# Collective scientific assessment as a relevant tool to inform public debate and policymaking: an illustration about the effects of plant protection products on biodiversity and ecosystem services

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# Collective scientific assessment as a relevant tool to inform public debate and policymaking: an illustration about the effects of plant protection products on biodiversity and ecosystem services

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**Abstract :**

Several sustainable development goals cannot be achieved without implementing a new generation of environmental measures to better preserve or restore biodiversity and ecosystem services. However, understanding and addressing biodiversity loss and ecosystem degradation is a challenging problem that is not solvable without integrating the best and latest science. It is crucial to enhance the legibility of this knowledge for decision-makers and policymakers following good-practice standards of scientific assessment. This is the main objective of collective scientific assessments (CSAs), as carried out by the French National Research Institute for Agriculture, Food and the Environment (INRAE) since the early 2000s following a documented procedure to inform public policy and foster public debate on complex interdisciplinary issues. This article describes the main steps of the CSA procedure designed by INRAE's Directorate for Collective Scientific Assessment, Foresight and Advanced Studies, from formulation of the initial question asked by public or para-public bodies (typically ministry divisions or environmental agencies) to wider dissemination of the results and conclusions. This process description is then illustrated through the example of a CSA recently commissioned by three French Ministries (for Ecology, for Research, and for Agriculture) regarding (i) contamination of terrestrial, freshwater, and marine ecosystems by plant protection products (PPPs); (ii) the resulting effects on biodiversity and ecosystem services; and (iii) possible prevention and mitigation strategies. The capacity of this kind of CSA to inform public debate and policymaking is then exemplified through a description of the main outcomes generated by the latest CSA dealing with the adverse effects of PPPs. We also provide a short overview of some key expectations from the current CSA, with a focus on the recent development of the ecosystem service approach in ecological risk assessments of PPPs in the European Union. This illustration demonstrates

that CSAs, which are applicable to a wide variety of complex interdisciplinary questions that are not limited to environmental issues, are a relevant tool to inform public debate and policymaking.

**Keywords** : Expertise, Transfer of knowledge, Pesticide, Biocontrol, Ecological risk assessment

## 1. Introduction

The 2030 Agenda for Sustainable Development adopted in September 2015 sets out an ambitious action plan to end poverty, protect the planet and improve the well-being of people around the world through the implementation of 17 Sustainable Development Goals (SDGs). Preserving or restoring environmental quality is a prerequisite to achieving most of the SDGs (Racioppi et al. 2020). Looking beyond these SDGs, there is growing scientific consensus that conserving terrestrial and aquatic biodiversity is a crucial objective for a wide range of sustainability programs (Glaser 2012; Bach et al. 2020; Tickner et al. 2020). As biodiversity is fundamental for supporting and maintaining ecosystem functioning (EFSA Scientific Committee, 2016; van der Plas 2019), this consensus is in line with the notion of ecosystem goods and services that contribute to human health and well-being (Millennium Ecosystem Assessment 2005). Therefore, during The United Nations Conference on Sustainable Development that took place in June 2012 (Rio+20 Conference), and in continuation of the Convention on Biological Diversity adopted in 1992, EU Member States have explicitly recognized the intrinsic and extrinsic value of biodiversity and the need to preserve ecosystem services as critical foundations for sustainable development and human well-being (United Nations General Assembly 2012). The European Commission (2020) recently proposed a biodiversity strategy for 2030 that highlights the key role of biodiversity and associated services for Europe and the need to reduce pollution and restore ecosystems.

The EU framework programme for Research and Innovation 2021–2027 (European Commission 2018) demonstrates a clear political ambition to establish the EU as a leader in the effort to achieve the SDGs. This objective requires the implementation of an appropriate framework programme, supported by sustainability-oriented thematic agendas (Kastrinos and Weber 2020), to move towards a next generation of environmental measures purposed with supporting efforts to better preserve or restore biodiversity and ecosystem functions and

services. However, understanding and addressing biodiversity loss and ecosystem functioning degradation is a challenging problem that is not solvable with current established methods (Sharman and Mlambo 2012; Sarkki et al. 2020). The challenge cannot, therefore, be met without integrating the best and latest scientific knowledge in the fields and disciplines related to this issue.

The role of science in informing decisionmaking and policymaking has been extensively discussed in the past decade, especially in terms of supporting global sustainability governance (e.g. Holmes and Clark 2008; Likens 2010; van der Hel and Biermann 2017). According to the InterAcademy Partnership (IAP, 2019), effective implementation of the SDGs requires access to scientific knowledge and independent expertise. In other words, and as proposed by Haas (2004), there is a need for "usable knowledge" that "encompasses a substantive core that makes it usable for policymakers, and a procedural dimension that provides a mechanism for transmitting knowledge from the scientific community to the policy world". This transfer from scientists to decisionmakers and policymakers continues to prove challenging in practice (Dale et al. 2019). However, there is a growing number of national initiatives designed to foster science–policy–practice interfaces related to biodiversity and ecosystem protection in a range of countries, such as Germany (Leibenalth et al. 2020) and the UK (Holmes and Clark, 2008).

There are several recognized methods of scientific assessment, such as meta-analysis, systematic review or participatory mapping (Navarro et al. 2020). Here, we present the approach developed by the French National Research Institute for Agriculture, Food and the Environment (INRAE)'s Directorate for Scientific Assessment, Foresight and Advanced Studies (DEPE) to provide scientific expertise and inform public policy debate. Entitled "collective scientific assessment" (CSA), this kind of expertise is based on documented procedures (INRA-DEPE 2018), from the external request issued by public structures through to deliverables and dissemination.

After describing the main steps in the procedure classically followed for CSA, we illustrate the process by looking at the example of an ongoing CSA (2020-22) focused on the impacts of plant protection products (PPPs) on biodiversity and ecosystem services. PPPs are defined here as synthetic pesticides (active substances and formulations) and their transformation products, and encompassing biobased processes (biobased substances, pest control organisms, etc.) used in both agricultural and non-agricultural activities (e.g. greenspaces, gardens, public infrastructure, etc.). We then show how this kind of expertise is relevant for informing public debate and policymaking by describing the main outcomes generated by the earlier CSA published in 2005 that addressed the adverse environmental impacts of PPPs. Finally, we provide a short overview of some key expectations from the current CSA.

## 2. General description of a collective scientific assessment (CSA)

### *2.1. CSAs follow a documented procedure based on good-practice standards of expertise*

Public research organizations can support public policy through various kinds of actions, including the provision of expertise to shed light on key issues. Decisionmakers and policymakers can consequently benefit from a critical and intelligible review of the scientific knowledge related to a complex question. This is the main objective of CSAs (abbreviated 'ESCo' in French), which are reports based on collective assessment that follow a documented procedure defined by a code of conduct established by the DEPE of INRAE, in accordance with the French National Charter on Institutional Scientific Expert Reports (Fig. 1).

### *2.2. Initiation, governance and monitoring*

One of the specificities of CSAs is the multidisciplinary dimension of the question generally asked by public or para-public bodies including decisionmakers or policymakers (typically ministry divisions or environmental agencies), which the CSA process calls 'backers'. The

project initiation phase, which lasts six to twelve months on average (Fig. 1), corresponds to a period of dialogue between the backers and one or several relevant academic research institutes (RIs) that leads to the drafting and sign-off of a mutual agreement to which the co-constructed CSA purpose, objectives and agenda are annexed. This dialogue is a co-construction process supported by a preliminary exploration of the available scientific literature in order to get an estimate of the amount of relevant source material, to assess the scope and breadth of the topic and its degree of multidisciplinarity, and to identify points in the original request made by the backers that require clarification. This phase also includes setting up the various committees that will contribute to CSA governance and monitoring (see Fig. 2 for example), such as an oversight committee and a stakeholder advisory committee. The oversight committee, which is composed of representatives of the backers, the RI and the project team, is a decisionmaking body. The stakeholder advisory committee is a consultative body that includes representatives of the main actors in society likely to be concerned by the conclusions of the CSA (e.g. environmental and consumer associations, local authorities, professional organizations, economic stakeholders in the agrifood and environmental sectors, scientific interest groups) in order to capture and integrate their reactions, comments and opinions.

### *2.3. Coordination and scientific experts*

Each CSA is coordinated at operational and scientific levels by a project team (manager, scientific leads, librarians) (Fig. 1), following the guidelines established by INRAE (INRA-DEPE 2018). Global coordination of the process is tasked to a specific RI staff member who operates as project manager. Scientific leadership is provided by senior scientists that are appointed by the mandated RIs according to their scientific competences and their capacities for collective work. They also represent the expert panel and contribute to academic mobilization of the results.

With the support of the librarians, the scientific leads and the project manager select scientific experts based on the four core principles underpinning CSAs: competence, plurality of disciplines and approaches, impartiality, and transparency (INRA-DEPE 2018). Impartiality is assured by a declaration of interest, which both scientific leads and experts are required to submit ahead of further analysis by a dedicated review panel before final appointment. Experts almost exclusively come from academic research institutions and universities, with possible (but limited) participation by representatives of governmental agencies or offices if needed. Experts from the private sector cannot be involved in CSAs. Declarations of interest are archived and made available in response to external request. Each final extended CSA report includes an analysis of the links and conflicts of interests to make it public.

In consultation with the scientific experts, librarians are also responsible for the bibliographic corpus (see section 2.4 below). They assist experts in producing requests for the collection of references, and they produce the final list and bibliometric analysis of the references used and cited in the CSA.

### *2.4. Production and use of bibliographic corpuses*

CSAs are mainly based on the international academic literature, which can be supplemented as and when needed by 'grey' literature such as government reports, policy statements, thesis reports or technical publications. The use of 'grey' literature has to be justified on grounds of the specificity of the subject and its unique or recent character explaining why no equivalent source can be found in the peer-reviewed academic literature. Qualification of these sources is the responsibility of the experts who evaluate the robustness of the results and conclusions.

After the preliminary bibliographic search performed during the initiation phase, the bibliographic corpus is produced by the librarians, in collaboration with the scientific experts and the project team, throughout the assessment and write-up period (Fig. 1). Librarians and

experts co-elaborate a set of bibliographic requests that are used to query and explore international bibliographical databases. The initial corpus obtained is then gradually refined by the experts to arrive at the final corpus that is exploited and referenced in the extended report. This process is based on a descriptive analysis of the corpus that provides the foundations for selecting the main results concerning established knowledge, controversies, and heterodox or innovative approaches. During this process, experts are required to explain why they have added or rejected references and which criteria they used to qualify references from the grey literature. Justifications can be integrated into the final extended report (see section 2.5). The elimination process wants special care so as not to reject certain references that serve to populate a table of current scientific controversies.

Transparency over the corpus analysis and reference selection (or rejection) process and the description of the inclusion and exclusion criteria for sources are crucial to assure the credibility of the CSA. Therefore, each CSA extended report describes the procedure used to produce the corpus together with qualitative and quantitative analyses of the corpus. To this aim, librarians conduct statistical, bibliometric and cartographic analyses of the cited bibliographic corpus.

### *2.5. Deliverables and dissemination*

CSAs seek to inform public policy and foster public debate. CSA results and conclusions therefore need to be made public and freely accessible to a wide audience. First, they are presented in a final seminar that can be organized at a national or international level. To reach the widest possible audience, this seminar is freely open to the public and can be filmed to be made available online on the RI websites a few days after the event (with simultaneous translation in English and/or other languages where appropriate).

Three kinds of formal final reports are generated: i) an extended report, ii) a condensed report, and iii) a summary report (Fig. 1).

The extended report brings together all the critical contributions and analyses written by the experts on the basis of the bibliographic corpus, which is comprehensively referenced. It also describes the general framework of the CSA, the collective of experts involved, and the process and methods used throughout the exercise. Written under the responsibility of the experts and scientific leads, the extended report is posted online by the RIs. This report serves as a basis for the project team to draft a condensed report under the supervision of the experts.

The condensed report is designed to be accessible to a wide audience (e.g. scientists in other fields, teachers and students, informed public, etc.). The oversight committee is consulted to rule on whether the document is readable and relevant to the CSA specifications and whether its content is appropriate to support public decisionmaking. However, the experts group remains the final decisionmaker regarding final content and conclusions. The condensed report is then made freely available online in both French and English. Finally, a summary report of less than 10 pages (in French and in English) is freely disseminated by the RIs in the widest possible way (mailing lists, websites, social media, etc.).

Over and above these requested deliverables, it is equally important to improve the reach and impact of each CSA by disseminating its main results and conclusions within the international scientific and practitioner community. With that vision, scientific leads and experts are encouraged to publish the results of their work in peer-reviewed journals and to present them at scientific conferences. In addition, the project team needs to remain active for a few years after the CSA to communicate as much as possible to various stakeholders and the wider public in order to help share key knowledge and foster public debate, in line with the missions of public RIs.

## 3. Focus on the CSA on the effects of plant protection products on biodiversity and ecosystem services along the source-to-sea continuum

### *3.1. Context and objectives*

In 2019, the French Ministries for Ecology, for Research and for Agriculture commissioned INRAE and Ifremer (French Research Institute for Exploitation of the Sea) RIs to conduct a CSA on the effects of PPPs (as defined in the introduction section) on biodiversity and ecosystem services along the source-to-sea (i.e. terrestrial–freshwater–marine) continuum. More specifically, the mandated CSA concerned a critical analysis of the current science on i) contamination of terrestrial, freshwater and marine ecosystems by PPPs, ii) the resulting effects on biodiversity and ecosystem services, iii) the methods available for *a priori* and *a posteriori* environmental risk assessment of PPPs, and iv) possible strategies for prevention and mitigation of PPP contamination and ecotoxicological effects. Besides its scientific relevance (matching to both the INRAE's and Ifremer's spheres of competence), both the RIs considered the request as pivotally relevant from a societal perspective.

CSA coordination was entrusted to the INRAE's DEPE, with financial support from the French Office for Biodiversity (OFB) as part of the French ECOPHYTO plan that aims to reduce the use, risks, and impact of PPPs while sustaining economically efficient agriculture (Fig. 2). The project agreement was signed off by the different parties in early 2020.

### *3.2. Governance and implementation of the expert panel*

The structure and governance of the CSA are illustrated in Fig. 2. The project team involved three scientific leads and three librarians coordinated by a team manager belonging to the INRAE DEPE. As indicated above (Section 2.3), the project team was in charge of identifying and recruiting the experts, mainly based on a first analysis of the scientific literature using preliminary bibliographic requests covering as of the entire CSA scope as possible. Taken together, the 46 experts, including the three scientific leads, have contributed to about 2000 publications in international journals, including a large number of co-publications (Fig. 3).

This CSA also relies on two committees (Fig. 1 and 2). The oversight committee is composed of representatives of the three backer ministries, the two mandated RIs, the funders, and representatives of the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) which is the national authority for marketing authorizations on PPPs. Given the large scope of the CSA and its potential impact on a wide range of environmental, economic and social sectors, the stakeholder advisory committee gathered more than 20 different public, private and associative actors.

### *3.3. Potential outcomes: examples from the 2005 CSA on "Pesticides, agriculture and environment", and new challenges*

The earlier CSA dealing with the environmental effects of PPPs was conducted in 2004–2005. It was entitled "Pesticides, agriculture and environment: How to reduce the use of pesticides and limit their environmental impacts" (Aubertot et al. 2005). Its societal impact was assessed in 2011 (Hocdé and Colinet 2011). On the public action front, it was clearly established that the 2005 CSA served as a scientific support for the French Interministerial Plan for the Reduction of Pesticide Risks (adopted in June 2006) as well as for the French *Grenelle de l'Environnement* stakeholders forum organized from July to October 2007 by the French government, and the resulting raft of legislative measures. It further contributed to the adoption of environmental measures by the French National Assembly as well as the drafting and publication in 2008 of the first version of the French ECOPHYTO Plan to "reduce and improve the use of plant protection products", which has since been revised twice (ECOPHYTO II+ Plan 2018). This management plan has enabled to fund several research projects to improve knowledge on the fate and effects of PPPs in the environment. The dissemination to the general public was also evidenced by the publication in 2006 of 148 press articles related to the main results and conclusions of this CSA. Moreover, these results and conclusions have been used by various

pro-environment non-governmental organizations to disseminate scientific knowledge and information to stakeholders and the general public. This analysis confirms the relevance of CSAs to enhance the interactions between scientific knowledge, decision and policy making, and public debate.

The 2005 CSA was dedicated to conventional pesticides used in agriculture, with a limited focus on the resulting environmental effects outside agricultural areas (Aubertot et al. 2005). In comparison, the current CSA addresses a new field of investigation by considering the ecotoxicological effects of PPPs, including natural substances and biobased processes (which started to gain wider use in 2005 and so had not been high on the agenda in the previous CSA) used in both agricultural and non-agricultural activities, in both terrestrial and aquatic environments along the source to sea continuum. Moreover, and as explicitly stated in its title, the current CSA has given specific focus to biodiversity and ecosystem services. It reflects the increasing awareness among environmental managers, decisionmakers and policymakers of the importance of biodiversity and ecosystem services, which are recognized as priority goals for protection in the ecological risk assessment (ERA) on PPPs (Maltby 2013; EFSA 2016; European Commission 2020). However, the ecosystem service approach still leaves a number of issues unresolved for ERA on PPPs. They include, but are not limited to, the need to identify quantifiable indicators and relevant endpoints for evaluating the effects of PPPs on ecosystem services (Faber and van Wesem 2012; Faber et al. 2019) and to define clear and quantifiable protection goals and restoration targets (Maltby 2013). In this context, the current CSA deliverables are expected to serve as an important scientific basis for further decisionmaking at French and/or EU level to better protect (or restore) biodiversity and ecosystems against the direct and indirect adverse effects of PPPs.

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**Figure 1:** Main steps of the procedure classically followed for Collective Scientific Assessment (CSA)

**Figure 2:** Structure and governance of the Collective Scientific Assessment (CSA) on the effects of plant protection products on biodiversity and ecosystem services along the terrestrial–freshwater–marine continuum (2020–22)

**Figure 3:** Scientific network map of the 46 experts (including the three scientific leads) with number of publications per expert and number of co-authored publications. This graph was obtained from a Web of Science extraction performed in March 2021 (Clarivate Analytics) using Intellixir© software

**Figure 1:**

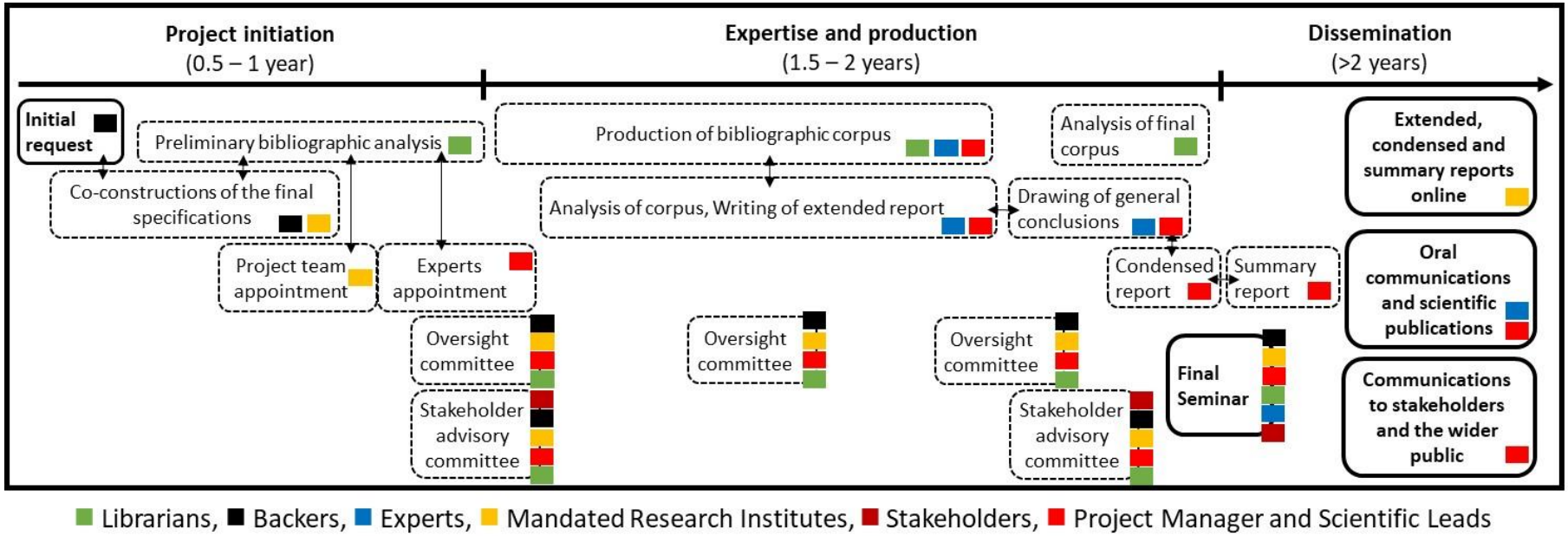

Project initiation
(0.5 – 1 year)
Expertise and production
(1.5 – 2 years)
Dissemination
(>2 years)
Initial request
Preliminary bibliographic analysis
Co-constructions of the final specifications
Project team appointment
Experts appointment
Oversight committee
Stakeholder advisory committee
Production of bibliographic corpus
Analysis of corpus, Writing of extended report
Oversight committee
Analysis of final corpus
Drawing of general conclusions
Condensed report
Summary report
Oversight committee
Stakeholder advisory committee
Final Seminar
Extended, condensed and summary reports online
Oral communications and scientific publications
Communications to stakeholders and the wider public
Librarians, Backers, Experts, Mandated Research Institutes, Stakeholders, Project Manager and Scientific Leads

**Figure 2:**

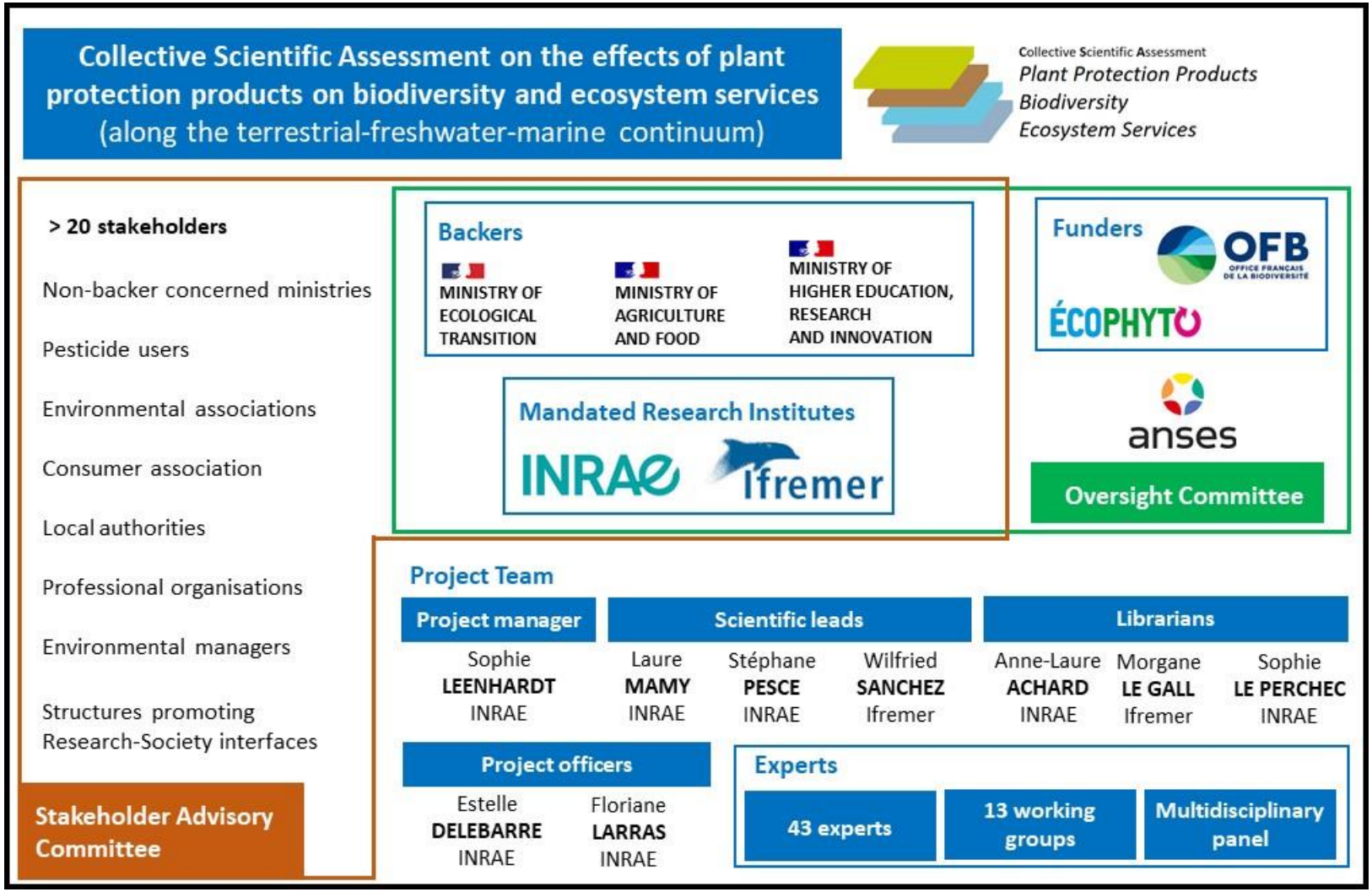
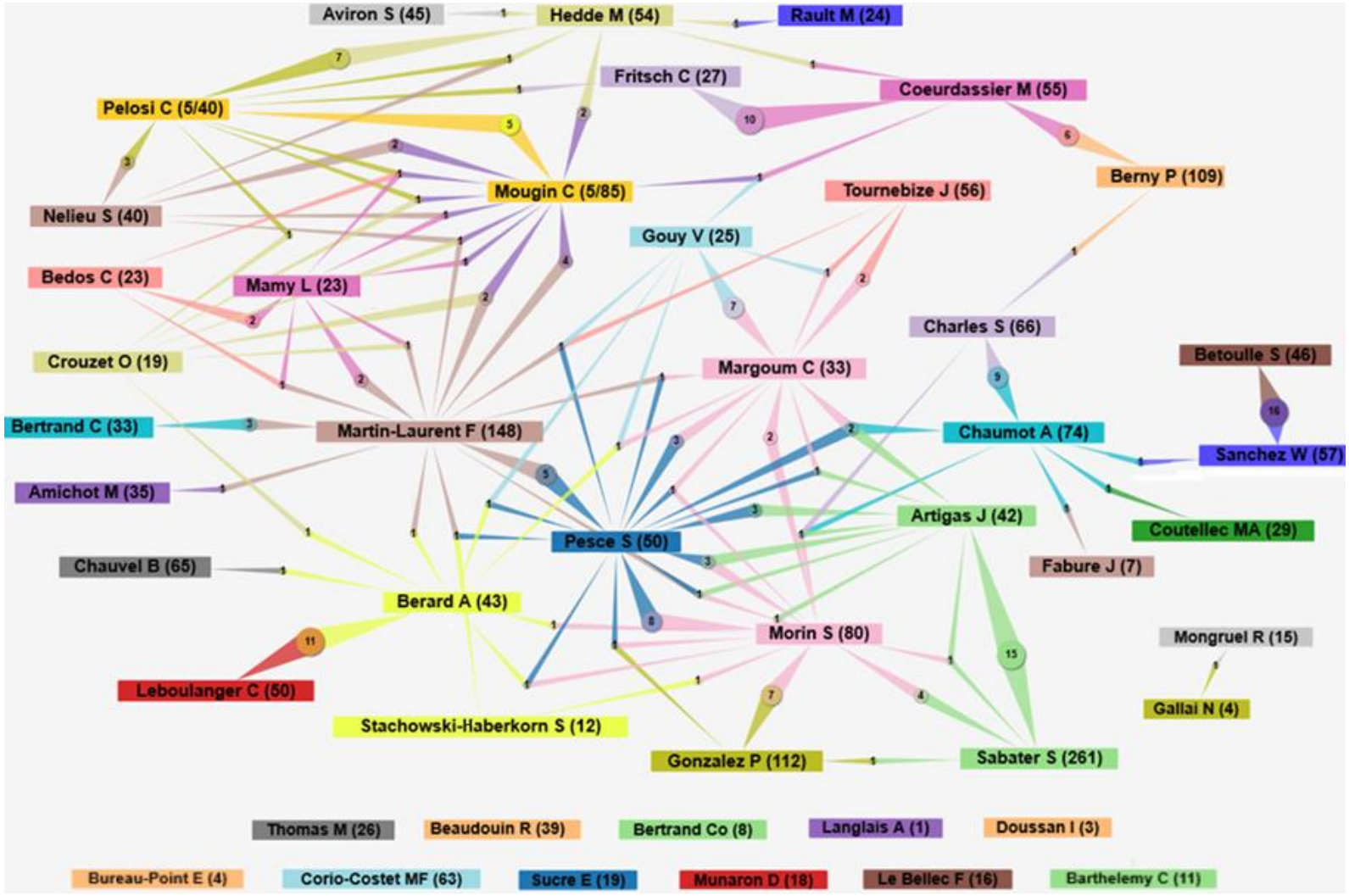

Collective Scientific Assessment on the effects of plant protection products on biodiversity and ecosystem services (along the terrestrial-freshwater-marine continuum)
Collective Scientific Assessment
Plant Protection Products
Biodiversity
Ecosystem Services
> 20 stakeholders
Non-backer concerned ministries
Pesticide users
Environmental associations
Consumer association
Local authorities
Professional organisations
Environmental managers
Structures promoting Research-Society interfaces
Stakeholder Advisory Committee
Backers
MINISTRY OF ECOLOGICAL TRANSITION
MINISTRY OF AGRICULTURE AND FOOD
MINISTRY OF HIGHER EDUCATION, RESEARCH AND INNOVATION
Mandated Research Institutes
INRAE
Ifremer
Funders
OFB
ÉCOPHYTO
anses
Oversight Committee
Project Team
Project manager
Sophie LEENHARDT INRAE
Scientific leads
Laure MAMY INRAE
Stéphane PESCE INRAE
Wilfried SANCHEZ Ifremer
Librarians
Anne-Laure ACHARD INRAE
Morgane LE GALL Ifremer
Sophie LE PERCHEC INRAE
Project officers
Estelle DELEBARRE INRAE
Floriane LARRAS INRAE
Experts
43 experts
13 working groups
Multidisciplinary panel

**Figure 3:**


Aviron S (45)
Hedde M (54)
Rault M (24)
Fritsch C (27)
Coeurdassier M (55)
Pelosi C (5/40)
Mougin C (5/85)
Tournebize J (56)
Berny P (109)
Nelieu S (40)
Gouy V (25)
Bedos C (23)
Mamy L (23)
Charles S (66)
Crouzet O (19)
Margoum C (33)
Betoulle S (46)
Bertrand C (33)
Martin-Laurent F (148)
Chaumot A (74)
Sanchez W (57)
Amichot M (35)
Artigas J (42)
Pesce S (50)
Coutellec MA (29)
Chauvel B (65)
Fabure J (7)
Berard A (43)
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