will be asked to all representatives of the four stakeholder groups in both countries, along the thematical lines of 1) *Identification*: What is for you a fish parasite? [sub-question: Can you give an example?] 2) *Perception/value:* What do you think about fish parasites? [SQ: Are parasites part of biodiversity? Are parasites linked to fish-health?] 3) *Practices:* What should we do with parasites? [SQ: Do you think parasites are in danger? Should we govern parasites like we govern other species?]. These simple, open and non-leading questions are chosen to reveal peoples' actual experiences and avoid implications of desired answers. All interviews will be recorded and transcribed to be analysed via a computer-assisted qualitative data analysis software (e.g. ATLAS.ti, Nvivo).

At the local level (group 1), interviews will primarily be conducted outdoors. For instance, through fieldwork visits to the Norwegian Fusta River, we will participate in river management activities carried out by representatives of the river's local management board, like spawning fish surveys, fish ladder inspections and maintenance of river-side facilities for anglers. Walking interviews[82,83], i.e. research-based outdoor conversations, will be carried out by the rivers and lakes, making it easier for people to express themselves and to unfold the physical aspects and values entwined in the locally situated human-river engagements. At the regional and national level, during interviews with group 2-4, the main, common questions will be expanded to address these stakeholders' degree of involvement in parasite knowledge production and management, their evaluations of the current knowledge base and own practical experience, considerations of challenges and opportunities regarding parasite integration in future management, and evaluations of potential future priorities, responsibilities, and mandates. Interview analysis will allow a wide range of discourses relating to parasites among stakeholders to be identified, in addition to a classification of the main parasites' perceptions (e.g. parasites as danger, parasites as a problem, parasites as endangered species, etc.) and a gradient of parasites associated values from the most negative to the most positive. **M4.1** Stakeholder interviews in each case country completed and analysed. **D4.1.1** Popular scientific article on parasite perceptions in Norway "Thriving parasites for a healthy river?"; **D4.1.2** Popular scientific article on parasites perception by environmental stakeholders in Switzerland "Why should fish parasites be loved?".

Task 4.2 Confront perceptions and co-produce integrated action plans to address parasite biodiversity conservation. Two one-day workshops will be organised in each country on the same model. Workshop 1 (WS1) will be dedicated to the presentation and discussion around parasites perceptions (informed from Task 4.1) and the first results from WPs1-3. Amongst others, WP1 will share insights on parasites of potential relevance for monitoring schemes in Norway and Switzerland. Parasite perceptions, values, knowledge and risk evaluations will be exchanged, confronted and discussed. Main questions to address will be: 1) What different parasite values are present? 2) What parasite knowledge is available? 3) What can be improved in the knowledge base (actionable science) and policies (at the various levels)? The resulting synthesis of exchange and working paper on parasite representations will further inform the second workshop (WS2) dedicated to co-producing guidelines for developing integrated action plans to address parasite management and conservation. Main questions to address will be: 1) Why is it relevant to integrate parasites in environmental monitoring and governance? 2) How to improve the integration of parasites in environmental monitoring and governance? 3) Can we imagine and develop a national Red List for parasites? Together, we will draft a policy brief on challenges and opportunities for integrating parasites in environmental monitoring and governance for each country. **M4.2.1** Workshop 1 and synthesis; **M4.2.2** Workshop 2; **D4.2.1** & **D4.2.2** National policy briefs on challenges and opportunities for integrating parasites in environmental governance [Norwegian & French]; **D4.2.3** Publication on stakeholders' parasite perceptions and risk evaluations, based on comparisons between Norway and Switzerland; **D4.2.4** Publication on "co-production of actionable science in parasite biodiversity".

Task 4.3 International exchange of parasite knowledge and experiences for future management and monitoring*.* Case study stakeholders will gather for a one-day online seminar, together with all IMPACT partners and other invited stakeholders from EU partner countries and associated networks (see Sections B, D), to share their experiences of being involved in the project and their involvement in integrating parasites into policy and/or management. IMPACT partners and stakeholders will discuss the utility of key WP outputs (Fig 1.b), including EU parasite diversity status & trends, Red List Assessments, parasite reference libraries, eDNA monitoring harmonisation, and policy briefs, under the overarching goal of co-producing actionable science in parasite biodiversity. All participants will further exchange knowledge and experiences of integrating parasites in environmental management and biodiversity monitoring schemes, to co-produce a pan-European policy brief with lessons learned from the project and advice on future collaboration and knowledge exchange for including parasites in future biodiversity monitoring and conservation management policies. **M4.3** International knowledge exchange seminar; **D4.3** Pan-European policy brief.

Expected outcomes in WP4:

- Unprecedented insights into social representations of parasites
- Popular science articles on parasite perceptions in Norway and Switzerland
- Publications comparing Norwegian and Swiss parasite perceptions and risk evaluations, and the co-production of actionable science in parasite biodiversity
- Co-produced national and pan-European policy briefs on challenges and opportunities for integrating parasites in environmental governance and monitoring

Synergies and Added value in WP4:

- Stakeholder-developed WP1-3 outputs will inform workshops and knowledge exchange seminar
- Stakeholder feedback will refine priorities across all WPs
- Our collaborative, multidisciplinary approach spanning natural to social sciences, academics to stakeholders, and local communities' knowledge to policy makers, will facilitate the inclusion of parasites into transnational biodiversity monitoring, and international conservation strategies

Novelty of planned research. Our project will be the first comprehensive and concerted effort in Europe to place parasites on the map of biodiversity monitoring and conservation by determining general patterns and trends in parasite diversity and by providing the necessary tools for future inclusion of parasites in biodiversity monitoring, conservation and policy. Our ground-breaking work will lay the conceptual and methodological foundations for future expansions of this approach to other unrepresented host and parasite groups and to other ecosystems. Our research will support environmental managers to achieve a paradigm shift of taxonomically unbiased conservation goals, through our focus on the current status and long-term trends of arguably one of the most diverse, yet most neglected components of European biodiversity, parasitic helminths. We will go beyond tracking parasite species richness to reveal changes in taxonomic, genetic and functional parasite biodiversity, and provide a critically needed baseline to assess the impacts of global change on aquatic ecosystem health. Our project will establish the first Red List assessments for European fish parasites, which includes parasites of fish species from the Arctic, a regional hotspot of ecological change[1]. IMPACT will provide novel results by reassessing European fish parasite species taxonomic diversity, where the re/discovery of cryptic and previously synonymised species is likely. We will future-proof

parasite species identification for biodiversity monitoring by establishing a reference library of molecular data associated to a curated voucher collection of European freshwater fish parasite species. We will conduct the first critical evaluation of eDNA as a replacement or complementary tool for the simultaneous detection of multiple parasite groups. We will harmonise this approach to be integrated in existing aquatic monitoring programs by co-developing an action plan with stakeholders responsible for environmental management and policy making to promote the integration of parasite detection into existing monitoring programmes. The strength, originality and novelty of this project also lies in its interdisciplinary and transnational dimension. Qualitative approaches in social sciences will allow the analysis of mental models that preside over the thinking, the action and the regulation in relation to parasites.

Transnational added value of the proposed research. Close partner collaboration through regular meetings, research visits, co-supervision of graduate students, and secondments of postdocs (e.g. NL -> ES/DE/NO, DE -> NO, CR -> CH) will ensure effective transnational knowledge transfer and strengthen synergies and added value of the project in relation to science and policy competency. This unique project will be a significant step towards capacity building in Europe in regard to synthesising and harnessing supranational knowledge on parasite biodiversity with the aim to contribute to improved biodiversity monitoring for European waters (also applicable to other ecosystems). IMPACT will build national-level parasite biodiversity monitoring capacity by linking international experts in morphological and molecular taxonomy to parasitologists and non-specialists in academic and public sectors by developing standardised guidelines for parasite assessments and associated training activities in partner institutions. IMPACT will work closely with natural history museums as biodiversity repositories for future generations and the project will make significant specimen contributions to European museum collections. Our consortium of nine European partners across seven countries combines broad science and policy expertise, gender, and career stages, which will enable early-career researchers to benefit from transnational collaborations with world-leading experts. Individual researcher networks include an extensive international group of scientists and stakeholders for whom the outputs of IMPACT will be highly relevant and an added transnational value of the proposed research. IMPACT will elevate perceptions and experiences of local stakeholders from different geopolitical and ecological contexts to an international level, and promote the development of pan-European strategies for integrating parasites in environmental management and biodiversity monitoring schemes. Our ambitious goals can only be achieved by a pan-European collaboration between scientists and stakeholders, empowering and maximizing the synergies between countries, viewpoints and expertise. In doing so, IMPACT will build a foundation for improved transnational monitoring of biodiversity and ecosystem change for policy and society.

Relevance for policy and society. Parasites are the most undervalued, yet essential, components of healthy and resilient aquatic ecosystems, which as a whole play pivotal roles for human societies and nature. The importance of preserving aquatic ecosystems is highly endorsed by national and international agreements, such as the EU Water Framework Directive (2000/60/EC), the '*White Paper on adapting to climate change*', and UN Sustainable Development Goals - #15 halting biodiversity loss and #14 life underwater. However, parasites lack formal protection, and are not explicitly included in current biodiversity policies or monitoring strategies, such as the EU Biodiversity Strategy for 2030, despite their role as ecosystem engineers determining whether good ecosystem health is attained[13]. IMPACT will provide new information and critically assess the eDNA approach to support environmental decision-makers and managers to develop biodiversity strategies and monitoring programs that recognise the importance of biodiversity at all trophic levels and the impact parasites have on ecosystem health[11], evolution and human use of provisional ecosystem services. Specific policy actions will include national policy briefs on the challenges and opportunities for integrating parasites in environmental governance, and a pan-European policy brief on lessons learned from IMPACT and advice on future collaboration and knowledge exchange for integrating parasites in biodiversity monitoring and conservation management policies.

Stakeholder engagement approach. We follow the good practices for co-production of Actionable Science[84]. Active engagement with relevant stakeholders and management authorities during the preparation of this proposal has identified that the challenge is not only to identify the gap in public policies, but also to understand why those gaps exist. Hence IMPACT specifically utilises an interdisciplinary approach that incorporates Norwegian and Swiss stakeholder case studies to gain deep insights into values, norms and knowledge forming the perceptions and management of parasites. Lessons learned from managers' practical experiences with parasites will be of relevance for clarifying priorities and mandates for integrating parasites in future biodiversity monitoring and conservation policies. The co-produced action plan and resulting policy brief at the national-level will be brought to the international stage through our knowledge exchange seminar with *environmental decision makers and managers* (e.g. European (& national) Environment Agency; Ministry of Climate and Environment (NO), Ministry for the Ecological Transition and the Demographic Challenge

(ES)), and *international and national NGOs* (e.g. IUCN Global Species Program (CH), RAVON (NL), National Biodiversity Data Centre (IR)).

References [1]Carlson et al. 2020 *Biol Cons* 250:108596; [2]Dobson et al. 2008 *PNAS* 150: 11482; [3]Marcogliese 2008 *OIE Rev Sci Tech* 27:467; [4]Hohenadler 2019 *Parasitol Res* 118:2543; [5]Carlson et al. 2017 *Sci Adv* 3:e1602422; [7]Vidal-Martinez et al. 2010 *Trends Parasit 26:*44; [8]Cizauskas et al. 2017 *R Soc Open Sci* 4:160535; [9]Poulin et al. 2016 *Parasitology* 143:114; [10]Wood et al. 2023 *PNAS* 120:e2211903120; [11]Selbach et al. 2022 *Trends Parasitol* 38:109; [12]Wood & Johnson 2015 *Front Ecol Environ* 13:425; [13]Hatcher et al. 2012 *Ecol Environ* 10:186; [14]Gange et al. 2022 *Cons Biol* 36:e13719; [15]Thomas et al. 2005 Parasitism, biodiversity and conservation *In* Parasitism and Ecosystems. Oxford Uni Press; [16]Llopis-Belenguer et al. 2020 *Int J Parasitol* 50:1089; [17]Bower et al. 2015 *Inland Waters* 5:1; [18]Amundsen et al. 2019 *Limnol Oceanogr* 64:S11; [19]Gomez & Nichols 2013 *Int J Parasitol: Parasit Wild* 2:222; [20]Gibson et al. 2005 Host–parasite database of the Natural History Museum, London. www.nhm.ac.uk; [21]Dallas et al. 2018 *Global Ecol Biogeogr* 27:1437; [22]Carlson et al. 2020 *Proc Roy Soc B* 287:20201841; [23]Dallas 2016 *Ecography* 39:391; [24]Dobson et al. 2008 *PNAS* 105:11482; [25]Gregory & Blackburn 1991 *Parasitol Today* 7:316; [26]Walther et al. 1995 *Parasitol Today* 11:306; [27]Froese & Pauly (Eds) 2023 FishBase. www.fishbase.org; [28]Brosse et al. 2021 *Global Ecol and Biogeog* 30:2330; [29]Stephens et al. 2016 *Ecol Lett* 19:1159; [30]Poulin et al. 2011 *Phil Trans Roy Soc B: Biol Sci* 366:2379; [31]Halvorsen et al. 1971 *Norweg J Zool* 95:181; [32]Conneely & McCarthy 1984 *J Fish Biol* 24:363; [33]Orts-Muñoz 1994 PhD thesis, U Valencia; [34]Blowes et al. 2019 *Science* 366:339; [35]Hillebrand et al. 2018 *J Appl Ecol* 55:169; [36]Pavoine & Bonsall 2011 *Biol Rev* 86:792; [37]Llopis-Belenguer et al. 2019 *Trends Parasitol* 35:972; [38]Benesh et al. 2017 *Ecology* 98:882; [39]Llopis-Belenguer et al. 2020 *Ecography*, 43:559; [40]Llaberia-Robledillo et al. 2022 *Biol Invas* 24:543; [41]IUCN 2012 Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: V4.0; [42]Kottelat 1997. *Biologia* 52:1; [43]Kottelat & Freyhof 2007 Handbook of European Freshwater Fishes. Berlin; [44]Pérez-Ponce de León & Poulin 2018 *J Helminth* 92:197; [45]Valkiūnas et al. 2008 *Trends Parasitol* 24:247; [46]Pleijel et al. 2008 *Mol Phylogen Evol* 48:369; [47]Brooks & Hoberg 2001 *Trends Parasitol* 17:273; [48]Gibson 1984 *Systematic Parasitol* 6:241; [49]Scholz et al. 2018 A guide to the parasites of African freshwater fishes *In* Abc Taxa. CEBioS, Royal Belgian Institute of Natural Sciences; [50]Faltynkova et al. 2020 *Parasitol Res* 119:2439; [51]Blasco-Costa et al. 2014 *IJP* 44:703; [52]Barčák et al. 2017 *Folia Parasit* 64:027; [53]Brabec et al. 2023 *IJP* in press; [54]Benovics et al. 2021 *Parasitol Res* 120:481; [55]Blasco-Costa et al. 2016 *Systematic Parasitol* 93:295; [56] Brabec et al. 2015 *Parasites Vectors* 8:1; [57]Monnens et al. 2023 *Gene* 851:146952; [58]Han 2022 *Mol Ecol Resour* 22:768; [59]Folkerts et al. 2022 *F1000Research* 10:48; [60]Astrin et al. 2023 *ZooKeys* 365:67; [61]Johnson et al. 2023 *Science 379:*1192; [62]Ceballos et al. 2017 *PNAS* 114:E6089; [63]Bass et al. 2015 *Trends Parasitol* 31:499; [64] Bass et al. 2023 *Trends Parasitol* 39:285; [65]Fossøy et al. 2020 *Environ DNA* 2:53; [66]Douchet et al. 2022 *Environ DNA* 4:627; [67]Thomsen et al. 2015 *Biol Conserv* 183:4; [68]Holman et al. 2021 *Environ DNA* 4:108; [69]Thomas et al. 2022 *Parasitology* 149:261; [70]Hupało et al. 2021 *Hydrobiologia* 849:155; [71]Pawlowski et al. 2022 *Sci Total Environ* 818:151783; [72]Bohmann et al. 2022 *Mol Ecol Resour* 22:1231; [74]Hohenadler et al. 2019 *Parasitol Res* 118:2543; [74]Soldánová et al. 2017 *Int J Parasitol* 47:327; [75]Prati et al. 2020 *Ecol Evol* 10:4031; [76]Jane et al. 2015 *Mol Ecol Resour* 15:216; [77]Richey et al. 2018 *J Aquat Anim Health* 30:130; [78]Chan et al. 2022 *Sci Rep* 12:9947; [79]Rose & Dooren 2011 *Austral Humanit Rev* 50; [80]Haltley 2011 *Austral Humanit Rev* 50; [81]Boholm & Corvellec 2011 *J Risk Res* 14:175; [82]Jones et al. 2008 *J Res Practice* 4:2; [83]Skår 2009 *Nor Antropol Tidsskr* 20:167; [84]Beier et al. 2017 *Cons Lett* 10:288; [85]Amano et al. 2023 *Nat Sustain* doi:10.1038/s41893-023-01087-8.

B. Communication and outreach plan

Who are IMPACT's end users and why is the project relevant to them?

Nature management advisors & policy makers - aquatic monitoring program prioritisation, disease outbreak forecasting, and parasite inclusive decision-making - *benefit from parasite diversity status & trends, Red Lists, harmonised sampling protocols, innovative eDNA monitoring tools, policy briefs (Fig. 1b)*.

Environmental NGOs - unique insights into parasite biodiversity and the benefits of protecting it – *benefit from parasite diversity status & trends, Red Lists.*

(Inter)national Red List authorities - integrate parasites in Red Lists by establishing expert committees – *benefit from parasite diversity status & trends, Red Lists, harmonised sampling protocols.*

Museums, national and global species data aggregators - aligned with their mission to act as repositories of biodiversity, raise awareness to the general public, and make data accessible – *benefit from parasite diversity status & trends, harmonised sampling protocols, curated specimens and DNA libraries*.

Scientific community - understanding of parasite biodiversity, and educating the new generation – *all.*

Fisheries - be aware of parasites in ecosystems, and interest on economically relevant parasites – *benefit from parasite diversity status & trends, harmonised sampling protocols,innovative eDNA monitoring methods.*

Local community & general public - increase familiarity with parasites – *(in)directly from all activities.*

How and when will communication take place?

All IMPACT communication activities will benefit from NINA's (co-ordinator) in-house communication department, which is highly experienced in developing written and film content for (inter)national media across multiple platforms, and will provide communication training (kick-off meeting). IMPACT addresses English-language bias in conservation decision making[85] by taking a multilingual communication approach to ensure end users across Europe can easily access project developments (e.g. multilingual video closed captioning, local language social media content and policy briefs). See Gantt chart for schedule.

Website and social media: IMPACT's webpage will feature a project overview, activity updates, instruction videos, and plain language summaries of peer-reviewed publications and policy documents. We will develop content for NINA's social media channels. All partners will promote IMPACT on their own websites and social

media, in addition to developing local media content for science websites (e.g. forskning.no), magazines (e.g. Pro Natura Magazine), and other organisations interested in aquatic life, biodiversity and conservation.

Stakeholder newsletter: Online IMPACT progress updates every 2nd month (written and/or short videos) following Steering Group meetings, with feedback refining future activities.

International knowledge exchange seminar (WP4): This key, concluding communication event will provide IMPACT stakeholders an arena for knowledge exchange and mutual learning.

Policy briefs: Presenting co-produced advice on national and international parasite integration in environmental governance (total 3).

Parasite species lists & Red List assessments: Geographically & taxonomically referenced parasite occurrence data will be made available for biodiversity information centres and Red List authorities to aid in biodiversity reporting and species' extinction risk assessments.

Instruction videos: How-to-guides for parasite sampling and vouchering to support print guidelines (on IMPACT webpage).

Popular scientific articles: Raise awareness of why parasites deserve protection to wider public.

Outreach events: IMPACT researchers are active in on-campus/museum/aquaria outreach events (e.g. Night of the Science, Science Slams), and will utilise these established meeting points to make IMPACT science and innovation accessible to the wider public.

Peer-reviewed publications & scientific meetings: IMPACT will yield 13 open access papers (see WP Deliverables), aiming for high-impact peer-reviewed interdisciplinary publications in addition to leading field-specific journals (e.g. Taxonomy; Biological Conservation; Ecology & Society). Moreover, results will be disseminated to the scientific community at national and international meetings (e.g. International Symposium on Fish Parasites; Symposium for European Freshwater Sciences; EU Congress of Conservation Biology).

C. Description of project coordination and management

IMPACT will be coordinated by Rachel Paterson (PI) of the Norwegian Institute for Nature Research (NINA), who has previous administrative experience as coordinator of large-scale national and international projects (e.g. Norwegian Environment Agency NEA, 2021-present; EU Horizon 2020, 2017-20) and stakeholder workshops (e.g. Sjøørret, 2021-23; NRN-LCEE, 2018). Paterson will be supported by Isabel Blasco-Costa of the Natural History Museum of Geneva, who brings complementary national and international project management expertise (e.g. Swiss National Science Foundation 2017-21; SwissCollNet 2022-23; EU FP7-PEOPLE 2009-12). IMPACT consortium management benefits from a multi-disciplinary and multi-national team of PIs, each experienced in coordinating diverse projects with national and international stakeholders, with previous/ongoing collaborations; Paterson & Blasco-Costa (WP4 Norwegian case study, 2015-present); Balbuena & Blasco-Costa (Ministry of Science & Innovation, ES, 2016-19, 2020-present); Blasco-Costa & Scholz (EU FP7 2009-12); Leese & Sures (RESIST, DFG-CRC 2021-24); Sures & Scholz (EU FP7-ENVIRONMENT BIOFRESH, 2009-14), Sures & Selbach (bilateral DE-SA cooperation BMBF/NRF 2017-21); Sures & Thieltges (Marie Curie PARAISO, 2022-present).

NINA is a world-leading applied ecology institute that delivers national (e.g. Ministry of Climate and Environment, Directorate of Fisheries) and international (e.g. IUCN SSC Salmonids, IPBES) management knowledge at the biodiversity-society boundary. NINA provides exceptional project management resources for coordinating large consortia, including a certified Quality Management System (ISO 9001:2015, Cert. No. 1744). IMPACT benefit's from NINA's in-house communication department; high-end computing capacity coupled with dedicated IT personnel to support data storage and technical needs; state-of-the-art video and audio systems for hosting virtual meetings, in addition to in-house meeting, seminar and restaurant facilities for up to 70 participants.

Overall Coordination. IMPACT will have kick-off, mid-term and final meetings, where all consortium partners will participate, in addition to bi-monthly Steering Committee (SC; co-ordinator + WP leaders) meetings (see Gantt chart). The kick-off and final meeting will be hosted in-person at NINA (Trondheim, NO), whereas mid-term and SC meetings will be held digitally. Digital meetings will facilitate stakeholder participation, with interactive discussions and feedback shaping project developments to ensure stakeholder relevant outcomes are achieved. The three-day kick-off meeting will focus on presenting WP objectives, familiarisation with NINA's Quality System and support infrastructure, data management plan development, and building stronger ties among partners. Whilst there is a strong collaboration history amongst partners, not all partners know each other, nor are they familiar with all disciplinary approaches integrated here. Half-day SC meetings will provide a dynamic platform for partners across WPs to discuss ongoing and upcoming activities to ensure the exploitation of WP synergies and review risk mitigation (Table 1). Stakeholders will be invited to SC

meetings, with digital updates (via stakeholder newsletter) made available in national languages. The one-day mid-term meeting will focus on evaluating progress and mitigation plans, and presenting initial results. The two-day final meeting will be held after the one-day international knowledge exchange seminar (Task 4.3), with a focus on evaluating the overall outcomes from IMPACT, in addition to discussing future work identified through the course of the project, and providing an opportunity to offer feedback on project coordination and management. Microsoft Teams will be our project communication, scheduling and file sharing hub.

Table 1. Potential risks, level (low L, medium M, high H) and mitigation strategies

Potential risk	**Level**	**Mitigation strategy**
WP1. Long-term and/or raw data from historical studies is unavailable	L	Availability of data confirmed from authors/institutions during proposal development.
WP1. Target fish species are locally rare or absent at re-sampled sites	L	Change sites if a sufficient number of fish cannot be captured from initially planned locality.
WP2. Poor quality specimens for robust species diversity reassessments	L	WP2 partners provide voucher sample training to WP1 partners.
WP2. Problems generating genetic data suitable for diversity evaluation due to small size or DNA quantities	M	Alternative strategies including pooling multiple individuals if DNA quantity was low, resolving to using traditional PCR and Sanger sequencing.
WP3. Not all parasite groups can be recovered by eDNA	M	Redesign primers.
WP3. eDNA amount in field samples too low for some parasite species	M	Increase filtered volume of water.
WP4. Lack of interest in participating by key stakeholders	L	WP4 partners have active collaborations with key stakeholders interested in joining the project.

Work package coordination, support and first tasks. The four WPs will be carried out in close collaboration among partners. WP leaders have specific experience of the topic, data and required analyses, and will direct the timetables and progress of their WP, under the overall project coordination of Paterson and Blasco-Costa. WP1 will be led by Paterson, Thieltges & Balbuena. Fish parasite occurrence data will be obtained from the Host-Parasite database of the NHM London. Selbach and Primicerio will provide long-term fish-parasite datasets across northern Norway. All WP1 partners will organise sampling trips to historical locations, test specimen vouchering guidelines for WP2, and facilitate access to parasite community datasets from their country, including unpublished data and non-English studies, to be compiled and analysed by the WP1 postdoc. Blasco-Costa and Scholz (WP2 co-leaders) will create parasite specimen vouchering guidelines to be tested by WP1 partners, who will in turn provide specimens for parasite species taxonomic diversity assessments. The WP2 PhD student will also provide mitogenome and ribosomal molecular data that will be informative for primer design in WP3 and verified species identifications for WP1. WP3 will be led by Sures and Leese, with Sures and Selbach coordinating eDNA field sampling. The WP3 postdoc will design primers based on molecular data from WP2 guided by Sures, Leese & Blasco-Costa. Rybråten and Salomon Cavin will lead WP4, and will conduct semi-structured stakeholder interviews with the assistance of the postdoc and WP4 partners. Postdocs and graduate students, benefiting from co-mentorship and training from IMPACT's transnational partners, will be recruited late-2023 to ensure their full integration into project activities. Furthermore, IMPACT is supported by local teams of highly experienced field and laboratory technicians, researchers and managers, in addition to bioinformatic expertise.

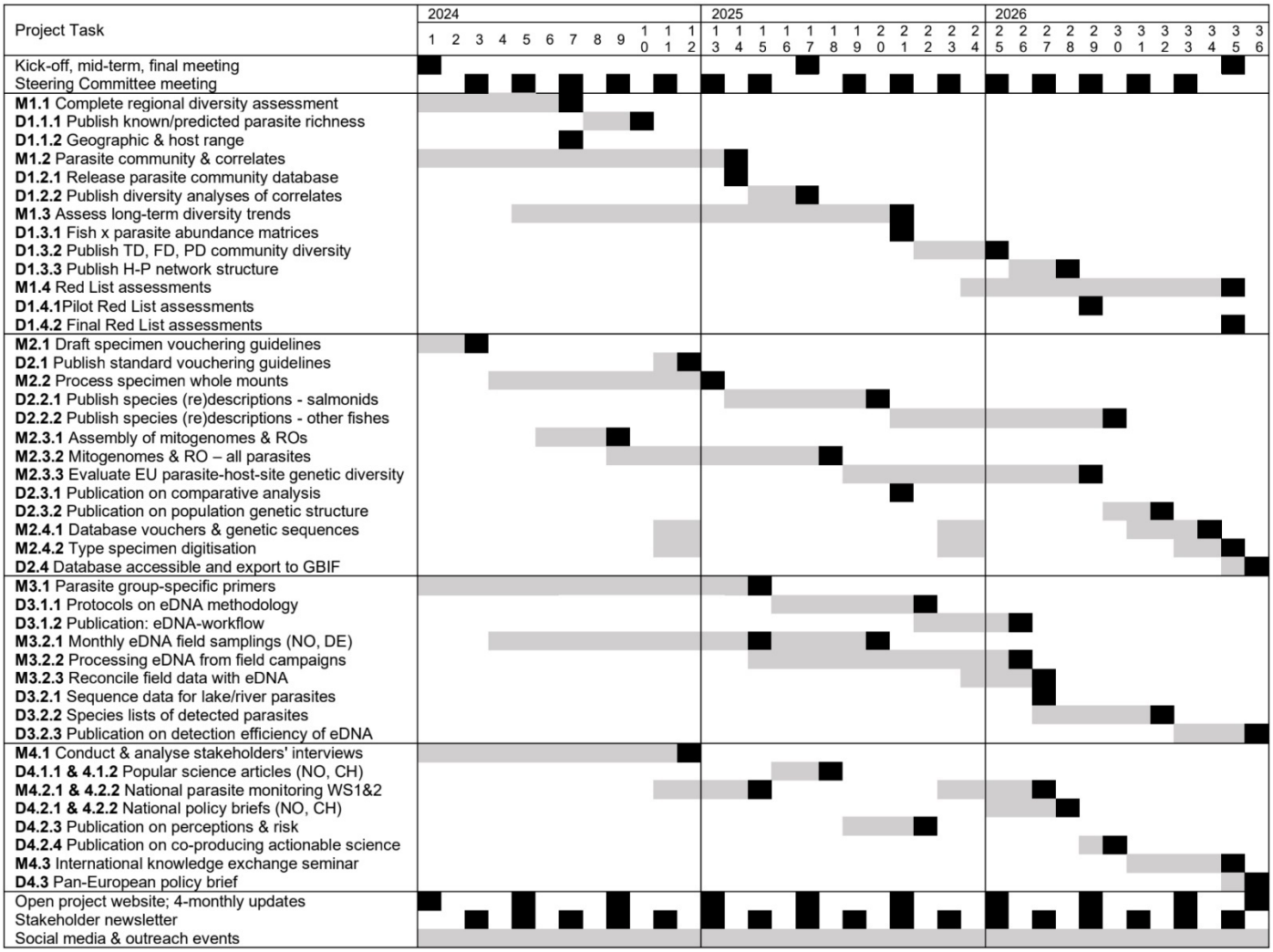
D. Interconnection to national and transnational research projects and programmes

Transnational: IMPACT policies will feed into NINA's active involvement in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and engagement in Alternet, Europe's Ecosystem Research Network for assessing biodiversity changes. IMPACT will link to Bioscan-Europe (part of the International Barcode of Life Consortium; Leese) dedicated to connecting DNA-based biodiversity monitoring initatives, and to eDNAqua-Plan (Biodiv-2022 01-01 Horizon EU; Leese Task leader) and iTrackDNA (Canada; Leese advisory board). Regional and national level Red List assessments will aid national reporting to Convention on Biological Diversity, and Sustainable Development Goals, in addition to providing a proof-of-concept for integrating parasites in global threatened species evaluation policies via IUCN SSC Parasite Specialist Group (Blasco-Costa). IMPACT connects with Europe's fish parasitologist community via yearly Ichthyoparasitological Symposium (Sures organiser). By offering training to graduates and postdocs IMPACT contributes to the strategy "Training for Species Knowledge" to ensure a sufficient number of species specialists exist for medium- and long-term biodiversity monitoring across Europe.

National: *DE:* we link to the collaborative research centre (CRC) 1439 (DFG-funded, ID 426547801; Sures/Leese) exploring parasite community responses to multiple stressors, and to the German Thünen Institute (Inst. of Fisheries Ecology via Sures) responsible for European eel/parasite stock assessments, in addition to projects dbDNA, TrendDNA and GeDNA (financed by the German Federal Environment Agency; Leese). *NL:* IMPACT connects to ongoing NIOZ long-term fish monitoring (via Thieltges) in coastal waters, including migrating freshwater species. *CH/ES:* IMPACT capitalises on Salomon Cavin's AGORA 'unloved animals' project (CRAGP1_199817 JSC) and Blasco-Costa's SNSF whitefish parasite diversity project (31003A_169211; Blasco-Costa), which has been expanded by Blasco-Costa/Balbuena's Ministry of Innovation & Science of Spain (PID2019-104908GB-I00). *CR:* Our co-produced policy brief will be used by the Nature Conservation Agency of the Czech Republic (via Scholz). *IR:* Our project aligns with the National Biodiversity Action Plan 2023-2027 objectives, with O'Dwyer expanding links with the National Parks and Wildlife Service, and Inland Fisheries Ireland to promote inclusive aquatic biodiversity monitoring and protection. *NO:* IMPACT utilizes NRC-funded SALCUL networks (Rybråten) bridging diverse knowledges for improved salmon management, and links to Paterson's NEA parasite-trout migration, and Fusta parasite recovery projects (WP4). Innovative tools will advance UiT's long-term Northern Norway biodiversity monitoring programs that inform research and management strategies in northern freshwater systems.

E. Time schedule and working programme (use a Gantt chart or equivalent)

Below, the Gantt chart outlines IMPACT project management, core research tasks and dissemination activities timeframe. Postdocs and graduate students will be recruited late 2023. Grey bars indicate working period; black bars indicate completion of milestone or deliverable.



F. Proposed Data Management Approach

Datasets and other digital outputs of long-term value

This project will generate the following data of long-term value:

a. Data on parasite and host species, spatial distribution, functional traits and infection at each site of occurrence, and Red List assessments.
b. Clean genetic data (incl. eDNA sequence reads) for hundreds of parasite species, abiding to the agreements of the Convention on Biological Diversity, the Nagoya Protocol and EU Regulation No. 511/2014 for the use of genetic resources.
c. Interview data, and parasite discourse content.
d. Scripts used for data analyses.

All data produced will sum up to ca. 100 TB over the course of the project.

IMPACT will reuse the following data; Host-Parasite database NHM London, GBIF, Limnofauna Europaea, GenBank, published host-parasite checklists, and host and parasite trait databases, unpublished stakeholder reports and raw data sets from fish-parasite surveys.

Data policy and the FAIR principles (i.e. they should be findable, accessible, interoperable and reusable)

Datasets and their associated metadata will be deposited at Zenodo.org with Digital Object Identifiers (DOI) in accordance with funder policies. NINA coordinates the Living Norway Ecological Data Network which facilitates open, reproducible and transparent sharing, use and reuse of ecological data to the benefit of society and science, with all IMPACT partners committed to using best practices for storing and disseminating open data.

Members of the team responsible for the Data and Digital Outputs Management Plan

The coordinator together with WP leaders will be responsible for implementation and updating.

Management of data and digital outputs during the project to ensure their long-term value is protected

Project data will be stored at institutional servers (NAS connected, daily backed-up) under the IT department supervision, ensuring maximum security, integrity and availability. Project data with be shared between partners via Microsoft SharePoint.

Management after the project ends to ensure long-term accessibility

Files deposited in Zenodo (min. 10-yr retention) will be made public at time of publication with DOI, allowing datasets behind a publication to be identified and accessed.

Red List assessments will be submitted to national biodiversity data centres (e.g. NBIC) and the IUCN SSC Parasite Special Group in a format accessible to the IUCN Species Information Service, the central database for storing and managing species assessments for the IUCN Red List.

Genetic data will be submitted to GenBank and species data will be integrated in national and international databanks (e.g. NCBI, GBIF). We will store files in open archival formats (e.g. pdf), or include software and its version number information when this is not possible. The coordinator and the NINA library service will manage and overlook this process.

Curated reference library collection including sequenced vouchers and type specimens, and semi-permanent mounts digitised using SwissCollNet protocols, will be made available in GBIF and the future Swiss Virtual Natural History Collection portal and Global Registry of Scientific Collections.

Interviews (WP4) will be carried out in the Responsible Research and Innovation (RRI) framework. Qualitative data collection and storage will follow the standards of the Norwegian Data Protection Office (NSD) and the Open Research Data policy statement of the Swiss National Science Foundation.

What restrictions, if any, on how the data and digital outputs

Our data does not include sensitive data thus, no restrictions are envisaged.

Ensure data security, privacy, and intellectual property restrictions associated with datasets and digital outputs in derivative products

Data will be made available under Creative Commons licenses, such as CC0 or CC-BY.

Supporting documentation and other information to support the longer-term re-use of the data and digital outputs

All samples on which data are collected will be prepared according to published standard protocols in the field. The dataset will be accompanied by a README file, describing directory hierarchy and file naming convention and an INFO.txt file describing the protocol used in that experiment.

Costs required to manage the data and digital outputs to ensure long-term accessibility

The costs of long-term storage in Zenodo (4TU.ResearchData back-up) are included in the budget of Thieltges. This arrangement will be included in the Consortium Agreement.

Attachment 2: Background included

According to the Grant Agreement (Article 16.1) Background is defined as “data, know-how or information (…) that is (…) needed to implement the Action or exploit the results”. Because of this need, Access Rights have to be granted in principle, but Parties must identify and agree amongst them on the Background for the Project. This is the purpose of this attachment.

PARTY 1

As to **STIFTELSEN NORSK INSTITUTT FOR NATURFORSKNING**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section “Access rights to results and background”, sub-section “Access rights to background and results for implementing the Action”)**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section “Access rights to results and background”, sub-section “Access rights for exploiting the results”)**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 2

As to **MUSÉUM D'HISTOIRE NATURELLE DE LA VILLE DE GENÈVE**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 3

As to **ATLANTIC TECHNOLOGICAL UNIVERSITY**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.
Knowledge of methods used for fish sampling, collecting parasite specimens, and processing samples.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 4

As to **NWO I - ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 5

As to **UNIVERSITAT DE VALÈNCIA - ESTUDI GENERAL**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 6

As to **BIOLOGY CENTRE OF THE CZECH ACADEMY OF SCIENCES**, it is agreed between the Parties that, to the best of their knowledge, the following Backgrounds are hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Knowledge of methods used for collecting and vouchering parasite specimens and depositing them in curated collections.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.
Taxonomic expertise required for parasite identification, re-evaluation of taxonomic species concepts and unravelling cryptic species.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 7

As to **UNIVERSITY OF DUISBURG-ESSEN**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.

PARTY 8

As to **INSTITUTE OF GEOGRAPHY AND SUSTAINABILITY, UNIVERSITY OF LAUSANNE**, it is agreed between the Parties that, to the best of their knowledge, no data, know-how or information of **INSTITUTE OF GEOGRAPHY AND SUSTAINABILITY, UNIVERSITY OF LAUSANNE** is Needed by another Party for implementation of the Project (Article 16.1 and its Annex 5 Grant Agreement, Section “Access rights to results and background”, sub-section “Access rights to background and results for implementing the action”) or Exploitation of that other Party’s Results (Article 16.1 and its Annex 5 Grant Agreement, Section “Access rights to results and background”, sub-section “Access rights for exploiting the results”).

This represents the status at the time of signature of this Consortium Agreement.

PARTY 9

As to **UIT THE ARCTIC UNIVERSITY OF NORWAY**, it is agreed between the Parties that, to the best of their knowledge, the following Background is hereby identified and agreed upon for the Project. Specific limitations and/or conditions, shall be as mentioned hereunder:

Describe Background	**Specific restrictions and/or conditions for implementation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights to background and results for implementing the Action")**	**Specific restrictions and/or conditions for Exploitation (Article 16.4 Grant Agreement and its Annex 5, Section "Access rights to results and background", sub-section "Access rights for exploiting the results")**
Freshwater fish - parasite community raw datasets from published and unpublished sources	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.	Data available to project participants for purposes stated in the IMPACT proposal for the duration of the project.

This represents the status at the time of signature of this Consortium Agreement.