Expert Activities as Part of Research Work: The Example of Biodiversity Studies

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In a fast-growing body of literature on the science-policy interface, surprisingly few studies have examined the way researchers' expert and advisory activities are embedded in scientific practice and academic careers. Little attention has been paid to scientists' points of view on their own expert and advisory activities. Drawing on an empirical survey of biodiversity studies, we focus on scholars' choices and trajectories in order to document why and how they become involved in this range of activities. Our results show how expert activities and scientific work are co-produced and articulated. A key result is that the nature of expert and advisory activities researchers are involved in, is closely related to the way they consider it possible to generalize ecological knowledge to various fields and networks. We also show that expert and advisory activities can help biodiversity scientists meet some of the requirements weighing on academic work (i.e. securing funds, showing social relevance or obtaining access to the field).

Keywords: scientists, expert and advisory activities, biodiversity

Introduction

In the field of environmental studies, scientists are often suspected of, or praised for, being political activists in favour of nature conservation. This kind of commitment is considered to be either a bias weighing on their work, or a praiseworthy and heroic investment. Nevertheless, very little attention has been paid to the actual relationships between environmental scientists' political or public commitment and their daily scientific work. For instance, literature has documented how the word 'biodiversity' was coined by a group of famous biologists who were political activists in favour of nature conservation (Takacs, 1996). However, such studies tell us almost nothing of the scientific programs and research work performed by the scholars. Therefore, according to this study, we might expect that there would be no links between the scientists' research activities and their other commitments. What is considered to be the researchers' political or public commitment (i.e. giving conferences or writing books for the general public) and their scientific work would be at best two distinct and impermeable fields: otherwise scientists are suspected of being partial and their results of depending on ideological preferences. Other previous work showed how researchers' epistemic culture could influence their opinions about

the risks of GMOs (Bonneuil, 2006). Once again, this work draws on an unaddressed border between the scientists' "public involvement" and their scientific culture. On the other hand, Frickel (2004) suggests that a culture of activism among environmental research professionals is emerging, and that this new environmental activism involving scientists could affect what is considered to be credible research: however, he deals with the institutional and organizational conditions of scientist activism rather than with scholars' individual trajectories and commitments.

More specifically, in a fast-growing body of literature on the science policy interface[1], surprisingly few studies have examined the way scientists' expert and advisory activities, addressing managers, decision-makers or stakeholders, are embedded in the rest of their scientific practice. Much attention has been paid to the relationships between experts and deciders or between experts and citizens or lay-people; recent debates in science studies have focused on the experts' role in decision-making in a technical democracy (Millstone & Zwanenberg, 2001; Collins & Evans, 2002; Jasanoff, 2003; Rip, 2003; Wynne, 2003). But few studies scrutinize this range of activities to show what it has to do with researchers' agendas, networks and field-work. Focusing on scholars' choices and trajectories and paying attention to the individuals' point of view in their own expert and advisory activities, we aim to take a pragmatic look at this range of activities in order to document why and how scientists engage in these activities. Our goal is to contribute to documenting how expert activities and scientific work are co-produced and articulated.

We propose to use the notion of 'articulation' to outline the different dimensions of scientific work. This notion was first developed to identify all the forms of "tinkering" implemented by researchers to construct do-able problems while complying with various levels of requirement (pertaining to experimentation, the laboratory and the social world, including distant colleagues and financial backers) (Fujimura, 1987): "Articulating consists in creating strategies by which researchers juggle, balance and meet multiple, simultaneous demands at many levels of work organization" (Fujimura, 1987: 275). The concept of articulation has then been further developed to underline the absence of conceptual determinism in the definition and pursuit of research problems; it highlights the fact that problem definition requires a contingent co-construction and alignment of instrumental and conceptual aspects (Griesemer, 1992). We show here that, as part of their work, scholars also articulate advisory and expert activities supporting managers and policy-makers, and that these investments are co-produced with other aspects of their research activity.

Using the notion of 'articulation work', we do not only want to highlight the fact that expert and academic activities are interdependent and in co-evolution in scholars' careers. The notion of articulation, as defined by previous work, also stresses that scholars do not always follow well-defined strategies serving generic plans and theoretical purposes (Clarke and Fujimura, 1992). In other words, the notion of articulation is a very interesting and heuristic notion because it is closely related to the notion of 'tinkering', which suggests that scholars' activities do not follow directly from theoretical programs or "real" scientific questions: instead, scholars progressively construct their work by tinkering between different aspects in somehow contingent and unpredictable ways. Scientific knowledge is created in unforeseeable and open ways that were described by Pickering (1995) as a "man-

gle" of theories, experiments, machines and social organization. Of course, there are important differences between the context in which the notion of articulation was first used by Fujimura to analyze scientists' work in the lab, and the context we want to describe, where we address the issue of academic trajectories and careers. Crucially, we do not address the same scale of scientific work, so we did not directly observe scientists' work: instead, we drew on their oral statements (see below). And verbally, researchers could have stressed *ex post* logic rather than real hesitation and tinkering. Yet, we always encouraged interviewees to give concrete examples instead of only general and abstract answers. We chose to use the notion of articulation in this context because we found that the stories they told us were very diverse and accorded an important position to contingent reorientations and opportunities that emerged during the course of action: the ways in which they engaged in expert activities did not conform to a predefined plan but were indeed performed as part of an ongoing process of co-construction with other dimensions of their work.

Methods

We carried out an interview-based survey (qualitative semi-directed interviews) on roughly 30 French researchers representing various specialties in biodiversity studies (i.e. population ecology, microbial and functional ecology, systematics). Most of these researchers held positions as research directors or professors in charge of laboratories – although we also met several young researchers and a number of retirees – and belonged to various institutions (universities and public research institutes). These interviews were backed up through the exploration of web pages presenting individuals and teams and reading some of their papers. Some of these institutions – such as the French National Centre for Scientific Research (CNRS) – are traditionally dedicated to fundamental research, while others – such as the French National Institute for Agricultural Research (INRA), or the French Institute of Agricultural and Environmental Engineering Research (CEMAGREF[2]) – are devoted to so-called finalized research, focusing on agricultural issues and rural or environmental problems. We retraced the careers of these researchers and invited them to look back at changes in terms of their research topics, fields and instrumental systems as well as their expert and advisory activities. This meant that we sometimes had to specify that our goal was to understand their participation in ministerial scientific committees, their contribution to the drafting of reports for policy-makers as well as their activities in feeding back information to management authorities.

Conducting interviews was a relevant method for us for discussing how expert activities and academic work mutually feed into each other. Of course, we could have observed scientists' activities *in situ* over quite a long period of time: it might have given us a slightly different view of the place occupied by expert activities in their daily agendas, highlighting the practical comings and goings between these activities and the rest of their work. But such a method would take quite a long time, depending on the frequency of these activities in the researchers' daily work, before demonstrating its significance. Moreover, it would have meant a focus on lab personnel, while doing interviews allowed us to interview a diversified panel of researchers as regards their scientific domain and their institution. This broad panel of interviewees made it possible to refute the hypothesis that the institution of belonging (devoted more or less to applied

or fundamental research) is the most important parameter in explaining the type and extent of scholars' expert and advisory support activities. We noticed that in any given lab, expert activities were substantial for some researchers and marginal for others.

Moreover, addressing the question of how expert activities and academic work are co-produced and articulated demanded an approach on the scale of individual trajectories and careers. Carrying out interviews to reconstitute scholars' biographies was the best method to address this scale. In fact, we needed to understand the researchers' questions, instrumental approaches, and expert activities quite well, but without having an excessively detailed description of each of these aspects. Interviews were an appropriate method for that level of understanding, because they made it possible to reconstruct the main characteristics of the scientists' work during their career (i.e. research questions since the PhD, types and locations of field work, changes in institutional affiliation and charges, network, expert activities) without going into too much detail in the description. Furthermore, interviews allowed us to collect not only facts and events, but also individual meanings. And it was also important for us to understand what it meant for scholars to work on the topic of biodiversity, when and why they used that word rather than another, and finally why they engaged in expert and advisory activities based on this topic.

Lastly, conducting interviews with researchers while being ourselves researchers from another field (sociology) is a situation that deserves further explanation. A few of the interviewees were colleagues, working in the same institution (CEMAGREF) and sharing the same facilities. We did not face any major problems when asking scientists for an interview. We presented our survey as dealing with their approach to the idea of biodiversity in their work, and we specified that it would be part of a collective social science research project funded by the National Research Agency[3]. The Agency's reputation throughout the academic community may have helped us to obtain appointments and be considered as "real" researchers by some of the interviewees. During the interviews, and especially with our colleagues from CEMAGREF who we generally met at the beginning of the survey, we stressed the fact that we were not specialists in biodiversity studies and that we needed a great deal of explanation about their approaches, questions, positions and so on. We preferred to be accepted as outsiders learning to know the field, rather than "intellectuals" with fixed opinions. That is why some researchers were quite disappointed when they asked us to specify the main research hypothesis on which our survey was based. Most of the researchers spoke quite easily of their expert and advisory activities, perhaps because these activities were subjects that the interviewees thought to be more relevant for a sociological survey than their research questions and approaches. Moreover, for some of the interviewees, expert activities are an important aspect of their work, which can take up a lot of time; however, they do not have many opportunities to mention these activities, as they are often considered to be unimportant in relation to the usual criteria of academic excellence. Some researchers, broadly involved in expert activities, are on their own and isolated from the rest of their team in the lab.

In the following, we present our analysis on the co-production of academic work and expert activities. Understanding why and how biodiversity scientists invest in expert and advisory activities first requires examining what it means for them to work on biodiversity; let us begin by briefly

documenting how biodiversity studies have been set up in France[4].

The Emergence of "Biodiversity studies"

Examining the historical background of the scientific community working on biodiversity would require an in-depth socio-historical approach. This is not our purpose here: we simply want to understand what it means for researchers to become involved in biodiversity studies. Like studies on global change (cf. Kwa, 2005), biodiversity studies have not resulted in standardized research agendas. Instead, biodiversity has been taken up differently by different specialists in their own working agendas, ranging from modelling to field collection work. However, it is especially important to note that, for all researchers, the theme of biodiversity entails a strong injunction for scientific work to be socially and environmentally relevant.

Collectives and disciplines

In the 1990s, temporary collectives were brought together to work on research projects based on biodiversity issues. These collectives were financed through calls for projects, which depended on the French Ministry of the Environment, on the one hand, and the CNRS on the other. These programmes were themselves linked to the Man and Biosphere (MAB) international programme: the French leader of this programme (Robert Barbault) was also in charge of the CNRS biodiversity programmes and became president of the IFB (French Biodiversity Institute). Established in 2000, the IFB consolidated and maintained existing programmes aiming to promote and organize biodiversity research. Its first mission was to prepare the draft of the national strategy for biodiversity, which was released in 2004 and constitutes the foundation of French public policy with respect to biodiversity. The overall sums allocated to the institute's calls for projects quickly grew, rising from a little over one million Euros in 2000 to twelve million in 2007. The creation of the new Foundation for Research into Biodiversity in 2008, replacing the IFB, ensured the sustainable development and institutionalization of biodiversity. The goal of the new FRB is to focus on biodiversity-related challenges, pertaining to civil society but also companies. The FRB also initiated a new project to identify and interview teams and individuals working on biodiversity in order to update this list. This concern can partly be explained by the creation of the IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services), which is the biodiversity equivalent of the IPCC (International Panel on Climate Change): the FRB aims to identify biodiversity experts in France who could potentially participate in expert studies to be carried out within the framework of the IPBES. Hence, biodiversity was included in both scientific and political agendas at the same time.

Mullins (1972) describes several successive stages in the scientific community institutionalization movement. It starts with a paradigmatic phase (informal links between researchers), followed by a dogmatic phase (formalized communication and co-publication network), and, finally, an academic phase (the setting up of reviews and degree courses). According to this typology, it would seem that today biodiversity studies are in the middle of the dogmatic phase: relatively informal collectives have been created to work on short-term projects, while a more sustainable drive to institutionalize biodiversity can also be seen with the creation of teams, labs, reviews and research stations dedicated to "biodiversity". Indeed, several research laboratories or departments

have been created (or renamed) to work on biodiversity: the "Biodiversity, Systematics and Evolution" department (Paris Sud-Orsay University); the "Ecology and Biodiversity Management" department at the French Natural History Museum; the "Biodiversity and Ecosystems Functioning" team (Bioemco laboratory) or the Master's degree course in "Ecology, Evolution and Biodiversity" in Paris. This "dogmatic" phase is reflected in the expression *biodiversity studies,* which is sometimes referred to directly in English by French researchers.

Nevertheless, the field of biodiversity sciences remains especially diverse. Compared with the climate science community which has become structured around a number of instruments like climate simulation models and large databases (even if this community remains divided, for instance between different styles of climate modelling, see Shackley, 2001), biodiversity studies are characterized by an important disciplinary diversity. Not surprisingly, biodiversity offers an opportunity for both ecology and systematics to be definitely considered as scientific disciplines in France. Not surprisingly, biodiversity has helped to strengthen the development of a "Big Science" in ecology[5] that now relies on the new instrumentation, developments in mathematical modelling and statistics as well as molecular biology. But at the same time, the rise of biodiversity concerns has helped to give taxonomy a new impetus. This trend similarly relies on the modernization of species identification equipment (for instance barcoding, see Waterton et al., 2010). Actually, biodiversity has revived the divide between a scientific approach based on species – which is classically developed by taxonomists, and a scientific approach based on interactions and communities – which is classically argued by ecologists[6]. Ecologists often refer to taxonomy as the "fauna flora approach" or the "beasty" or "herbarium" approach, trying to relegate the taxonomic approach to something that has become out of date. Biodiversity can thus be defined either as a question of species quantity or a quality of interactions. Hence it is grasped by different epistemic cultures (Knorr-Cetina, 1999), leading to different tools and concepts for measuring and assessing the environmental situation.

Nevertheless biodiversity also fosters the development of these disciplines by giving researchers the opportunity to develop a new rhetoric, stating the relevance of their work in a context of environmental crisis.

A promise of social relevance and environmental usefulness

Biodiversity constitutes a powerful promise of social relevance and environmental usefulness. Here, we do not mean that researchers are opportunistic and have taken advantage of the popularity of biodiversity to get funds or an audience. Biodiversity leads to real changes in scientific questions, approaches and instruments. Yet, for the researchers interviewed, biodiversity did not so much constitute a new scientific object as a promise of social and environmental relevance.

Examining how researchers used the word 'biodiversity' in their web pages provided useful insights into their apprehension of this topic. It clearly shows that their use of the word relates to a social context rather than a research topic. In fact, addressing biodiversity referred to a perspective of environmental usefulness, namely biodiversity conservation. Therefore, they very often used the word in the introductions of papers, theses or communications to point to a political context and a social demand. They referred all the more to biodiversity when they intended to secure funding for their work, for instance when submitting research proposals. They also referred to biodiversity when they had to

explain their work to non-scientists; on the other hand, as an interviewee explains, "if you speak to someone who works in your field, the word 'biodiversity' doesn't mean anything at all!" This feature suggests how difficult generalising knowledge beyond the lab or specific fields can be for "biodiversity scientists". We will see below that conviction in the possibility of generalising knowledge on biodiversity is indeed a crucial issue in order to grasp the way scientists invest in expert activities.

Interestingly, the scientists themselves were well aware of the risk of opportunistic use of the biodiversity slogan. They were rather critical of their own practices and vocabulary – or those of their colleagues. Our survey highlighted how they endeavoured to define, case by case, when it was legitimate to use the word and when it was not – i.e. when the title of the research included the word biodiversity while the content was actually much narrower.

Therefore, for scientists, working on biodiversity meant striving to produce results that were to some extent relevant to managing current pressing environmental problems. This is also another reason why many people quickly and readily agreed to participate in our study, and why they were particularly talkative when we came to questions concerning the way a scientific community devoted to biodiversity had developed. Some of them used highlighting expressions in their answers to our questions (i.e. 'spectacular progress', 'enormous problem'), suggesting that they had much to say on this issue. We may suppose that an interview with sociologists was, for some of them, an opportunity to address social concerns on the environment. However, as we shall see, many of them expressed doubts about the direct usefulness of their work. Generally, when we asked them to what extent they worked on biodiversity, most of them carefully chose their words when answering: they spoke of precautions and scruples. They were indeed sceptical about the effective relevance of their own work, but at the same time shared a general expectation of relevance for biodiversity studies.

Of course, this promise of social relevance is not specific to the topic of biodiversity alone: this type of promise is crucial to scientific rhetoric (cf. Gieryn, 1983; Hessels et al., 2009). But the issue of biodiversity, like other environmental or sanitary issues, has specifically raised significant expectations in the scientific capacity to solve important and urgent problems; it has also strengthened the injunction for scientists to be concerned about social relevance issues and to engage in social and political arenas, as stated by Larigauderie and Mooney (2010): "We strongly believe, thus echoing […] the conclusions of the 700 scientists who recently met at the Diversitas[7] Open science conference […], that the time has come for scientists to educate themselves about policy work in order to become 'responsive to the knowledge needs of society'. Scientists can no longer hope that their work will somehow be used by policy makers".

The Co-production of Academic Work and Expert Activities

In accordance with this promise and hope for social relevance, scientists working on biodiversity develop expert and advisory activities commissioned by managers, policy-makers and stakeholders. Our survey made it possible to specify how this range of activities was co-produced and co-developed with other features of the scientists' work and careers: their epistemological approach, their mobility, networks and partnerships, their products, and – last but not least – their field-work. We identified two types of researchers who depend not on the amount of time or work

they spend on this range of activities, but on the type of expert and advisory activities they get involved in. We qualify these two types of researchers as "globally-focused" and "locally-focused" because they share a broad or, on the contrary, narrow trust in the possibility of generalizing scientific ecological knowledge beyond the specific fields and areas in which it was first produced[8]: globally-focused researchers believe that it is possible (to a certain extent and under certain conditions) to produce universal knowledge out of situated research whereas locally-focused researchers are much warier of this possibility and prefer to develop acute knowledge of the specific fields and areas in which they usually carry out their experiments and observations. A key result is that the kind of expert and advisory activities researchers involve in is closely related to the way in which they consider it possible to generalize ecological knowledge to various fields and networks. We shall then show how scientists articulate expert and advisory activities with some of the requirements weighing on academic work (i.e. securing funds and access to the field, showing social relevance).

Globally-focused and locally-focused researchers

On analysing the interviews we had conducted, we were first struck by the diversity of the research agendas: biodiversity was surprisingly far from being a deterministic orientation making research programs and approaches uniform. Some scholars were old enough to have started their work during a period when the word 'biodiversity' was not yet used or even coined: they seemed to have partly recycled their previous research to start working on this topic (for instance using older data for new research questions and trying to adapt older instruments to the question of assessing biodiversity). However, a divide was evident between researchers whose career was oriented towards technical support and advice to rural actors about the relationships between biodiversity conservation and agricultural practices – be it farmers or managers of protected areas – and researchers whose career was paved with numerous publications on biodiversity in prestigious scientific journals. Some of the researchers in the first category were our own colleagues at CEMAGREF, while many of the others were members of the CNRS. Thus initially we were tempted to distinguish between scientists characterised by academic success in biodiversity and scientists focusing on expert and advice activities on the best way to maintain biodiversity in natural areas. But this divide was unsatisfactory for several reasons. First of all, the "experts" were also researchers who had written peer-reviewed articles or developed innovative research programs in order to produce new knowledge about biodiversity conservation. Furthermore, researchers who had published many papers in prestigious journals were also involved in expert and advisory committees and sometimes had a more activist profile than the others: for instance, they were members of associations for environmental protection and spread alarming theories about biodiversity loss. They weren't therefore "independent" scientists working in an ivory tower, isolated from general environmental issues, while others are heavily involved in socio-economic or political matters. Moreover, these two ideal-types suggested that the fundamental or applied orientation of the researchers' institution was the decisive difference. But the panel of interviewees showed widely differing profiles and trajectories within the same institution or lab – for instance, some researchers at CEMAGREF had mainly developed expert activities commissioned by nature managers, while others had

chiefly carried out academic work. Previous work has shown that the policies of so-called finalized and fundamental research institutions are increasingly convergent, requesting all environmental scientists to write papers in peer-reviewed journals and prove their relevance regarding environmental management (Hessels et al., 2009; Tetart & Torny, 2009). This is why it was necessary to better qualify these two contrasted categories of researchers to obtain an accurate view of their resemblances and differences.

Closer examination suggested that most researchers conducted expert and advice activities to different extents, yet not in the same arenas: while a first type of researcher was involved in local or national management arenas (those we call "locally-focused"), the second one was involved more in international expert committees (those we call "globally-focused"). And it appeared that these two types of researchers also differed in the type of epistemological thinking they favoured (contextualised and sometimes monographic in the first case; general and abstract in the second), in their professional mobility (international or anchored in a place) and their field relations. Let us take a closer look at the results.

Some of the researchers interviewed were characterized by their close proximity to the management authorities of natural areas (national or regional nature parks), regional or local authorities or local government offices (e.g. regional scientific committees in charge of natural heritage). They had adopted the position of being providers of technical support for these local management authorities and established enduring relations with them. Several researchers, firstly trained in agronomy and working on mountain agriculture, explained that, from the early 1990s onwards, they had re-oriented their work to address the issue of biodiversity. They sought to produce empirical evidence showing that grazed mountain areas were more diverse (composed of more numerous plant species) than ungrazed mountain areas. Drawing on their older data on mountain vegetation to assess its food value for livestock, and trying to make new experiments to assess the effects of grazing on the diversity of plant species, they re-oriented their main research questions towards the assessment of plant diversity. For them, agricultural bodies and protected areas were potential financial backers. These institutions were interested in expert assessment of the stakes underpinning biodiversity; moreover, they acted as land purveyors for field-work (cf. infra). These researchers had produced a certain number of guides and methods for diagnosing and assessing alpine plants, which were highly appreciated by environmental management authorities and were also used as a reference in professional agricultural environments.

Some of these researchers belonged to CEMAGREF and INRA[9] and were more than 50 years old. But there were also CNRS[10] researchers, at different stages of their careers, who had woven close relationships with different types of local, public and private institutions involved in biodiversity management – in particular environmental protection associations. For instance, some of them participated in initiatives taken by associations, such as producing a regional flora atlas or setting up a biodiversity observatory. One researcher from CNRS worked on developing methods to assess and monitor the state of conservation of plant species impacted by construction projects (e.g. roads or industrial facilities). He had become a very popular adviser to a number of national parks and regional and local authorities seeking to develop environmental strategies and programs. At the time of the interview, he was finishing an 80 page booklet for managers and was

also in charge of a section in a journal for nature managers. But he also wrote articles in international scientific journals. He explained:

> My research is really involved, it is not only applied research[11] where one publishes results in a report and it's finished and one goes on to something else! We try to follow up, to assess, to go further…

Other researchers, rather belonging to fundamental research institutions, had also developed expert activities but in different conditions and arenas. They moved around in national assessment arenas, taking part in permanent ministerial groups or spot initiatives such as the national report coordinated by INRA focusing on "Agriculture and Biodiversity", or by participating in groups of international experts (e.g. the IPCC)[12]. One of them tried to trace the evolution of many plant and animal populations according to various climate scenarios. Having worked, since his PhD, on data concerning many species in many ecosystems – which is rather uncommon for an ecologist – he was largely considered by colleagues and the media as a "biodiversity specialist". As a member of one of the IPCC working groups and a ministerial working group, this researcher was also regularly interviewed by journalists because of his contribution to modelling and predicting the evolution of species distribution. Another researcher worked on the relationships between agricultural practices and biodiversity conservation trying to assess plant diversity in terms of functional diversity[13] rather than species diversity: in so doing, she developed an innovative scientific approach that local managers were less interested in. She participated in the national "Agriculture and Biodiversity" report. A third researcher, a microbial ecologist, analysed the way soil biodiversity – that is to say: the genetic diversity of microbes living underground – was impacted by different factors (such as the quantity of nitrogen). At the time of writing, he was involved at the highest level in the French Foundation for Research into Biodiversity. Such scientists published in prestigious scientific reviews, some of them in *Nature* or *Science*. Most of them did not write technical guides and were less familiar than the previous category of researchers with local management authorities and the areas they manage[14]. Some management authorities did not see what use they could make of work that appeared to them to be at once theoretical and disconnected from the specific issues they had to face locally.

Certain researchers were also impossible to classify because they were deeply involved in both local and very global expert and advice arenas. For instance, an insect specialist working on the effects of livestock drugs on coprophagic insects was very often sought after by French nature parks which wanted to produce charts on the use of agricultural chemicals in their territories (which turned him into a "locally-focused researcher"). But he was also a participant, and one of the founders, of an international expert committee on this subject, the Dung Organism Toxicity Testing Standardisation group, which aims to publish standards and norms meant for governments or firms (which turned him into a "globally-focused researcher").

These two categories of researchers, who could be distinguished by the type and scale of their expert activities and the main products of their work, also differed in terms of their epistemological approaches. The "locally-focused experts" had mostly acquired in-depth knowledge of the areas they worked in as well as the specific practices applied to them – but had experienced relatively limited mobility at international level. Their studies concerned

a specific territory (for instance an area in the Alps, or even a specific environment in this area) and could be monographs. For instance, some of these researchers developed approaches stemming from the recognition of plant species and borrowed methods from systematics (the science of species identification and classification) and phytosociology (a science that analyzes how plants form communities). With the aim of understanding the influences between the type of plant life existing on a given site and the human practices applied to it, they had developed a sharp focus on local vegetation and the specific characteristics of agricultural practices and places. That is why a number of these "locally-focused experts" were very often reluctant to provide general statements on factors explaining biodiversity. One agricultural ecologist in the team we described above underlined the difficulty in formulating answers that made it possible to isolate human factors from physical factors, as well as in predicting changes when attempting to understand the effects of farming practice on biodiversity:

> There's nothing trickier than trying to understand the dynamics of these mountain environments, their effects on the conditions of use [...] So if you take the 30 years of work done here [...] we've never been able to establish a prognosis of evolution, of these ... For example, these thirty or so facies, umm... unless there's a specific case ... [...] It's really complicated because.... scientifically nobody is capable of drawing up hypotheses beyond a certain type of evolution lasting several decades.

One researcher who claimed to do "involved research" believed that being settled in a place where one has been personally living for a long time is a precondition to having real knowledge of the area and its actors. After having worked in Canada and in Britain during his studies and PhD, he had been working in the South of France for 22 years.

Unlike these locally-focused experts, researchers developing expert activities at a more global level were characterized by significant mobility over the course of their career (often carrying out post-doctoral studies abroad). They manipulated knowledge stemming from observations and experiments carried out in highly diverse places and countries. For example, one interviewee had done a post-doc in Australia and another (the modeller mentioned above) in South Africa. The latter was in touch with a number of colleagues abroad who sent him their data so that he could model future changes in species distribution depending on climate change. Unlike the "locally-focused experts" who stressed the difficulties they had in producing general hypotheses about biodiversity outside specific contexts, these "globally-focused experts" (especially the modellers) believed available knowledge to be sufficiently robust – albeit peppered with uncertainties – to announce the results of their diagnoses: for instance, highly probable migrations or extinctions of certain species caused by climate change (for the modeller); the damaging effect of certain chemical molecules on insects (for the specialist of coprophagic insects). Modelling (with or without bioinformatics) seems to have greatly contributed to the rise in general hypotheses on future biodiversity changes, whatever the geographic area and type of life is being considered. Another modeller, an ecosystem functional theorist, has contributed to demonstrating the relationship between the diversity of an ecosystem and its successful functioning (e.g. its stability). This researcher was also a very good example of a "globally-focused expert": he had worked in three different

countries (in Europe and in Canada); his collaboration was very often sought out by field ecologists in many countries that asked him to model the interactions inside different ecosystems; lastly, he was involved in international arenas promoting biodiversity studies and seeking to make them useful for stakeholders (such as the international scientific program Diversitas and the International mechanism of scientific expertise on biodiversity IMoSEB).

These two types of researchers eventually differed in terms of their relationship with the field. Researchers operating in local arenas studied the field for its own sake, employing a highly contextualized, monographic mode of reasoning. Conversely, those operating in the national and international arenas related to the field as if it were a laboratory or a model in order to understand more general mechanisms linked to more general research. The field was considered to be a research area in the first case and a research laboratory in the second. In the second case, scientists sought out "the right kind of framework to answer [their] questions". As explained by the microbial ecologist (see above), their problem was in finding sites providing all the right conditions for carrying out observations and experiments. They were not so much interested in the sites themselves:

> In fact, the important thing for us is to have the right level of manipulation and control over the environment, the quantity of nitrogen that's in it... the disturbance, and all that [...]. Because if we've only got the field... the field, we end up having X sources of variability...

In both cases, the ways in which researchers conducted their field-work, both on a pragmatic level – how they managed access to the field, what kind of partnerships and relationships with local actors they developed – and on an epistemological level – what did the field really represent for the process of knowledge production and their argument – appeared to be crucially related to the type of expert and advisory activities they deployed.

Articulating expert activities and academic requirements

Finally, we want to suggest how researchers can articulate their investments in expert activities with some of the requirements weighing on academic work. In the case of the "locally-focused researchers", helping managers and stakeholders had sometimes been the initial goal for some of them, in particular at a time when research organisations' requirements were not so high in terms of academic publications. But today all researchers must demonstrate their ability to publish in international journals, so that it is more difficult to spend a great deal of time developing long-term relationships with managers. Some researchers felt that it was really difficult to bridge the gap and do both very good academic research and useful research for managers or stakeholders (whatever the scale); while others explained that it was only a question of time and organisation. Conducting expert and advisory activities might even help researchers to meet a certain number of professional requirements which weigh on academic work – i.e. to secure funds or access to field-sites and to demonstrate social relevance.

Firstly, of course, researchers set up links and networks with the world of environmental management and action in order to finance research. In this context, current changes in research funding can be seen to incite even fundamental research laboratories to authorize, or even encourage, some of their researchers to develop special relationships with local partners, notably

local authorities, as well as participating in national and European calls for projects.

Furthermore – and probably contrary to the links established in other disciplines or fields with industrial firms – researchers often endeavoured to showcase their collaboration with management authorities, e.g. authorities in charge of protected areas. Indeed, these networks reflected the growing demand for partnership, which is also reflected in the calls for projects published by the French National Research Agency (ANR). Some management authorities were besieged with requests to take part in ANR projects, even to the point of being saturated:

> We've already been through that with the ANR projects. I don't know how many ANR requests we've answered and so people come to us because they need a geographic base. A protected area is a plus point in ANRs, apparently. So we've had a lot of requests, we've answered, I can't remember, five, six, perhaps seven, anyway, only one came off…[15]

Crucially, developing relations with management authorities also helped to provide researchers with the right conditions for empirical work as well as facilitating access to the field. Indeed conducting research into biodiversity means working in the "open air", in environments that mostly cannot be controlled, unlike the microcosmos of a laboratory (cf. Kohler, 2006). Scientists' manipulation activities involve, for example, putting up fencing or enclosures to prevent animals from accessing certain areas. Now this kind of operation can be particularly tricky in mountain areas owing to the harsh climate and difficult site access. These problems may lead to some sites being abandoned as they are considered too remote. Furthermore, a certain amount of measurement work has to be performed on fresh plant material. This means having a field laboratory next to the sites being studied. However, empirical work also has its share of relational requirements: the areas studied are occupied and used for farming or nature conservation. The very least requirement is to obtain the agreement of breeders and shepherds (or conservationists), although some farmers are even asked to help with the field work at times. This is not always very easy, as illustrated in the following discussion between an ecologist and the interviewer:

> Q: Was it easy to find an alpine pasture where you could set up enclosures?
> A: No, no, we had to jump through hoops. They even… Well, what year did we start? It was in 2000… 2001, 2002… There were even some breeders who threw them out. So, it wasn't… it really wasn't easy to find breeders who agreed to take part in the protocol.

Researchers spent a considerable amount of time establishing and nurturing good relations with breeders and shepherds who have agreed to an observation site on the alpine pasture they use for farming. Deferred grazing areas are a problem for breeders as it means they have to do without those areas for farming. Even if they accepted the researchers and their activities, breeders were not willing to increase their work load, which is often substantial, in order to contribute to the research project. This was reflected in the words of one ecologist interviewed:

> For example, spreading different doses of liquid manure is no easy matter. And then, not putting any in one corner, well for the farmer doing the spreading, it's complicated. He says to us "so, when are you going to be done with it all because I've had enough!"

In this context, investing in a partnership with a park – involving some expert and advice activities in return – represented a significant opportunity for researchers to develop their activities in good conditions, on a sustainable study site possibly equipped with housing facilities and easily accessible. To do this, it is often necessary to establish close contacts with the management authorities of the areas concerned, and this notably entails some kind of exchange for the work performed on the sites to help with their management. Sometimes, the management authorities are even involved in deciding on the angle to be adopted in the issues explored by the researchers. As some management authorities had already been collecting samples and data about the flora and fauna on their site for some time, such contacts also afforded access to long-term data series. These were precious for research addressing the effects of global changes on species and communities.

These results show that, while one might expect academic work to provide resources to fuel expert advice activities, it is also true that these activities may provide research work with important resources, such as access to the field and partnerships.

Conclusion

For many years now, the image of the isolated scholar working away in his ivory tower has been dropped from thinking about scientific work and the profession of researcher. A fast-growing body of literature addresses the science-policy interface, focusing particularly on the position and role of experts in a technical democracy. Here, we proposed to help highlight scientists' expert and advisory activities by focusing on researchers' choices and trajectories. We examined the links developed by biodiversity researchers with national or international decision-makers by participating in expert committees and contributing to expert reports, but also the links they wove with nature managers, farmers or breeders in negotiating collaborative conditions for producing knowledge that could be both useful for management purposes and relevant for academic production.

Our results show how expert activities and scientific work are co-produced and articulated. The distinction we proposed between "globally-focused" and "locally-focused" researchers stresses the fact that the range of expert activities scientists are involved in, is closely related to other dimensions of their work – such as mobility, partnerships, type of products, relationship to the field, type of epistemological thinking. More specifically, the kind of expert and advisory activities researchers develop appears to be closely related to the way they consider it possible to upscale ecological knowledge. We then suggested how scientists can articulate their expert and advisory activities with some of the requirements weighing on academic work. In many cases, this range of activities may even be an important asset for biodiversity scientists in their attempt to secure funding, demonstrate the relevance of their work and last, but not least, obtain access to field-sites enabling them to carry out empirical work. These results help understand not only why scientists spend various amounts of time in expert activities but also the type and scale of expertise they develop and how this range of activities is embedded in the rest of their work.

These results also suggest that, although they are often overlooked or underestimated by STS scholars and the scientists themselves, advisory and expert activities must be considered to be an integral part

of scientific work. They do not fall beneath or to the side of "real" scientific work. Surprisingly, expert and advisory activities are not specific to institutions or researchers who might be qualified as "applied" or "finalized". Therefore, our study also contributes to questioning the demarcation between relatively fundamental or finalized types of research as well as between research modes 1 and 2 (cf. Gibbons and al, 1994; Nowotny and al, 2001). Rather than two different research "modes", there could be two different styles of work that researchers develop and articulate, depending on circumstances and purposes.

The choice we made in this study to draw on an empirical qualitative survey made it difficult for us to propose very general and transverse statements; instead, it allowed us to obtain an in-depth and detailed view of a few biodiversity scientists' trajectories and involvements: in that sense we ourselves developed a kind of "locally-focused" approach. Does it mean that our results are absolutely specific to the field of biodiversity studies? Biodiversity studies result from a changing social demand (with growing concerns about global changes) meeting a changing scientific community which experiments on new issues of environmental relevance. Our results surely have something to do with the fact that biodiversity studies are a newly institutionalised research field, in which researchers share a sharp sense of the social and political demand for scientific knowledge useful for environmental management purposes. While political activism for nature protection is criticized both by stake-holders and biodiversity scholars themselves, researchers' commitments to expert activities is also certainly linked to their investment in the theme of biodiversity as a promise of, and hope for, social relevance. However, it is important to note that literature has shown that the notion of relevance is an integral part of every kind of research, even if the meanings of relevance depend on fields and on history in a changing contract between science and society (Hessels et al., 2009). We can suggest the hypothesis that expert and advice activities take up more space and time for scholars in biodiversity studies than in some other fields, but we could very probably observe similar activities and similar co-production and articulation between expert and academic activities in other sectors which have been recently defined as giving rise to growing social concern, for instance the climate community or the community which works on food safety (Tetart & Torny, 2009). However, in the case of biodiversity studies, this co-production also draws on the ecologists' crucial need for access to the field. In other disciplines where field work is not so important, we can expect that the articulation between expert and academic activities, if there are indeed such activities, takes other forms and meanings in researchers' agendas. In any case, further research is needed to consider more closely how researchers deal with the demand for relevance in their field, what it means for them, and above all, how this question is dealt with in practice in their daily research work.

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Notes

1 See for instance some of the books which have addressed this issue since the early 1990s: Jasanoff (1990); Szerzynski, Lash and Wynne (1996); Fischer (2000); Miller and Edwards (2001); Latour (2004); Bocking (2004); Brown (2009); Callon, Lascoumes and Barthe (2009).

2 CEMAGREF was recently renamed IRSTEA (Institute of Research in Science and Technology for Environment and Agriculture)

3 The interviews were conducted during two phases, in 2008 and 2010, within the context of two different projects funded by the National Agency for Research. In the first phase, we asked researchers about their experience and knowledge of the relationships between biodiversity conservation and farming practices. In the second phase, after questions on their research trajectory, other questions addressed the constitution of the scientific community of biodiversity studies in France.

4 This case study was first presented at the 34th 4S annual meeting, Washington, 28 October-1 November 2009.

5 The setting up of this "Big Science" in ecology has been compared with the exploration of space, matter (atomic) or the genetic code: 'We need a major research effort similar in size to space exploration programmes in order to explore the Earth's biodiversity, the causes and consequences of its loss, and the best means to conserve and use it.' (Loreau, 2005). Michel Loreau is in charge of the Diversitas programme

designed to promote research into biodiversity at international level. He is also the author of the book: The challenges of Biodiversity Science, Excellence in Ecology, book 17).

6 With the recent notion of "ecosystem services", which designates the functions fulfilled by living organisms, and which are of interest to human societies, such as climate control, the water cycle, flower pollination, etc., it is no longer a question of maintaining species as such but of maintaining services (and possibly the specific species contributing to such services). Qualified as utilitarian and anthropocentric by its detractors, this approach poses the problem of knowing how to determine which species are important for a given type of service (and which species will be important in the future). The tension thus created is not only epistemological but also political, since assessing the destruction of services constitutes an alternative approach to assessing species extinction in order to diagnose biodiversity erosion (CBD, 2010).

7 Diversitas is an international program which fosters scientific research into biodiversity.

8 There are of course limits to this dichotomy, notably due to individuals who are halfway between both models of articulation. We give an example of this case below.

9 INRA (French National Institute for Agricultural Research) and CEMAGREF (French Institute for Agricultural and Environmental Engineering Research) are devoted to so-called finalized research focussing on agricultural issues and rural problems.

10 Centre for National Scientific Research.

11 There is a play on words in French between "impliqué" (implicated) and "appliqué" (applied).

12 On the other hand, very few French researchers were involved in the MA (Millennium Ecosystem Assessment).

13 Plant functions are characteristics that contribute to ecosystem function and are measurable (i.e. carbon or nitrogen content and plant height).

14 Although some wished to develop, or had developed, relations with protected areas (especially so that they can develop in situ observation and experimentation work in real environments).

15 This aspect has been further developed in Granjou C. and Mauz, I., "L'équipement de territoires de production et d'échange de données en écologie. L'exemple de la constitution de la Zone Atelier Alpes" (The Equipping of Ecological Data Production and Exchange Areas. The Example of the Construction of the Alps Workshop Zone), to be published in Revue d'anthropologie des connaissances (Anthropology of Knowledge Review), section on "biological resources".

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