

Co-operative Research on Environmental Problems in Europe
(CREPE)

WP5 CSOs' interventions into agri-environmental issues

Final report, November 2010

FP7 Science in Society Programme
Call SiS-2007-1.2.1.2: Co-operative research
Grant agreement no. 217647

Authors
Willem Halfman
Mieke van Hemert

Radboud University Nijmegen - Faculty of Science
Department of Philosophy and Science Studies
Nijmegen, The Netherlands
w.halfman@gmail.com
www.halfman.net

Contents

SUMMARY	1
1 ORIGINAL PLAN FOR THE WP	4
2 RESEARCH ACTIVITIES	5
2.1 Methods and sources	5
2.2 Workshop “Knowledge for Action”	7
2.3 Complications in the study	8
3 CASE STUDY RESULTS	10
3.1 Science shops in the Netherlands	10
3.2 The Wadden Academy	14
3.3 Dutch volunteer naturalists	17
3.4 Conclusions for the study	22
4 RELEVANCE TO THE OVERALL PROJECT	24
ANNEX: DUTCH VOLUNTEER NATURALISTS	25
1 Public Data-managing Organisations	25
2 VOLUNTEER NATURALISTS	26
3 INSTITUTIONALISATION OF VOLUNTEER NATURAL HISTORY	27
4 TENSIONS	29
4.1 Negotiating conditional ownership	29
4.2 Contextual and standardised account of nature	30
4.3 Motivation and the cause of conservation	30
4.4 Establishing cognitive authority	31
5 VOLUNTEER NATURALISTS AS CO-OPERATIVE RESEARCH	33
6 WIDER IMPLICATIONS	35
6.1 Cooperation and the standardisation of nature	35
6.2 Relating research to societal needs and (research) policy	36
6.3 PGOs: solutions to sustainability issues	36
TABLE: PRIVATE DATA-MANAGING ORGANISATIONS (PGOS)	38
REFERENCES	40

Summary

This study describes experiences of CSOs in their engagement with (agri-)environmental research in the Netherlands. It maps out diverse forms of engagement with research – from CSOs participating in research programming, CSOs performing their own research, to forms of mediation between CSOs and researchers. For each of these forms, the study included specific case studies based on qualitative research in the Netherlands: the Wadden Sea Academy, the collection of biodiversity data by the Dutch volunteer naturalist networks (including their use in environmental monitoring), and the Dutch science shops. The study aimed to identify patterns and tensions in these forms of interaction, in order to articulate problems and choices in the CSOs' engagement with research. Through a longer-term perspective, it has focused on problems in structural cooperation, rather than project management (analysed in CREPE work package 8).

Three case studies

Dutch science shops

Science shops are organisations providing civil society actors access to university research. They allow societal needs to enter research agendas on a grass-roots level, while allowing researchers access to socially relevant problems and to the actors involved. Dutch science shops covered a wide variety of disciplines and issues, often specialising in particular problems and their relevant knowledge, but environmental problems have always been prominent. Typical examples include analysing soil samples for soil pollution concerns, or designing alternative traffic routes to reduce noise pollution and hazards.

Dutch science shops have existed since the 1970s, but have fallen on hard times, with privatisations and university reorganisations that in most cases have re-oriented their mission to more commercial goals. Meanwhile, in spite of the Dutch science shops being on the defensive, the science shop model is spreading all over Europe. While the science shops do not necessarily correspond perfectly to the model of co-operative research, civil society participation in research is at the heart of their mission. The experience of their long-term development is relevant to other forms of participatory research elsewhere.

Science shops face a particular range of recurrent arguments and challenges at Dutch universities. In the climate of output-steered, professionalised university management, sub-units are pressurised to either generate income or journal publications (and preferably both). While it is tempting to perform towards these indicators when the legitimacy of science shops is questioned, this strategy also holds as risk, as it implicitly acknowledges the relevance of such output indicators. While tempting in the short run, in the longer run this strategy leads to further arguments pushing science shops towards generating more income and more publications. These results ultimately negate the core mission of providing knowledge to civil society.

Diversification of services, allies, and funding has helped some science shops to extend their support network. Successful science shops also invest heavily in the visibility of their contributions, and in the development of performance indicators on their own terms. Science shops also have to maintain a reputation for high quality research and members of science shops, for example through close cooperation with academic researchers. In the past, Dutch science shops were able to ride a wave of high academic commitment to civil society concerns. The cautionary tale of the Dutch science shops contains a warning for what happens after this wave passes, e.g. as a result of a new university management modes. To maintain societal participation, it has to prepare for what comes after the initial wave.

Wadden Academy

The Wadden Academy is a platform that aims to create a sustainable knowledge base for the protection of the Wadden Sea. It seeks cooperation with societal actors like the Wadden Society, a powerful CSO defending the environmental importance of this sea. The Wadden Sea is the intertidal zone that borders on the South-East of the North Sea and stretches from the north of the Netherlands to Denmark. It is an area of exceptional ecological importance, harbouring rich bird and marine life. Some of its small islands have the highest plant biodiversity in the country. At the same time, the Wadden Sea holds commercially interesting cockle and mussel banks, and sits on top of a promising gas field.

The Wadden Academy operates under the umbrella of the Royal Academy of Sciences and is funded by national government, in the context of an agreement with the commercial interests. It is to contribute to a Nature Restoration Programme: cooperation between scientists and actors involved, including nature organisations, is to result in a shared vision of ecological recovery. This includes shared fact-finding and shared definition of research questions that can help settle some of the disagreements in the assessment of the state of this sea and its future.

The Wadden Academy has managed to build trust and discursive alignment towards shared goals, changing the climate of polarised conflict that preceded it. Both nature organisations and scientists acknowledge that participants argue and act strategically, and that alignment of the strategies of scientists and activists, while acknowledging different roles, tasks and identities, asks for sustained efforts and frequent meetings. Among scientists there is a growing willingness to focus research on concrete, urgent problems, while nature organisations such as the Wadden Society are putting much effort to elaborate proposals for nature restoration in consultation with scientists. This has occurred through the transformation of ad hoc and informal exchanges with scientists to more institutionalised forms of cooperation.

Private Data-managing Organisations

'Private Data-managing Organisations' (PGOs) are a set of ten organisations that observe and register biodiversity in the Netherlands, each of them specialising in a specific group of organisms, such as birds or fungi. They involve between 15 and 20 thousand volunteer naturalists, who spend much of their spare time performing biodiversity censuses, often according through strict protocols and standardised forms. The resulting data are used in public policy for nature conservation, in evaluation and development of conservation measures by managers of nature reserves, or in application procedures of town and regional planning decisions, but also for research, or public information and education. Increasingly, resulting indicators are used to assess environmental impacts. Farmland bird counts are used to assess natural environment impacts of changing agricultural practices, such as increasing pesticide use, the reduction of crop diversity, or the destruction on hedge rows through extensification. Biodiversity indicators have also found new uses in the assessment of climate change impacts.

The PGOs have been extremely successful in organising a solid set of institutions that allow civil society volunteer organisations to cooperate with professional researchers, producing knowledge that is a vital ingredient of public policy. Their model of participation is perhaps counter-intuitive to the format one might expect in co-operative research: it makes use of fairly formal institutions, contractual relations and bureaucratised data processing.

By setting up national offices run by professional staff, funded through public projects and donations, PGOs have managed to reconcile the 'romantic' conservation concerns of their volunteer constituency with the rationalist universals of state and market. They have specified conditional ownership of observation data and the databases as a whole, designed governance structures that put the volunteer constituency in a strong control position, and have found ways to keep volunteers motivated to collect data according to protocols by showing the benefits to protection of the natural environment. Most remarkably, the PGOs have managed to build a high level of cognitive authority, with carefully verified and virtually unrivalled databases.

Strategic issues

The three cases give rise to strategic advice to organisations with co-operative research ambitions, based on both success and failure experiences. They have to face three crucial problems.

Legitimacy

First, the reality of science for civil society is that it has to prove itself constantly. It has a **problem of legitimacy**: it has to justify benefits not readily expressed in the currently appreciated indicators of rationalised science management, which favour earning capacity or publication output. Co-operative research hence needs to make an **extra effort to make its contribution visible**. Especially since co-operative research may not always score well on standard output indicators and because science for civil society is not self-evident to administrative or political principals, the advertisement of co-operative research benefits needs extra attention. Concrete and visible contributions of co-operative research to environmental protection are also crucial to keep the CSO side of the cooperation on board.

The cases studied also suggest that **co-operative research should avoid compromise on research standards**, as other stakeholders are likely to challenge its research credentials as a way to dislodge unfavourable results. With the involvement or advice of professional researchers, well-documented development or use of methods, use of the peer review system of science, or extra care for meticulous data gathering, co-operative research can try to pre-empt such challenges. An important way to show scientific credibility is through scientific publications, even if this does not seem immediately interesting to a CSO partner.

One last important principle is to **maintain the civil society mission**. Attempts to perform well commercially or in academic terms may seem tempting in the short run, but undermine the specific mission in the long run. It may be possible to also perform as a partner in commercial research or work for public policy, who may provide rich resources, but ultimately it is the specific contribution to civil society projects that distinguishes co-operative research from commercial contract research or academic projects.

Protection

A second key problem is how to **protect civil society concerns**. CSOs face a highly organised worlds of research and public policy, in which they risk being instrumentalised as sources of data, token consultation audiences representing societal interests, or policy implementation conduits. CSO partners in co-operative research need protection from such pressures and the cases studied offer some suggestions. One powerful strategy is to **guarantee a share of project ownership to CSO partners**. This can entail control over resulting data, publication or copy rights, but also a share in research resources. Institutional guarantees, including legal conditions of data ownership, or organisational statutes putting member councils in charge, assure that CSOs keep some control over projects and can enforce such control in a conflict. Another strategy to protect CSO concerns is to **share control over research** planning, to allow CSO partners to define problems, make sure civil society concerns are included, or deadlines are timed to decision making. This may require formal governance structures that provide civil society members genuine control over priorities and allocations.

Continuity

A third key problem co-operative research organisations have to face is **the problem of continuity of cooperation**. Our case studies show how co-operative research requires time for unconventional cooperation to grow and develop. Partners may meet through occasional projects, but more structural cooperation allows partners to improve mutual understanding and to find solutions for problems in the cooperation. Experiences in our case studies suggest that **formalisation of relations can help continuity**. Personal contacts, shared vision and enthusiasm for civil society causes may be crucial for co-operative projects, but formalisation of relations can help take cooperation to the next level, even though this may not come naturally to civil society projects that see themselves more as a movement than as a formal organisation.

In addition, **co-operative research organisations should build diverse support networks**, as non-evident legitimacy means financial and administrative support will always be unstable. Networks of CSO partners can support co-operative research with public legitimacy and political support if need be, while diversification of sources of income can guarantee continuation even if the principal has a change of vision.

Environment as research object

The case studies not only provide insight into the organisation of co-operative research, but into diverse visions of the natural environment. On the one hand, the case studies show how civil society organisations talk of a nature that is rich, local, imbued with intrinsic values, to be admired for its particular aesthetic qualities. Amateur biologists are foremost concerned with the observation of a particular rare bird, appreciated for its remarkable plumage, rather than its contribution to an indicator of climate change.

Such a rich and localised experience of *specific* nature, perhaps best called 'romantic' for lack of a better short-hand, seems irreconcilable with the rationalised account of nature by state and market. To cockle fishermen and gas companies, the Wadden Sea is also a resource, holding potential wealth that can be measured in monetary terms, and hence made comparable to alternative fishing grounds or gas fields. In public policy, measured nature acquires universal characteristics that serve to assess choices in agricultural development or environmental protection, or compare the efficiency of protecting one forest rather than another.

On the other hand, these cases also show how, on a pragmatic level, cooperation between these opposite accounts is possible, albeit with a lot of work and careful manoeuvring. These cooperative schemes challenge the idea that agreement on all fundamental values is a necessary basis to proceed with environmental protection. The amateurs cooperate with the translation of romantic nature observations into cold numbers, on the pragmatic grounds that these numbers help protect the natural environment. 'Universalised' indicators of nature are extended to indicators of environmental quality, such as measuring the effects of climate change through biodiversity, assessing the likely distribution of escaped genetically modified rapeseed.

CSO-driven research shows a model to develop research priorities that is pro-active. Rather than to wait for public initiatives, Dutch science shops, Wadden Sea activists, and amateur biologists pushed forward with research for civil society interests – supported by public projects where available, but without them if necessary. Public research funding on a project level, both national and European, can fuel such endeavours. But CSOs have their own responsibility to set up organisations that can articulate stakes in research. Through such organisations, they can shape different understandings of societal problems, agri-environmental issues and sustainable development – as an alternative to the attempt to convince public institutions to champion their agenda for them.

1 Original Plan for the WP

Objectives

1. To identify diverse experiences of CSOs' interventions into research, the key opportunities found and the difficulties encountered.
2. To analyse how those experiences manifest different meanings of 'the environment' and sustainable development.
3. To focus specially on agri-environmental cases in the Netherlands, where CSOs have been notably involved in research over the last two decades.
4. To inform CSO involvement in research issues through suggestions and recommendations: "dos and don'ts", of practical use for CSOs, researchers, and research managers who want to work with CSOs in research.

Rationale

The involvement of civil society organisations with science has recently become an important topic of attention in European science policy. Following the report on "co-operative research" (Stirling, 2006) and public consultation of CSOs on their potential role in research by DG Research, CSO involvement now receives special attention in the 7th Framework Programme, especially in the Science and Society section. A growing body of literature analyses and often advocate increased CSO involvement with research (Irwin, 1995; Stilgoe, Irwin, & Jones, 2006; Wilsdon & Willis, 2004; Wynne, 1996).

Although these proposals may seem novel, CSO involvement with research has a long and varied tradition. One can think of the experiences with science shops over the last decades, but one can also go back further in time to trade-union involvement in technologies at the workplace (Noble, 1979), or the roots of the environmental movement and its activist scientists (Carson, 1962). Countries with strong traditions of consensus politics, such as the Netherlands or Nordic countries, had interesting experiences with CSO involvement in research and research policy in the field of agri-environmental research. This study will reflect on such experiences with CSOs' interventions in research over the last two decades.

Research questions

- For CSOs' involvement in research on agri-environmental issues today, what can be learned from previous efforts, especially in the Netherlands?
- How did those experiences manifest different meanings of 'the environment' and sustainable development?
- How were opportunities for involvement opened up and later closed down?
- How can CSOs' involvement be understood more systematically? What patterns emerged?
- What are strong and weak points of each pattern? What are bottlenecks and caveats in each of them?

Patterns of CSO involvement with research

There is a large, heterogeneous range of examples of CSO involvement in science. It can be difficult to get a clear overview and to learn from past experiences. A list would include the following (Stirling, 2006):

- use of research results by CSOs in advocacy via courts, the media, or lobbying either government or industry;
- participation in design of research programmes, identifying future needs and research priorities;
- participation in research by providing knowledge (e.g. biodiversity and knowledge of nature) or by providing alternative world views (participatory modelling)
- research performed or commissioned with CSO means (CSO research facilities, quality testing research by consumer organisations).

Dutch experiences with CSO involvement in agri-environmental research include all of the above. For example, one of the interesting experiences in the Netherlands concerns councils advising on strategic priorities and research needs for research. Since these four councils had remits for four specific sectors of research, they were colloquially called the Sector Councils. These councils have a history of almost three decades and existed for health research, environmental research, agricultural research, and development studies. They were originally installed as a means to provide a platform for discussion between users and researchers to identify lacunae in research, future research needs, or assess the state of the research system. Not all of these councils exist today (the one for development research having been recently abolished) and their specific tasks and organisational format have

developed in divergent ways over the years. The discussions around the sector councils provide interesting insights into the problems with institutionalized participation acquiring corporatist qualities or the changing role of these organisations as research policy moved from directive to accommodative (Halfman & Hoppe, 2005).

An overview of Dutch experiences will show the possibilities and limitations of various forms of involvement. Some cases are elaborated in more detail, including:

- Dutch science shops active in agricultural and environmental research
- The Wadden Academy, a cooperative platform researching the Wadden Sea's future.
- The involvement of nature conservation CSOs in bio-monitoring in the Netherlands

Tasks and methods

1. Desktop research, based on an analysis of documents and previous research on CSO involvement with research: selection of key cases and secondary analysis of available material
2. Interviews with key actors where needed : CSO leaders with experience in engaging with research, to fill the holes in the available secondary material
3. Link those results with those of the CRÊPE WPs on the ERA and cooperative processes, as well as related research projects (such as the FP6 STACS project); and feed-back on the draft from CSOs (and academics)
4. Liaise with a users group of CSOs, consisting of those involved in the CRÊPE project, as well as key individuals involved in similar issues in the Netherlands.
5. Netherlands workshop including the above organisations and individuals

Partners' roles

This WP was to be carried out originally by the University of Amsterdam, which was changed to Twente University before the project started and taken over by the University of Nijmegen in the last phase.

CSO networks

The study was to involve Dutch environmental and agricultural organisations that have been involved with research policy issues. Interest among these organisation seemed limited, until the very end of the study, when new avenues opened up for cooperation with the network of naturalist organisations.

Workshop

A workshop around involvement of CSO with research in the Netherlands was planned for month 9 (eventually held in September 2009).

2 Research Activities

2.1 Methods and sources

During the first period, the study focused on two tasks. First, the case studies were further specified, as reported below. This was based on secondary analysis of available material, some archive research, as well as interviews. Second, we tried to involve CSOs in the study, inviting CSOs to redefine the case studies and the overall study in terms that would be of interest to them. In order to this, we had contacts with a range of Dutch CSOs and academics who work on the boundary between science and activism (in the various meanings of that term). These contacts originally started off (or slipped into) the format of open, qualitative interviews. However, because this became too much a game of harvesting information from CSOs, we tried to shift to more open interaction. A workshop with CSOs worked as a focal point for these interactions, as it created a concrete question to see if there was enough mutual interest to discuss issues of science and CSOs.

In these explorations, we talked to:

- Petra van der Aa, Consumentenbond (The Dutch consumer organisation)
- Arjan Berkhuisen, WNF (World-Wide Fund for Nature)
- Sonja Borsboom, Burgerinitiatief Megastallen-Nee (Noord-Brabant) (Countryside citizen initiative, started from mega-stables for pigs) (present at workshop)

- Douwe Bouma, Stichting leefbaar buitengebied (Foundation for a livable countryside) (present at workshop)
- Pieter van Broekhuizen, IVAM Environmental Research Institute at the University of Amsterdam, former head of the chemistry science shop
- Alois Clemens, WNF (World-Wide Fund for Nature) (present at workshop)
- Wouter van Eck, Milieudefensie (Dutch branch of Friends of the Earth) (misses the workshop)
- Karin de Feijter, Stichting Natuur en Milieu (Foundation for nature and environment) (present at workshop)
- Egbert van Hattem, Science shop Univ. Twente
- Mieke van Hemert, Universiteit Twente (present at workshop)
- Anne-Charlotte Hoes, Free University (present at workshop)
- Marga Jacobs, Stichting Leefmilieu (Foundation for the environment) (present at workshop)
- Wil Janssen, Stichting Leefmilieu (Foundation for the environment)
- Gerard Kramer, Consumentenbond (The Dutch consumer organisation)
- Cora de Leeuw, Natuur en Milieu (Foundation for nature and environment)
- Maria van Leeuwe, Waddenvereniging (Wadden Sea organisation) (present at workshop)
- Anne Loeber, Academic, UvA
- Roelof van Loenen Martinet, Gelderse Milieufederatie (Environmental federation of CSOs in Gelderland)
- Bert van der Moolen, Friese Milieufederatie (Environmental federation of CSOs in Frisia)
- Hans Muilerman, Stichting Natuur en Milieu (Foundation for nature and environment)
- Henk Mulder, Science shop Univ. Groningen (present at workshop)
- Meggie Pijnappel, Radboud Universiteit Nijmegen (present at workshop)
- Ruud Pleune, Gelderse Milieufederatie (Environmental federation of CSOs in Gelderland) (present at workshop)
- Hans Revier, Waddenvereniging (Wadden Sea organisation)
- Claudia van Steen, Stichting Leefmilieu (Foundation for the environment) (present at workshop)
- Gerard Straver, Science Shop Wageningen Univ. (present at workshop)
- Jacques Swart, Univ. Groningen, Biology and Society (present at workshop)
- Esther Turnhout, Wageningen UR (present at workshop)
- Sander Turnhout, Stichting Veldonderzoek Flora en Fauna (Foundation for field research fauna and flora) (present at workshop)
- Henny van der Windt, Univ. Groningen, Biology and Society
- Victor Winter, Steunpunt Bètawetenschappen Universiteit Utrecht (Science shop Utrecht Univ.) (present at workshop)
- Bert de Wit, Raad voor Milieu en Natuuronderzoek (RMNO, advisory council for environmental and nature research) (present at workshop)
- Titia Zonneveld, Natuur en Milieu (Foundation for nature and environment)

As indicated, about 20 of these people joined us at a workshop, where representatives of CSOs and some academics discussed past experiences and future needs in the relation between CSOs and research.

2.2 Workshop “Knowledge for Action”

The workshop was organised around five topics, following the cases we had identified for research, but with some modifications to meet CSO comments. Each of the topics is listed below with participants and some main observations. This section is based on the workshop report (Halfman and van Hemert, 2009).

2.2.1 CSOs and research programming

Short presentations by Karin de Feyter (Natuur&Milieu) and Bert de Wit (RMNO) introducing a discussion about the possibilities for CSOs to participate in research programming. Programming includes the allocation of research funds to priority research issues and fields, the formulation of research priorities and research programmes, potentially reaching down to the level of more specific research questions or framing of research projects.

The generally shared observation was that it is becoming more difficult for Dutch CSOs to get involved in research programming, due to shifting governance structures. In the past, CSOs had a systematic and guaranteed chair at the table at several research programming organisations and platform, including the RMNO or the platform for agricultural research. Now, CSOs have to wait for an invitation or lobby hard to get involved, which is a long-term strategy that not all CSOs can follow. At best, CSOs get invited to participate in very broad stakeholder consultations, where researchers and/or civil servants are in charge, such as around agricultural research, especially for Wageningen University. Suggestions by CSOs may be taken up, but they no longer have the leverage to insist. (It is symptomatic that the RMNO ceased to exist in January 2010.) However, CSOs still see possibilities, but the style of operation has changed and now relies more on networking and lobbying.

2.2.2 Research by CSOs

This session focused on field biology and the databases run by conservation CSOs, organised around two short presentations by Esther Turnhout (Wageningen University) and Sander Turnhout (Foundation for field research fauna and flora). These organisation collect data from amateur biology enthusiasts and turn them into professionally managed data sets. This data management is financed through project, in which biodiversity information is made available. This mostly concerns government conservation policy and reporting obligations for international agreements (such as EU biodiversity policies). Project income can partly also be used by field biology CSOs for activities or small conservation projects.

The data management organisations are very concerned with the quality of their data. They work with triangulation of field observations, photographs, or automated plausibility checks to generate what they see as sufficiently. Academic values as independence and methodical rigour are considered very important.

The CSOs present seemed to see this as a special case, but we did find parallels in data collection by other environmental CSOs as well, although not on an equally systematic basis. A major problem of the financial construction for access to data is that it becomes hard for ordinary citizens or other CSOs to access data.

2.2.3 CSOs commissioning research

We discussed the possibilities for CSOs to commission research based on a case presented by Mieke van Hemert (Twente Univ. and researcher on this study). (The original plan was to match an academic with a CSO on this topic as well, but the CSO representative cancelled.)

The case was a study ordered by the Dutch consumer organisation and an environmental CSO (*Consumentenbod* and *Natuur en Milieu*), questioning the assumptions in the way health risks of pesticides in food are assessed. The study, executed by a Wageningen research institute, studied combined exposure of children to a group of pesticides with a similar physiological effect, in stead of the substance-by-substance approach that is still the backbone of chemical risk assessment.

The case shows how CSOs get drawn into fierce attacks on independence of the study, methodological soundness and validity of a diverging approach. An accusation was that the study did not follow appropriate protocols, whereas the purpose of the study was to challenge the dominant protocol or risk assessment. The challenges to the study, as well as extensive media attention (spun in contrasting ways depending on media involved), put the issue on the agenda. The study later even appeared in reports of the very authoritative Health Council of the Netherlands.

CSOs present clearly recognised these patterns and they pointed out the typical objectives in commissioning research. One is to challenge a dominant approach, typically in the assumptions of framing of public policy. A second and often combined one, is to put issues on the policy agenda. They pointed out that raising controversy or doubt can be part of their strategy to get issues on the

agenda. Some claimed this is the case irrespective of the quality of the report, but this was questioned by others, claiming a CSO would lose all credibility if they would manipulate or spin research reports too far.

2.2.4 CSOs and science shops

This topic was mainly carried by explanations of the operation and possibilities of science shops for CSOs, presented by Henk Mulder (Univ. Groningen) and Gerard Straver (Wageningen). They explained the principles used in working with CSOs and shared some examples of projects that helped CSOs with their campaigns.

Although there is a family of principles that these science shops use to interact with CSOs, not all Dutch science shops use the exact same set of principles. For example, Groningen will only work with small CSOs that do not have resources to access research (which excluded most of the CSOs present at the workshop). Variety of the format of the science shops also increases as they are under pressure of their universities, in many cases with severe budget cuts and in some even complete change-over to contract research units, working for a commercial tariff only.

One of the interesting lines in the discussion was to what extent CSOs can actually help science shops survive, for example through letters of support, but perhaps also with more pro-active political action. This was one of the occasions during the day where it became clear that access points of CSOs to research erode under pressure of academic performance or economic returns, if they are not defended through political action.

2.2.5 CSOs and research networking

If institutional access to research is indeed eroding, except for the handful of CSOs with sufficient resources to commission research, then 'networking' could be the alternative mode of action. This was discussed around the case of the Wadden Sea, where a management plan is being drawn up in combination with research projects. This has the structure of a network organisation, in which CSOs have an important role. (Discussed in more detail below.)

From the part of the Waddenvereniging (Society for the Wadden Sea, CSO), Maria van Leeuwe explained the unexpected possibilities this presents for CSOs to really push for a better management plan for the Wadden Sea, especially with respect to alternatives for mussel fishing. Jacques Swart (Groningen University) presented his analysis of what goes on in the Wadden Sea, pointing out that the present format seems to be raising enthusiasm, but that the conditions are special: there is a covenant, a threat from government to impose a solution if actors cannot find a solution, as a large amount of resources for this project. (More detail on this case below.)

2.2.6 Results of the workshop

The workshop material (recording, notes, presentations, brainstorm session) was analysed in more detail, as it offers a lot of insight into past experiences with research, strategies of CSOs to deal with research, and bottle-necks, all of which can be useful for other CSOs in the future. There was support among the CSOs present to collect and make available such experiences in the form of a handbook. For CSOs that have not experience with research, this should include some very basic information, such as on getting access to electronic versions of scientific journals, but the handbook should also include some of the more 'advanced' issues discussed at the workshop.

2.3 Complications in the study

The study on involvement of Dutch NGOs with ag-environment research has faced two major problems in the initial phase of the research, the first of an organisational nature, the second with the format of the study itself.

First, the study was seriously troubled by personnel capacity. The time available to do the research of the main researcher (Willem Halffman) was severely limited by a change to a new employer, taking over a lecturer position with a heavy teaching load. The department did not have the personnel capacity to compensate for the extra research time needed for this study, further complicated by the fact that most of the course work was new and needed substantial updating. A serious alarm about this situation has led to an intervention by the new head of department with a temporary reduction in course load and the hiring of an assistant researcher, Mieke van Hemert, to help out with the study. She has contributed with research on the case studies and has taken on a substantial amount of the work involved in organising the workshop with CSOs.

Continued tension over teaching load and shortage of time for the Crêpe study eventually led the main researcher to move to Nijmegen University in February 2010, taking the study along. At Nijmegen, the study was welcomed by the Department of Philosophy and Science Studies, which had a long-standing interest in (the philosophy of) nature and the environment. The move to Nijmegen also

proved particularly fortuitous as the Nijmegen campus houses the headquarters of several of the major volunteer CSOs that collect bio-diversity data. This proximity has made access and avenues for cooperation a lot easier.

Second, there also have been more substantial problems with the study. When the research application was written, no specific CSOs were involved in this study and the study was essentially not written along the lines of a cooperative research design. We would study the development of CSOs in the sector of environment and agriculture in order to make an inventory of experiences and difficulties in dealing with (funding, finding, using) research for their particular issues. The CSOs were then written into the study via interaction, informally through contacts and formal through a workshop. Because CSOs were not involved in setting up this study, bringing them in later is proving to be much harder than expected.

The problem with this approach is that the topic of our research is not one that is recognised by CSOs as a major issue. As social science researchers, and especially from our background in science and technology studies, we immediately see the importance of the problems between CSOs and research, but the CSOs we contacted tend not to frame their issues in those terms. They are interested in the particular difficulties involved with the research on environmental effects of pesticides, or where they can find researchers who are willing to help them with campaign projects. We may see this as examples of problems in the engagements of CSOs with research, but those are not their terms. The extra translation needed there is not easy and one of which we sometimes even think it may translate CSO projects into our plans more than the other way around.

In order to create more opportunities for CSOs to define the study (rather than use defining theirs), we set up our workshop with a very open platform around issues identified in talks with CSOs. We called them merely "talks", as we let go of our initial format of approaching CSOs with an interview protocol. Although this generated information, it was not conducive to the two-way interaction that should characterise cooperative research. We shifted from interviewing CSOs to very open conversations in which we tried to explain what it was we wanted to do and probing whether we could construct shared interests around this. The price to pay for this, was that our conversations no longer resembled interviews in the traditional social science methodology terms.

What we noticed was that many CSOs were very practical in these engagements. Some contacts were willing to tell us their story, but then showed no further interest in our study. Those that did show an interest, tended to want to know what it was that they could get from us. One example was an interest in participation in our workshop if we could explain how to be successful with EU cooperative research applications. A conclusion to draw from this is that the cooperative aspect needs to be present from the beginning, that is: in writing joint research proposals.

After we tried the opposite strategy of approaching CSOs with a very open agenda, it seems there was a difficult balancing act between research projects that are sufficiently concrete, and projects that are too defined. Initially, the study was too defined so CSOs saw little opening to connect it to their own interests (too specific, wrong focus). For the workshop, we had difficulty raising interest because we were giving up too much concreteness. It was no longer clear what our study was, because we tried not to define it (lack of concreteness).

Another important observation is that our CSO contacts found the idea of cooperative research a bit odd and having to understand our egalitarian proposals even a bit cumbersome. In organising the interaction, everybody seemed to prefer the tried recipes for organising interaction with researchers, perhaps as a way to reduce the complexity of the interaction. E.g. CSOs were interested in the workshop provided they could come and learn something (play the role of a student), or CSOs suggested we should invite them for a sounding board/advisory committee (standard practice in Dutch research projects). There are also concerns about finances. Some CSOs even suggested we pay them to come to our workshop. (In the end, we tried to resolve this with book vouchers for presenters, but that was clearly not a real fix.)

Originally, the study included the plan to write a handbook for CSO interaction with science, addressing anything from suggestions for the organisation to such cooperation up to ways to get access to scientific libraries. Under time constraint aggravated by the move of the study between universities, this part was eventually removed from the study in consultation with the project Coordinator.

The final phase of the study involved a case study of the Dutch organisations of volunteer naturalists and their censuses of fauna and flora, the Private Data-Managing Organisations (*Particuliere Gegevensbeherende Organisaties*, or PGOs). These are civil society groups performing counts of birds, plants, butterflies, or in fact a wide variety of organisms. Here, both access and interest were higher. We found interest in the tiny umbrella organisation of the PGOs, the Foundation for Field Research on Fauna and Flora (*Stichting VeldOnderzoek Flora en Fauna*, VOFF). The secretary of VOFF had an interest in the kind of research we were doing and provided entries to information, which included some meetings of the organisations, but also a demonstration of entomological field work. He also kindly helped with reviewing the report, which he in turn is planning to use to generate reflection

within the network of PGOs. Inversely, he has become interested more in science studies, which has now led us to initiate a PhD project on the PGOs. Meanwhile, we have also been invited to do a presentation at the annual meeting of the birding PGO (27 November).

The research on the PGOs looks like it is changing into cooperation with the PGOs. This was possible through personal contact and proximity, but most of all through shared puzzles and contacts that are recurring. In contrast, the workshop contacts, which seemed promising, have turned out to be more fleeting. The case suggests that cooperative research needs more than short-term initiatives, but requires more structured cooperation over a longer period of time. (This is also what the case study itself suggests for the cooperative research of the PGOs, which has brought together professional researchers, policy makers, and volunteers over a period of decades.)

3 Case study results

This section presents results for the three case studies in the Netherlands: science shops, the Wadden Academy, and volunteer nature census organisations. Science shops were selected for a number of reasons. They have a long tradition in the Netherlands, going back to the science and society movement of the seventies. Hence there is a wealth of experience, including documented practice and understanding. In addition, the science shops model is being followed in various European countries by an enthusiastic community. Ironically, this is the case as many of the science shops seem to be under fire in the Netherlands, with demands for financial self-reliance, re-orientation to commercial interests, or attacks on their legitimacy at publication-driven research institutions. Therefore the science shops offer both instructive material for the practical organisation of new science shops, as well as a warning against organisational strategies that lead to their demise.

The case of the Wadden Academy is a case of more systematic cooperation of CSOs in research programming, as a newer version of the 'sector councils', advisory organisations that were to suggest socially relevant research priorities, e.g. for the environment or agricultural research, as these seemed to have reached their expiry date. The Wadden Academy is sometimes presented as one of these sector councils. Although the formal status is somewhat different, its origins and concerns are very similar. The reason for including this case is that it is generally presented in Dutch policy circles as a promising alternative for identifying research priorities in cooperation with CSOs, with the specific aim of breaking through policy dead-locks – in this case the highly controversial future of the Wadden Sea.

The third case is that of the Dutch network of volunteer naturalists, gather data on the nation's fauna and flora for an integrated data system that is used in conservation management and policy, among other applications. This case offers an example of a well-organised and large co-operative research scheme, involving volunteers, professional researchers and policy makers. Among the three cases chosen, this is the one that seems the most stable over longer periods of time and that provides the strongest control to CSOs. At the same time, it is also the most pragmatic of the three – corresponding perhaps the least to the ideal of co-operative research, especially where its egalitarian assumptions are concerned. Rather, it is a case of CSO cooperation in a scheme revolves around mediation through rationalistic institutions, organising ownership, transforming observation into standard data, selling knowledge in a project-based market for conservation data in public policy.

Thus all three cases offer examples of co-operative research, all with their difficulties, but which have been dealt with in different forms and with different degrees (and understandings) of success. Some, such as the Wadden Sea, have more explicit tensions between different visions of nature, while the naturalist case is the most adroit at integration different visions.

3.1 Science shops in the Netherlands

3.1.1 Dealing with environmental problems

In 2004, researchers from the EU project INTERACTS (Improving Interaction among CSOs, Universities and Science Shops) stated that science shops seemed to be at a crossroads. Their intermediating role between academia and civil society serves an important function in contemporary knowledge society. In contemporary science and innovation policy discourse user involvement, trans-disciplinarity and societal relevance are highly valued. The translation of societal issues into research questions taken up by students and researchers provides concrete instances of science-society interfacing. But science shop activities are nowadays often considered marginal by university administrators, who tend to value input in terms of research funding and output in terms of scientific articles. This section discusses recent developments in the Netherlands, focusing on science shops dealing with environmental problems. The challenges that science shops have to deal with and their strategies in adapting to changing contexts are discussed.

In a comparison of science shops in Europe (Fischer, Leydesdorff, & Shophaus, 2004), Fischer et al. state that the number of science shops has been 'constantly high' in the Netherlands. According to

their count, some 19 science shops were established in the 1970s, more than 20 functioned during the 1980s, and between 10 and 20 science shops continued to function during the 1990s and 2000s¹. Their general diagnosis of the position of science shops in Europe signals tensions and challenges. On the one hand, the intermediary function of science shops, their contribution to making academic research relevant to society aligns well with the dominant discourse on knowledge production which stresses interactions between producers and users of knowledge. On the other hand, there is a trend towards commercialisation of research, science shops face budget cuts, and they are no longer connected to larger social movements. In the Netherlands too, science shops have been dealing with tensions and challenges in this respect. Wachelder attributes the decline of science shops late 1990s, early 2000s to the greater autonomy granted to university boards ('sturen op afstand') since the late 1980s, declining state funding of university research and a concomitant increase in commercial services, a changing political climate, a stricter academic regime with tighter schedules for students, an increased pressure to publish for academic staff and professionalising civil society organisations. The Leiden science shop was closed in 1998 not because it did not function well, but because of university wide budget cuts against the backdrop of the above mentioned changes. Providing community service or democratising science was also not on the agenda of Leiden's university board, Wachelder notes (Wachelder, 2003).

Over the last five years, the number of science shops in the Netherlands has further declined. March 2006, the precarious position of Dutch science shops is discussed in a newspaper article (Van Nieuwstadt, 2006). Early 2006, the science shop at the Free University of Amsterdam was discontinued. In Nijmegen, Eindhoven and Utrecht, science shops are transformed into university agencies providing services to small businesses, rather than just CSOs². The chemistry shop of the University of Amsterdam had become an independent, university based agency providing paid services a decade earlier. In Groningen, four science shops were forced to merge into one natural science shop in 2006, but the format of a CSO-oriented science shop remained. The science shop of the University of Wageningen has neither faced budget cuts nor major organisational transformation over the last decade. A tradition of doing research relevant to specific sectors in society in contrast with a 'classic' university like Leiden which considers academic peers as its main audience is an important difference (pers. comm. Straver 2009).

3.1.2 Role and function of science shops

Science shops mediate or perform research on request by civil society organisations. Originally, science shop clients were only non-profit non-governmental organisations, but some science shops now work for firms and governments as well (and then sometimes shed the label science shop). Still, clients are organisations which are supposed to be unable to pay for commissioned research (see Farkas, 2002 on how criteria developed). The mediation process as described by Mulder and De Bok involves ten steps: receiving/soliciting clients and questions, problem articulation, preliminary research which may or may not lead to a draft research proposal, finding a supervisor, finding a student or researcher, maintaining communication, facilitating presentation of results, supporting implementation of results and follow-up, discussing options of follow-up research, and evaluation (Mulder & de Bok, 2006). As Farkas (2002, p. 5) summarises:

'Through a process they call 'intermediation' science shop workers collaborate with clients to 'diagnose' possible areas where research would be helpful to an organization's pursuit of its goals, find students to conduct this research (often for their final thesis project), and professors to mentor them. Usually, the result is a report that clients can take to local governments and the media. Throughout this process, science shop employees mediate between the interests of the client and scientist so the final product serves the goals of all parties.'

Farkas considers intermediation one of the biggest accomplishments of science shops (Farkas, 2002, p. 213). In case studies, she provides some detailed accounts of intermediation processes. Science shop employees need to create trust, give emotional support, and deal with questions and problems analytically (Farkas, 2002, p. 170; Mulder & de Bok, 2006).

As science shops involve academic staff, students and civil society organisations, they benefit research, higher education and civil society, Mulder and De Bok (2006) argue. Science shops are 'university-community interfaces' and forums for risk and science communication. Science shops may also serve as an antenna or incubator as research projects may contribute to putting new issues on the research agenda, which may be then be taken up by the research community and turn into research lines.

¹ The exact number is hard to establish, not least because the definition of what does and does not count as a science shop is ambiguous, given the drift in format and goals of science shops.

² The new name of the Utrecht science shops is Knowledge Point (Kennispunt) and the label used for their activities is 'knowledge valorisation'.

3.1.3 Challenges and contexts

While the science shop concept has been embraced by EU science policy makers, and funding is made available to support the European science shop community, science shops in the Netherlands face important challenges.

First, university boards and faculties may or may not support the science shop ideologically and financially. Some recent transformations, mergers and discontinuances have been mentioned above. Decisions to continue or withdraw support for science shops are made in a wider context of science policies and university politics. The science and innovation policy discourse emphasizes competitiveness of science and innovation, foregrounding economic dimensions of the knowledge society – hence often reduced to knowledge economy (De Bok & Mulder, 2004; Fischer et al., 2004). Science shops are under a continuous pressure of legitimation vis-à-vis university and faculty boards.

Second, civil society organisations may come up with issues which do not easily fit research programs and/or curricula. Translation of problems into do-able research projects is a recurring challenge – and one in which science shops employees are experts - but developments in the organisation of research and higher education have decreased the room for manoeuvre, both for researchers and students. Over the last decades, research has been increasingly organised in large research programmes which constrain individual researchers in their choice of research lines and projects. Besides participating in research programmes, researchers do commissioned research, depend on funding from the commissioner. Furthermore, the pressure to publish articles in international peer-reviewed journals has increased, which further limits the available time and room for manoeuvre for researchers to engage in projects at the margin of their research interest. Students are subject to tighter schedules and curricula. Getting students interested in doing a science shop project is a continuous concern of science shops.

Third, the rise of internet has created enormous possibilities for gathering information and for interactively articulating and discussing issues. This development is sometimes used to argue that science shops are now redundant, as citizens Google for answers to their questions (Mulder 2009 pers. comm.). This simplistic rendering of research as information gathering does not do justice to the complexity of articulating research problems and mediation processes in which science shops, researchers and clients engage, but science shops have to defend themselves against such arguments. The rise of internet and ICTs have transformed the ways in which individual citizens and civil society organisations engage in debates on science and technology issues, but there is no reason to assume that this may replace science shop work. Internet and ICTs have also transformed scientific practices. Thus, the whole configuration of practices in which science shops serve an intermediating role has changed (Leydesdorff & Ward, 2005), which has made science shops to reconsider their practices.

Fourth, environmental organisations that were among the first clients of science shops, have professionalised. The contexts in which they need expertise and scientific research has changed importantly. The issues and questions that environmental organisations deal with at present, are much more complex than those of the 1980s. Environmental policies and regulations have been adopted at local, regional, national and international levels. In the 1980s, chemistry science shops were involved in testing amounts of toxic substances in soil samples. Environmental organisations now ask for scenarios for sustainable spatial planning at regional scales, e.g. to question assumptions made in scenarios and models used by governments. They also find that presenting counter-expertise is no longer enough, they are expected to come up with alternative solutions as well. In the Netherlands, environmental and nature organisations have large memberships, which allowed them to hire paid staff and professionalise. They sometimes find that they need counter-expertise having more status and authority than a student report and commission research from a research institute or consultancy firm. The budgets of these professionalised organisations do also to a limited extent allow for commissioned research that is paid for, hence they are no longer accepted as clients of the science shops that strictly apply the criterion of no financial means. New citizen associations and civil society organisations emerge around issues of local, regional, national or international scope. Among the issues which continue to give rise to concerned citizen groups asking for counter-expertise are odour, noise and health problems. Professionalisation of the original clients, environmental groups, made that science shops had to legitimise their existence anew (Farkas, 2002, p. 215).

3.1.4 Meeting the challenges

Science shops have been responding to the constant pressure to legitimize their existence in a variety of ways. Farkas (2002, p. 227) recommended that science shops be flexible in responding to dynamic political and scientific conditions. The strategies and new avenues discussed below illustrate that flexibility.

First, science shops diversified their services and sources of funding and sought new alliances. The chemistry shop of the University of Amsterdam works on a commercial basis for a range of clients but is also involved in capacity building of civil society organisations, funded by the EU. In the NanoCap

project, civil society organisations are trained, through a series of workshops, to develop independent, informed positions on nanotechnology. The natural sciences shop of the University of Groningen works for citizen groups, but also helps environmental organisations to get access to funding for research projects offered by provincial authorities and the ministry of VROM. The shop has formulated an EU project which aims to achieve synergy between public debates (partly on internet) and science shop work. Public debates on science and technology issues will be analysed with respect to the sorts of questions raised, these questions will then be further articulated into research questions, and fed back into the international science shop network. This project illustrates how the worlds of science shops and science communication are getting closer (pers. comm. Mulder).

Second, science shops have come to present evidence of societal, educational and scientific benefits of science shop work both qualitatively and quantitatively. Apart from the important but rather intangible aspects of science shop work such as building trust, there are clear cases of conflict mediation (Mulder, 2004). Sometimes, socio-economic benefits of science shop work are considerable. The Groningen science shop was involved in mediating a case on request of a citizen group protesting against a planned industry because they feared odour problems. Science shop coordinator Mulder found out that the industry had used a wrong odour norm. The case could be settled before a legal hearing was held. The science shop mediation had thus prevented a delay of a year for the industry to start producing, which meant the saving of jobs for 50 people during one year. An economist is elaborating a model to calculate such socio-economic benefits of science shops.

Among the educational benefits of science shop work are that students learn new skills, such as communicating with non-experts, solving a problem in context and project management (Fokkink & Mulder, 2004). They also become acquainted with political decision making processes (Farkas, 2002). In addition, science shop projects provide university lecturers with case material on societal problems.

Among the scientific benefits of science shop work are journal articles published on the basis of science shop projects. This however, seems to be more of an exception than the rule. Most science shop project results are published as reports. Some science shop projects lead to PhD studies. The science shop in Tilburg provides 50% of the funding of a PhD project and the department funds the other 50%, when after a feasibility study it is concluded that a client question can be translated into a PhD project. It is also common for projects to be included in university teaching projects.

Some university administrators consider science shop work inherently marginal to scientific interests. A former dean of the natural sciences faculty at the University of Groningen considered research on head lice, a topic for the Public Health Department of Groningen (GGD), not a scientific subject. He argued that the problem be solved by the local authorities and/or by Googling for remedies. The science shop had approached the problem in cooperation with the Public Health Department and found that a research program on head lice exists at the Harvard School of Public Health, ranked number one (pers. comm Mulder 2009). This may be anecdotal, but the image of science shops as marginal to academic research interests persists in some circles of university administration.

Third, to maintain an authoritative position vis-à-vis scientific and societal audiences, science shops employees need to be skilled in boundary work and maintain academic credibility. Quality control of student work by supervisors is essential. For most projects, science shops organizes a steering committee. Science shops may also profit from an advisory board. In 2006, the National Platform of Science Shops discussed the pros and cons of installing a national board to support the science shops in their political lobby in science and innovation policy circles (van der Avoird, 2006).

The position of science shops differs among universities, and within universities, among faculties. At the University of Wageningen, the centralized science shop has not suffered budget cuts or threats of discontinuance. The university has a tradition of doing research relevant to specific societal actors, and the science shop has a budget to pay researchers or their departments for their involvement in science shop projects. The position of the decentralised natural sciences shop at Groningen University is very different. The University of Groningen is a classic university with a tradition of doing fundamental research. The budget of the natural sciences shop does not allow to pay academic staff for research. The science shop thus needs to interest students and supervisors in science shop projects. The shop works with some 10 to 20% of the staff of the faculty.

Difficulties in finding students interested in doing science shop projects led the Wageningen science shop to ask students to come up with recommendations. The students recommended greater visibility of the science shop, the use of personal contacts with lecturers to advertise the science shop, and the tailoring of the science shop website to students, their interests and surfing-behaviour. The students also note that practical rather than ideological framing of science shop projects is preferred by the student population. This seems to be more generally the case. As science shop coordinator Mulder puts it:

'Students are interested in doing a science shop project as it provides them with an unusual and exciting experience, not so much because of societal concerns and idealistic motives. Societal engagement may grow in the course of the project.' (pers. comm. Mulder 2009)

3.1.5 Conclusion and prospects

Science shops face a particular range of recurrent arguments and challenges at Dutch universities. In the climate of output-steered, professionalised university management sub-units are pressurised to either generate income or journal publications (and preferably both). While it is tempting to perform towards these indicators whenever the legitimacy of science shops is questioned, this strategy also holds risks, as it implicitly acknowledges the relevance of such output indicators. While tempting in the short run, in the longer run this strategy leads to further arguments pushing science shops towards generating more income and more publications. The first leads to market-oriented research, market brokers, or possibly even a spin-off consultancy company, the second suggests dissolution into mainstream research groups. The added advantage from a management perspective is that the work then becomes commensurable with other units, providing clearer performance indicators and legitimacy for reallocations. These results negate the core mission of science shops to make knowledge available to groups in society who cannot afford to buy it and to provide researchers access to actors and problems they normally would not have access to.

These developments seem to identify university management as the main enemy in the decline of Dutch science shops, but the remaining science shops have developed strategies that combine the authenticity of the mission with support from university management – or at least have found ways to keep some of their mission alive in spite of ‘visionary’ intervention from higher echelons. What are these strategies?

Diversification of services, allies, and funding has helped science shops to extend their support network. At the same time, it has also allowed them to strengthen their specific niche in the ecology of research, for example by accessing research funds that are normally out of reach for academic researchers who lack relevant CSO contacts. A wide network not only provides access to actors and resources for projects, but also for political support under threat of cuts.

Science shops also invest in visibility of their contributions, to develop signs of performance on their own terms. This may involve economic or social benefits, contributions to teaching, or benefits for researchers, e.g. access to resources (even if these do not end up on the account of the science shop). Making science shops and their contributions visible in the university is absolutely vital.

Last, science shops have to maintain a reputation for high quality research and members of science shops have to make sure this is the case through close cooperation with academic researchers. If science shops acquire a reputation for second-rate projects at best interesting for beginning student projects, then they lose academic allies that are as vital as their CSO allies.

In the past, Dutch science shops were able to ride a wave of general agreement on the importance of strengthened relations between science and civil society, especially where the mechanisms of the research markets fail to provide for such relations. The cautionary tale of the Dutch science shops contains a warning for what happens after this wave passes. The drive of a shared cause and enthusiasm for civil society research in the academic system can put science shops on the map; but to keep them there, they have to prepare for what comes after the initial wave. Here too, the surviving science shops provide useful experience, experiences we found them very willing to share.

3.2 The Wadden Academy

3.2.1 Shifting forms of cooperation

Since the mid-1960s, protection of the Wadden Sea has been on the agenda of Dutch nature organisations, researchers and authorities (Wolff, 1997). Relations between these societal actors have been antagonistic at times, but also cooperative. From the early 1990s until 2005 a fierce controversy over the ecological effects of cockle fishing was the primary focus of public debate and science/policy interactions (Swart & Andel, 2008). An important turning point in the debate and in relations among societal actors was the approval by Dutch parliament of the plan of the ministry of Agriculture, Nature and Fisheries (LNV), late 2004, to ban mechanized cockle fishing, to lift the moratorium on gas exploitation in the Wadden Sea and to create a fund of 800 million euros from gas revenues to invest in nature restoration and research. Since 2005, several new initiatives have been taken involving cooperation between nature organisations, researchers and authorities. One of these new initiatives is the Wadden Academy, an institution under the umbrella of the Royal Academy of Sciences, which aims to create a sustainable knowledge base for the protection of the Wadden Sea and which seeks cooperation with societal actors like the Wadden Society. In the context of a Nature Restoration Programme, directed by the ministry of Agriculture, Nature Management and Fisheries, cooperation between nature organisations and scientists is to result in a shared vision of ecological recovery.

3.2.2 Conservation efforts

In 1965, the Dutch Society for the Protection of the Wadden Sea (Wadden Society) was founded to organise protests against the plan of the government to connect the Ameland island to the mainland,

in a context of concern about the ecological deterioration of the Wadden Sea. The legendary founding story reads that a 16 year old boy, Kees Wevers, wrote a letter of protest in a daily newspaper, which had the effect of mobilising people for a joint, organised way of protesting against the ecological deterioration of the Wadden Sea. On 16 October 1965, the the Wadden Society was founded. In the same year, a Wadden Sea Working Group of concerned scientists was established. The Netherlands Institute of Sea Research (NIOZ) played an important role in this group, which developed into an international working group of more than 100 scientists from the three Wadden Sea countries (Wolff, 1997). In 1974, a committee installed by the government chaired by engineer Mazure advised against reclaiming the Wadden Sea and instead protecting it. In ten years time, the fate of the Wadden Sea had been thoroughly reconsidered. In 1976, the government proposed to protect the Wadden Sea by a so-called Key Decision on Physical Planning (PKB), which was accepted by Parliament in 1980. In 1978, Denmark, Germany and the Netherlands had started international cooperation on the protection of the Wadden Sea and established a Common Wadden Sea Secretariat (CWSS).

Parts of the Wadden Sea were given protected status under the Nature Conservation Act in the following years, adding up to 1,500 square kilometres in 1993. A number of international regulations apply to the Dutch Wadden Sea. Parts of it are protected under the Bird directive (since 1991) and Habitat directive (since 2003) and are considered Ramsar-wetlands (since 1984). The 2007 amendment of the Key Decision on Physical Planning and the 1998 amendment to the Nature Conservation Act are current legal frameworks. In June 2009, the Wadden Sea (the German and Dutch parts, adding up to 10,000 square kilometres) has been given the status of UNESCO World Heritage Site. This status involves no new regulations.

3.2.3 Relations between the Wadden Society and scientists

From the establishment of the Wadden Society until the late 1990s, relations between NIOZ (Netherlands Institute of Sea Research) researchers and the Society have been cooperative, without much concern about demarcating between research and advocacy. Researchers contributed regularly to the Wadden bulletin which was considered, among others, a forum for communicating scientific research to the general public (Hans Revier pers. comm. 20 May 2009). Scientists from the NIOZ, located at the island of Texel in the Wadden Sea exchanged arguments against gas mining with the Wadden Society (Maria van Leeuwe pers. comm. 15 May 2009).

A turning point in relations between the Wadden Society and NIOZ researchers was a study on the effects of gas mining on soil subsidence and Wadden Sea ecology, commissioned by the Netherlands Aardolie Maatschappij (NAM, a private company with the government as shareholder) in 1999. The study, conducted by NIOZ (a research institute funded by the National Research Council), Alterra (a research institute funded in part by the ministry of Agriculture, Nature Management and Fisheries) and Delft Hydraulics (one of the so-called large technological institutes of which some 50% of the revenues are from ministries) concluded that the effects could be considered to be negligible. The Wadden Society questioned the independency of the researchers, suggesting that the interests of the commissioner, the NAM, made researchers reach biased conclusions (Turnhout, Hisschemöller, & Eijsackers, 2008).

In another controversy which concerned the impact of cockle fishing on the ecology of the Wadden Sea, arising at around the same time, NIOZ researchers were part of the same coalition as the Wadden Society (Turnhout et al., 2008). Researchers from NIOZ however argued that the Wadden Society should be more radically against cockle fishery, which created tensions within the coalition (Van Leeuwe pers. comm.).

3.2.4 Recent shifts in relations

Over the last decade, the Wadden Society has been undergoing reorganisation and reorientation. The activist profile of the Society was no longer considered appropriate in the eyes of director Henk Tameling who joined the Wadden Society in 2001. In an interview held in 2004, he drew a contrast between 'pure activism' and 'knowledge exchange on the basis of scientifically valid arguments' (Huseman, 2004). The Wadden Society was to reorient itself towards the latter profile. The forming of coalitions was also part of the new strategy, which was to make the Society authoritative and influential again. The new role was to contribute to policy making for an integrated management of the Wadden Sea, to draw up plans and alternatives instead of being reactive and opposing plans through legal procedures. To strengthen the scientific underpinning and credibility of its arguments and proposals, the Wadden Society, like other nature organisations, also decided it should have people with a scientific record within the organisation (Revier pers. comm.).

The establishment of a coalition of eight nature organisations and the joint publication of a Nature Restoration Programme for the Wadden Sea reflects this reorientation of the Wadden Society towards cooperative, policy oriented contributions. After the parliamentary approval, late 2004, of the governmental decision to allow gas mining in the Wadden Sea and to make available 800 million euro to restore nature in the Wadden Sea, joining forces among nature organisations to draw up nature

restoration plans was considered appropriate and timely. Late 2005, a brochure titled *Het Tij Gekeerd* ('The Tide Turned') was published and presented to authorities at the provincial level and the Minister of Environmental Affairs (VROM). The booklet proposed nature restoration in the Wadden Sea along five lines, of which four lines concern a specific type of Wadden landscape (the sea, salt marshes, inland nature areas, the islands) and the fifth concerns public involvement and experiencing. It presented scenarios for the Dutch part of the Wadden Sea towards the year 2025, involving a variety of ecological and cultural heritage restoration efforts on the basis of cooperation between authorities, nature organisations and farmers, while excluding seabed disturbing (shellfish) fisheries.

After the publication of *Het Tij Gekeerd*, the coalition of nature organisations joined forces with researchers from fourteen research institutes and universities, to elaborate a research programme for the scientific underpinning of nature restoration plans for the Wadden Sea area. This cooperative arrangement of nature organisations and researchers took shape in the context of the availability of funds for the Wadden Sea 'knowledge infrastructure', from the same Waddenfonds (some 4% of the total amount of funds). The research programme, entitled *Het Tij Geleerd* ('The Tide Learnt') was published late 2005, when the idea of a Wadden Academy, a scientific institution devoted to strengthening the knowledge infrastructure, was being elaborated in science/policy circles.

At the time, the Wadden Society was against the establishment of a new institution, but favoured coordination and cooperation amongst Wadden experts (Waddenvereniging, 2006). Scientists studying the Wadden Sea were divided about the establishment of a Wadden Academy. Piersma, ecologist at the NIOZ, with a chair at the University of Groningen invoked a distinction between fundamental research by NIOZ, RUG and NIOO researchers, which he considered to be a 'virtual Wadden Academy' and 'knowledge assembly' by researchers at policy oriented research institutes like Alterra and TNO, and complained that the research programming and research funding in which the Wadden Academy was involved was directed at the latter group of researchers (Alma, 2006). Thus, in 2006, Wadden Society and scientists like Piersma were against the establishment of a Wadden Academy. But since 2006, the Wadden Academy initiative appears to have convinced opponents such as Piersma and the Wadden Society that it has something to offer. Recently, Piersma contributed to the Wadden Academy knowledge agenda by writing a background report on the Wadden Sea as part of a network of ecosystems (Piersma, Gils, & Olf, 2009). The Wadden Society and the Wadden Academy jointly publish articles on Wadden Sea research for a broad audience, titled *WadWeten* ('Knowing Wad'). The Wadden Academy also has an advisory role in a Wadden Sea Nature Restoration Plan. The plan has been drawn up by a coalition of 8 nature organisations, the *Coalitie Wadden Natuurlijk* ('Coalition Natural Wadden'), in cooperation with the three ministries involved (agriculture, environment, water) and the Regional Wadden Board, which represents local (municipal), regional (provincial), national (ministries) and sectoral (water boards) authorities. The plan distinguishes six main targets to be realised by 2050: better water quality with clearer seawater, food web improvement, recovery of ecosystem engineers like sea grasses and shellfish, synergy between nature restoration and coastal defence, safeguarding the significance of the Wadden ecosystem in a global context, synergy between nature, culture and the economy. A concrete target is the restoration of mussel beds, by gradually decreasing the area in which the catching of mussel seed on the seabed is allowed and a complete ban by 2020, by shifting to alternative mussel seed production.

The joint elaboration of the Nature Restoration Plan (NRP) by civil servants, nature organisations and scientists is currently taking shape in sessions devoted to specific topics. For the island and the tidal area, different expert teams have been formed. Interaction also takes place at the many meetings, symposia, workshops and conferences devoted to the future of the Wadden Sea. Roughly the same group of people, somehow involved in Wadden Sea policies, research and management frequently meet in different settings to discuss plans, topics for research, etc. The elaboration of a shared vision and nature restoration measures is a precarious balancing act according to Maria van Leeuwe, who represents the Wadden Society in the Nature Restoration Plan network (Van Leeuwe workshop contribution). Van Leeuwe is a marine biologist by training, who did her PhD at the University of Groningen. In 2007 she came to work for the Wadden Society, to strengthen connections with the scientific world, to enhance credibility of the organisation's proposals and to keep informed about scientific developments. The joint elaboration of the NRP by experts from nature organisations and scientific institutions is progressing, but there are moments of crisis. Participants speak different (disciplinary) languages which creates a 'Tower of Babel' feeling and reached agreements risk to fall apart again (Van Leeuwe workshop contribution).

On the one hand, there are some factors working as a lubricant. There is an enormous amount of money available for the sustainable development of the Wadden Sea area: the so-called Wadden Fund. As criteria emphasize cooperation and co-production rather than competition, this fund stimulates the joint formulation of proposals for research and innovation activities by societal actors. There is also a sense of urgency among the actors involved. For decades, Wadden Sea ecology deteriorated while the fierce controversies made reaching decisions on restoration goals and interventions impossible. There is a feeling that 'it is time to act now', and that consensus, or at least a shared vision is a basic prerequisite. Late 2008, an agreement was reached between the ministry of Agriculture, Nature Management and Fisheries (now Food Quality), the Organisation of Mussel

Producers and nature organisations on the gradual abandonment of the current way of producing mussels, which severely affects seabed ecology, to an alternative mussel culture in which mussel seed is caught without disturbing the seabed. Both for this transition, for which mussel producers are being compensated financially, and for nature restoration measures funds are made available and a time schedule is agreed on. The catching of mussel(seed) on the seabed is to be abandoned completely by 2017 (Plan van Uitvoering covenant transitie mosselsector en natuurherstel Waddenzee March 4, 2009). The abandonment of seabed mussel catching is a legal requirement and the agreement specifies implementation.

While a shared sense of urgency and available funds help to bring parties together, also in the NRP network, there are also barriers to cooperation between nature organisations and scientists. Firstly, there is a long history of acting together, but also of antagonisms and overt conflicts, which makes (re)building trust a delicate affair. Secondly, representatives of nature organisations like the Wadden Society feel they are approached as activists who are biased in how they draw on scientific knowledge and how they argue (Van Leeuwe workshop contribution). Thirdly, while scientists are cooperative in the joint formulation of problems, they do not agree with nature organisations in aims for nature restoration and concrete targets (streefbeeld). They regard these targets as 'unscientific' (Van Leeuwe workshop contribution). This resembles the way an earlier attempt at setting ecological targets fared as a boundary device between scientists and policy makers (Turnhout, 2003; Van der Windt, 1995a). Familiar features of such relations are discursive demarcation of science/activism, the mistrust of how activists deal with scientific knowledge, and the invocation of activist (interest) bias to discredit activists' arguments.

3.2.5 Conclusion and prospects

Cooperation between nature organisations and scientists on Wadden Sea issues seems to have reached a new phase, in which the building of trust and discursive alignment towards shared goals are more explicitly strived after than a decade ago. Both nature organisations and scientists acknowledge that participants argue and act strategically, and that alignment of the strategies of scientists and activists, while acknowledging different roles, tasks and identities, needs sustained efforts and frequent meetings. Among scientists there is a growing willingness to focus research on concrete, urgent problems, while nature organisations like the Wadden Society are putting much effort to elaborate proposals for nature restoration in consultation with scientists. To this end, the Wadden Society is engaged in both ad hoc informal exchanges with scientists like it has done in the past, and the more institutionalised forms of cooperation in the elaboration of the NRP. Still, similar issues as in the past make that boundary work is sometimes experienced as unproductive. The setting of particular targets for nature restoration arouses controversies just like it did in the 1990s, which makes alignment a matter of keeping goals ambiguous and open, while agreeing on visions.

3.3 Dutch volunteer naturalists

3.3.1 Public Data-managing Organisations

'Private Data-managing Organisations' (Particuliere Gegevensbeherende Organisaties, PGOs) are a set of ten organisations in the Netherlands that observe and register biodiversity in the Netherlands, involving large networks of volunteer naturalists recording wildlife observations to databases. Each of the ten PGOs specialises in a specific group of organisms, such as birds, butterflies, or fungi. Volunteer birders, botanists, or entomologists spend their spare time recording organisms, in most cases according to carefully designed observation protocols, based on taxonomical knowledge learned through experience in nature and from their peers. During working hours, they are accountants, welders, teachers, and occasionally professional biologists, but they spend a large part of their spare time observing nature – often while filling out (digital) forms.

The PGOs set up biodiversity monitoring networks. For example, they organise their members to cover bird migration routes and count birds systematically as they journey through the Netherlands. Counting data are gathered in databases, where observations are processed and integrated. Over the last decade, some of these data are integrated on a European level, cooperating with an increasing number of national bio-monitoring schemes, to produce indicators for biodiversity (Gregory et al., 2005), including effects of climate change on biodiversity (Gregory et al., 2009; Noirot, 2010).

The resulting data are used in public policy for nature conservation, in evaluation and development of conservation measures by managers of nature reserves, or in application procedures of town and regional planning decisions, but also for research, or public information and education. The PGOs generate income through the analysis of their data for projects from various public and private organisations involved in nature conservation. In turn, the income is used for the improvement of the data infrastructure, for nature conservation projects, or for projects by and for the volunteers, such as summer camps, courses, meetings, or atlas projects. For the larger PGOs, this involves hiring

professionals who manage and process the data – in some cases involving administrative work that the volunteers find uninteresting.

Apart from providing a data stream to centralised databases, PGOs also perform specific monitoring projects, more or less depending on whether a policy actor can be interested in the data. (Sometimes they keep monitoring projects afloat purely with volunteer labour, but most projects involve project-based funding or occasionally philanthropy.) Such specific projects could involve an inventory of species in a specific area, or a project to monitor the progress of a specific set of organisms, such as invading exotic species. The PGOs also answer questions from organisations involved in conservation, which can grow into projects or paid data usage. Occasionally, they perform early warning functions, such as with explosive growth of a threatening species or the looming disappearance of a rare one.

As for the other case studies, there are three key questions for this study. First, there is the question of how diverse accounts of nature/the environment are accommodated in the co-operative research of volunteer naturalist organisations. Nature means something else in the volunteer study of nature and in a bureaucratic-rationalist policy regime. We will be able to illustrate this with the development from atlases to biodiversity indicators. Second, Crêpe asks how this co-operative research relates research more closely to societal needs, with an eye on informing policy debate and research priorities in Europe. Here, the Dutch co-operative institutions suggest a number of lessons for such policy learning, related to the gradual negotiation of tensions between volunteer naturalists, policy makers, and professionals. Third, the project aims to suggest alternative solutions to agri-environmental and sustainability issues. Even though volunteer naturalists may not have ready-made alternatives for rationalist policy makers' concerns, at least they do offer a model of deep involvement with these issues that challenges the notion of the citizen as an stubborn subject who needs to be coaxed into responsibility and sustainability. I will return to these questions towards the end of the case report.

3.3.2 Tensions

3.3.2.1 Negotiating conditional ownership

PGOs sell their data, or more precisely: charge fees for access to their data to governments, nature reserve managers, or building companies looking for data to be used in permit applications. This has effectively commodified the volunteers' knowledge of nature. However, access and ownership of these data is conditional and complex. The basic principle for PGOs is that the observer is the owner of the data. This means that the observer can also withdraw data, or even modify data, for example as a result of taxonomic renegotiations.

However, this distributed ownership of data creates problems once the data are traded as an integrated set and used in comparisons or composite indicators. For example, statistic procedures and mapping software are used to interpolate birding spots: gaps between observations are filled to create geographic maps of likely abundance of species. Individuals correcting or withdrawing their data could lead to different assessments or alter the knowledge base in delicate public decisions. This did not seem to be a major problem when separate PGOs sold access to their data, but the issue became more prominent with data integration in the umbrella VOFF and in preparation of the national database.

The solution that was worked out over the last years, was that data would be owned by its producer, but that verification and integration of data is also production, meaning that the administrators of the databases gain control as soon as they start to process data. From that point on the volunteers still have ownership: they can still decide what to do with the data, how to capitalise on them, and how to spend income, but they do so as a collective. Thus PGOs have had to negotiate the tension between a logic of observations owned by individuals (as copyright), but shared in a community, to a logic of databases owned by organisations that can trade these data with public and commercial organisations.

3.3.2.2 Contextual and standardised account of nature

Several researchers have documented the tension between the rational/bureaucratic account of nature and the experience of volunteer naturalists (Ellis & Waterton, 2004; Hinchliffe, Kearnes, Degen, & Whatmore, 2005; Lawrence & Turnhout, 2010). The point is not that the volunteer naturalist's account of nature is somehow unmediated. Birders also make take home a bird as 'a spot', a tick on a list possibly documented with a picture. In order to be relevant to the state-rationalised view, an observation must be stripped of some of its local context, be categorized in a taxonomic system that is relatively stable, in order to make nature comparable between places and over time. This is the precondition to be able to make a rationalistic assessment of which nature is more rich or deserving of protection and which conservation measures are most effective. Nature conservation is brought under the same 'results-based' or 'evidence-based' regime of efficiency as other policy fields. As nature conservation internationalises, this means data on nature have to be further transformed to remove idiosyncrasies of the local to be recontextualised in the tabulations of the trans-local.

To the naturalist, there are several issues at stake. The representation of nature may no longer fit to the preferred account of a unique place with a unique community of wildlife, with organisms that hybridise and vary, occasionally defying the deceptively neat boxes of official taxonomy. If the account was an inconsequential story about nature, then the naturalist could merely scoff and the 'misunderstanding' of the rationalistic version and move on. However, such accounts are consequential and may lead to planning decisions or management measures that actually alter the naturalist's prized nature.

Although there is some tension between the more immediate experience of fauna and flora in the wild context and the data in the database, the PGOs seem to have accommodated these tensions. They have done so partly by creating organisational buffers between the volunteers and the users, such as through regional project managers, professional offices, VOFF, and now also the National Data Authority. More importantly, the PGOs pay attention to the motivation of volunteers and make sure their concerns are met, keeping volunteers motivated.

3.3.2.3 Motivation and the cause of conservation

In order to have data that provide coverage of the country and its different ecological zones, volunteers have to put aside some of the rewards normally involved in field excursions. For example, an excursion to a unique pond that harbours rare amphibian may have to be replaced to an uninteresting pond that in all likelihood harbours no interesting species at all, just because a monitoring projects requires it be covered. Similarly, the one-hour 'turbo-bird count' for monitoring projects does not correspond to how most birders would normally enjoy nature.

The PGO structures provide other rewards to their volunteers. Integration of observations into databases adds to the sense of 'doing something useful'. 'Turbo-birding' is used for the production of the atlas of breeding birds, a beautifully illustrated and pricy book that received a lot of attention from the press, one of many books published by the birding PGO (SOVON Vogelonderzoek Nederland, 2003, 2009). In addition, many of the usages of these data are sympathetic to the volunteers. They may be used to assist managers of nature reserves, for example to assess the effects of measures such as mowing or grazing on biodiversity or the protection of rare species. They may also be used to identify areas with rare species that require priority protection, or make visible the presence rare or protected species to development projects. In order to keep these motivations going, PGOs have to invest in showing effects of contributions from volunteers. Data entries have to be made visible quickly, even if they require further verification and the connection between observation effort and use has to be made explicit.

However, this also has a potential downside: these same data may be used to argue against protection, perhaps of a patch of nature close to the volunteers involved. Especially in the Dutch PGO construction, where access to data can be bought by any interested party, including real estate developers and building companies, this may effectively mean that volunteer observers are undermining the protection of some nature. This has been a major source of problems for the willingness of UK volunteer naturalists to cooperate with data mining (Ellis & Waterton, 2004). However, the Dutch PGOs have decided that making their data available is better than the unexpected effects of zoning decisions based on inferior data and that this is a better guarantee for the defence of what they consider really valuable nature. This conviction is reinforced by volunteer control over the revenue from the data, that can be used for improved data management, education, or conservation projects.

3.3.2.4 Establishing cognitive authority

The authority of volunteer biodiversity data is not self-evident. It has to be established, argued and proven. Because the data are gathered by people not necessarily formally trained as field biologists and because the skill levels vary, the data of volunteers are not always recognised. For policy makers, this means they cannot rely on the cultural authority implied in science, including its underlying certification processes of peer review or stabilised methodologies. Scientists face colleagues who mistrust volunteer data as a source for field research and even for the management of nature reserves their reliability is not self-evident.

The Dutch PGOs have managed to achieve a high level of cognitive authority, e.g. compared to some neighbouring countries. There are a number of strategies that have been followed. First, the PGOs have carefully accumulated data of field observation, in some cases going as far back as the mid-nineteenth century and covering a wide variety of taxa. This means that no other organisation in the Netherlands has data on abundance and distribution of wildlife that even come close to what the PGOs have. The PGOs will insist on this in their public presentation, quoting number of records or range of coverage. By integrating these data in VOFF; they have been able to further establish and stress that there is no real competition.

Second, PGOs have transformed part of the random, disorganised observations through protocolisation and standardisation into more systematic registrations, increasingly also through ICT and internet applications. For example, all PGOs have developed standard forms on which

observations should be noted. These forms require field observers to not only note what species has been observed where and when, but also a range of parameters qualifying the observation. One method developed by birders is to register all birds for one hour, jokingly called turbo-birding by the field observers. Another is to ask field observers to register on specific times or places, in order to provide good coverage or avoid double counts, such as with waterfowl (SOVON Vogelonderzoek Nederland, 2002). Even taxonomy may be subject to standardisation, as taxonomies and nomenclature are occasionally under dispute. Such standardised registration not only makes it easier to add and compare data, but also to assess their reliability.

Third, the PGOs have cooperated with professional statisticians to improve counts and make statistically meaningful extrapolations from these counts. A break-through was the cooperation between the birding PGO and the Dutch national statistics agency, Statistics Netherlands, which began in 1990. Together, they formed a nation-wide network for ecological monitoring.

Fourth, once data are submitted to the databases, entry systems now have automated checks. For example, an observation of a butterfly species in an unlikely territory or unlikely time of year may raise a warning indicating to the operator that there may be a problem with this observation. Database managers will then typically resort to other sources of cognitive authority to check this entry, such as photographs, confirmation by experienced observers, or simply telephone contact with the observer to assess the likelihood of the observation.

Fifth, several of the PGOs employ professional field biologists, typically at their head office. They typically assist with data input and assessment, but also with standardisation and validation of observations, setting up or assisting with volunteer monitoring projects, or performing projects commissioned by government or conservation organisations (often in close cooperation with regional volunteer co-ordinators). Formally, these professionals are hired by these PGOs, mostly membership societies, in service of volunteer nature observation, but logic of project-based, client-oriented work has given rise to some parallel administrative structures in which the professionals are not necessarily directly answerable to an assembly of members. Some PGOs, such as the birding one, also involve scientists in advisory functions such as an advisory board, in order to improve the scientific quality of the data gathering.

Last, the cooperation of PGOs with professional researchers in joint projects improve data quality and data processing. For example, the birding PGO has cooperated with the national statistics agency and universities to improve protocols for monitoring projects and for the calculation of indicators and trends (SOVON Vogelonderzoek Nederland, 2003) and now cooperates with academic researchers to model bird flock hazards to air traffic. Research in direct cooperation with academic researchers also increases cognitive authority because it leads to academic publications.

Standardisation and verification practices, combined with a large accumulation of observation data and a gradual professionalisation of the PGOs are some of the key processes that have helped the PGOs to acquire cognitive authority. This has created opportunities to mobilise these data for conservation research, policy and management, but has also created some difficult tensions that these organisations have had to articulate.

3.3.3 Conclusion and implications

3.3.3.1 Cooperation and the standardisation of nature

Returning to the key questions for the overall project, there are some interesting lessons to be learned from the case of Dutch PGOs. First, with respect to the occurrence of different accounts of nature, the cooperation between volunteer naturalist CSOs, professional researchers and policy makers shows different accounts, but more importantly also a route to cooperation.

The volunteer naturalist experience of nature is one that is local and imbued with emotion and passion. In contrast, the account of nature in biodiversity indicators is abstracted, trans-local, and presented as rational and dispassionate (Lawrence & Turnhout, 2010). For the naturalist in the field, the ongoing concern is for this location, this observation of a wondrous organism, in the unique setting of this favoured spot of nature. This does not mean that the enjoyment of nature produces no abstract accounts – on the contrary. The popularity of nature observation is intimately linked (presently and historically) to the production of field guides, for use by the naturalist in the field, in order to find, recognise, and name an organism, pointing out what is notable or remarkable.

In contrast, the bird counts of a bird census are a process that removes the peculiarities of the specific bird, in order to produce a tabulated number. It is this number that makes nature comparable; first on a local scale, with inventories of species in a nature reserve to compare over time. Next, on a national scale, where the value of a nature reserve on one side of the country is made comparable to a nature reserve on the other side, in order to prioritise nature conservation goals at maximum efficiency. Eventually, nature is made comparable internationally, e.g. across Europe (Waterton, 2002), through data integration and composite indicators, in order to map the progress of biodiversity loss, climate change, or policy impacts.

Our analysis has stressed less the existence of this localised and passionate experience in contrast to the rationalised account of public policy, but the fact that it can be (and is) translated into the dispassionate rationalised account of nature in public policy. Observations are standardised, forms are filled out, and at least some birders are willing to spend part of their field experience in a way that does not come natural, turbo-birding, or going to uninteresting locations to count uninteresting organisms. What is remarkable is not the fact that accounts of nature are different, but that they actually managed to cooperate (Star & Griesemer, 1989).

In the Dutch case, this rationalisation has proceeded even further in the construction of the fairly complicated institutional structures that trade data and mostly data analysis with conservation policy actors. This accommodation of two nature accounts is fragile and has required long-term negotiation of conditions such as data ownership, the construction and governance of intermediate organisations and their governance, or the building of cognitive status. The Dutch example shows that, at least in the setting of its peculiar institutions, this is possible.

3.3.3.2 Relating research to societal needs and (research) policy

The case of Dutch volunteer nature study organisations shows one model of cooperation between professional scientists, civil societies and policy makers. It is a model that has come about through two decades of negotiation and articulation and that no doubt will go through further modifications. The key features of the current institutional solution are:

- Specification of the conditions of data and observation ownership: volunteers remain in control of their observations (e.g. with a right to correct) until further operations on these data put the PGOs in control, who can then trade data and data analysis, in return for resources that flow back to conservation and the volunteer study of nature.
- Standardised observation, modifying nature observation in return for use of observations in the construction of data and indicators useful for nature conservation and conservation policy, but also nature education.
- Cooperation with professional researchers, including statisticians at government agencies and academic biologists, in order to process data and increase quality.
- The construction of specialised organisations that buffer and negotiate concerns of policy, research, and naturalists, with volunteers largely in control of their data collecting organisations.

This close cooperation is less a forum where societal needs (in this case citizens' concern for nature) can be articulated. Rather, it is the shared concern for nature conservation that has created these institutions, starting with atlases and developing into integrated databases and compound indicators. Fuelled by project-based public funds and support from conservation organisations, nature study organisations have managed to create institutions that generate knowledge of nature that supports the concern for conservation that would otherwise not be affordable.

As for research priorities in this system, it should be noted that these are de facto negotiated between the volunteer organisations and their clients. Monitoring projects are more easily constructed with public funding, but then often require cooperation of the volunteers who have to find them meaningful (especially when extra observation is required). Inversely, volunteer organisations may proceed with monitoring projects on a more modest scale because of their own concerns.

3.3.3.3 PGOs and alternative solutions to agri-environmental and sustainability issues

The Dutch PGO model does not offer radical, alternative solutions for nature conservation or sustainability in general. In fact, one could even argue that 'romantic' nature has accommodated a rationalised management model: it is 'reformist' rather than 'radical'. (This is precisely why in some other countries – and even some quarters of Dutch conservationists – there is refusal to cooperate on counts that are used to protect priority nature, but also to legitimate giving up non-priority nature to real estate development.)

However, the volunteer naturalists do challenge the discourse of the citizen as a stubborn subject that needs to be coaxed into caring for the environment. Dutch PGOs and their tens of thousands of volunteers are part of a much wider network of conservation organisations, their members, and their education and information projects. Although policy makers may be tempted to see them as a conduit for conservation policy, they are just as much an articulation of such concerns. Through their extension networks citizens are able to express concerns for nature, allowing for a combination of nature study with enjoyment and protection. The PGOs offer a avenues for this commitment to be developed further in the direction of systematic study collaborating on instruments for nature conservation policy and even research. In this sense, they provide a career for 'amateurs of nature' to develop into 'serious amateurs'. As such, these organisations form the biggest, radical, and deeply rooted network for the public understanding of science imaginable, even if it is 'only' field biology, currently less prestigious in the academy.

3.4 Conclusions for the study

The overall conclusions from this study pertain to the experience of CSOs with research in the Netherlands. We interpret the three cases we have studied in retrospect as cases of co-operative research, even though each may not fit all parameters of the co-operative model (Stirling, 2006). The experiences in the Netherlands point to crucial problems that co-operative research involving CSO have to address, but also offer some suggestions on how to address these. These can be summarised in broad terms under the problem of legitimacy, the problem of protection, and the problem of continuity.

3.4.1 Problem of legitimacy

Co-operative research and the organisation of science-civil society relations are not self-evident, such as science-industry relations are. There are very good and strong reasons why CSO involvement in research is equitable, democratic, may raise support for science, help shore up threatened social causes, etc. Such arguments have been formulated at length elsewhere (e.g. Irwin, 1995), also in EU policy circles (e.g. Stirling, 2006; Felt, 2007).

The reality of science for civil society is that it has to prove itself constantly. The default state of discourse is one in which this research has to defend its legitimacy. It has to justify its benefits, as those are not readily expressed in the currently appreciated indicators of rationalised science management, especially in the universities. For example, Dutch science shops are vulnerable in the dominant performance measures such as earning capacity or publication output, or the redefinition of societal benefits as economic benefits. Attempts to compete with market-oriented research to boast income, or with academic research to boast publications is a battle lost beforehand. Research for civil society goals also has to defend the quality of its research, as it has to face challenges of activist bias or amateurism. CSO affiliated researchers in the Wadden Academy explained how they have to be extra meticulous about their research, as their affinities are used to question their scientific integrity. Similarly, amateur biologists have invested heavily in, for example, standardisation and data documentation in order to face the challenge of amateurism – a challenge that has effectively prevented data from policy use in other countries, where biodiversity censuses are only trusted when performed by professional biologists, even if they have only a fraction of the coverage and use the same observation protocols.

The project has identified three strategies to counter challenges to the legitimacy of co-operative research, which can be phrased in these maxims:

- *Do not compromise on research standards*
Even though 'scientific rigour' or even 'scientific method' means very different things to different specialisms, CSO-oriented research will be held to severe scientific scrutiny – quite likely even more than academic research. As the stakes of societal issues are high, such as the cost of environmental protection, other stakeholders will mobilise resources to challenge CSO research. With the involvement or advice of professional researchers, well-documented development or use of methods, use of the peer review system of science, or extra care for meticulous data gathering, co-operative research can try to pre-empt such challenges. The extra attention of the PGOs to shore up their cognitive authority shows this importance, but also offers pointers as to how this can be undertaken. The point was also stressed in the Wadden Academy and science shops case.
An important way to show scientific credibility is through scientific publications, as most scientists use this as a first proxy for the quality of research output. Even if this is not seem immediately interesting to a CSO partner, it will increase the cognitive authority of projects. Professional research partners in co-operative research have an interest in such publications and are most skilled at producing them.
- *Make your contribution visible*
Especially since co-operative research may not always score well on standard output indicators and because science for civil society is not self-evident to administrative or political principals, the advertisement of co-operative research benefits needs extra attention. Science shops make sure they show their contributions with exemplary stories and overviews of projects outputs to show to university management. One clear example was the project of the Groningen science shop to engage an economist in a study of benefits for the regional economy from the activities of the science shop. In the case of PGOs, such benefits have to be demonstrated to the civil society constituency through their members, such as through the need to include field observations in the databases quickly and show the link to conservation projects.
- *Stick to your civil society mission*
It may be possible to also perform as a partner in commercial research or work for public policy, who may provide rich resources, but ultimately it is the specific contribution to civil

society projects that distinguishes co-operative research from commercial contract research or academic projects. Both Wageningen and Groningen science shops have specified criteria for the kind of projects they will and will not undertake, in order to maintain their identity next to marketable contract research. The experience of the PGOs have shown how CSO research can be traded on a market, but with institutional guarantees to serve their members' projects in conservation. The experience of the science shops shows that conforming to pressures to simply generate income or to academic performance indicators ultimately undermines the legitimacy of co-operative projects. This is illustrated by the privatisation of some science shops to spin-off companies.

3.4.2 Problem of protection

Without special provisions, civil society easily becomes the weak partner in co-operative research. CSOs face a highly organised research world, with increasingly harsh competition and performance pressure. Researchers have learned strategies such as 'take the money and run', or 'use the CSO to legitimate this project'. Instrumental use of CSOs by researchers, as sources of data or tokens of societal interest was signalled during our workshop, but also Crêpe meetings. Similarly, partnership with government agencies can easily turn CSOs into instruments of policy implementation, or into a source of legitimacy to push ahead projects the CSO partner did not actually agree with (e.g. in token consultation or in the CSO audience at the end of a research project in which they had no say). This means CSO partners in co-operative research need protection from such pressures and the cases studied offer some suggestions.

- *Guarantee a share of project ownership to CSO partners*
This can entail control over resulting data, publication or copy rights, but also a share in research resources. The PGO case is the most elaborate example here, with clearly articulated ownership of data, shared ownership of some projects, and ownership of revenues generate by census data. Institutional guarantees, including legal conditions of data ownership, or organisational statutes putting member councils in charge, assure that CSOs keep some control over projects and can enforce such control in a conflict. Formal control through contracts, statutes, or ownership conditions are not necessarily enforced on each of the PGOs activities, but have been developed for use where needed, both in dealings with research partners and clients, and with the organisations.
- *Guarantee shared control over research planning*
Shared planning control guarantees that CSO partners can define problems to the needs of civil society, make sure civil society concerns are included, or deadlines are timed to decision making. The Wadden Academy case shows how the presence of CSO partners can actually taken social learning forward. The PGO case shows that CSO control may require governance structures that provide civil society members genuine control over priorities and allocations.

3.4.3 Problem of continuity

Co-operative research brings together research partners whose cooperation may run against the grain of research institutions. Partners may meet through occasional projects, but the mobilisation of research for civil society needs provides extra benefits if cooperation can continued in a more structural way, allowing partners to improve mutual understanding and to find solutions for problems in the cooperation.

- *Formalisation of relations can help continuity*
Personal contacts, shared vision and enthusiasm for civil society causes may be crucial for co-operative projects, but to really get the benefits of co-operative research, formalisation of relations can be considered. The PGOs have gone the furthest here, with well-articulated governance structures, including a market logic and cooperation in formal bureaucracies – all of which may not come naturally to civil society projects that see themselves more as a movement than as a formal organisation. The PGO structure also shows how this tension can be resolved with buffering organisations, formalised in professional national offices that function to support the membership and negotiate with strong public institutions, as long as these offices stay in close contact with and control of their constituency.
- *Co-operative research organisations should build diverse support networks*
Because the legitimacy of civil-society oriented research is never self-evident, financial and administrative support will always be volatile, as many Dutch science shops have had to learn. Networks of CSO partners can support co-operative research with public legitimacy and political support if need be. The Groningen science shop has been particularly successful if mobilising its societal partners when its future was questioned. Diversification of sources of income can guarantee continuation even if the principal has a change of vision, for example as science shops are able to use EU research grants while universities refuse to continue support.

4 Relevance to the Overall Project

The relevance of the work package for the overall project lies mostly in the observations on the processes of involving civil society concerns and organisations in research, formulated in the previous section. Nevertheless, there are some conclusion relevant to the more substantial issues in agri-environmental issues, in particular with respect to diverse accounts of nature.

On the one hand, the case studies show how civil society organisations produce accounts of a nature that is rich, local, imbued with intrinsic values, to be admired for its aesthetic values. CSOs speak for the Wadden Sea or other places of high value *in their own right*, not just as *cases* of more abstract biodiversity or a set of quantified indicators. Amateur biologists are foremost concerned with the observation of a particular rare bird, appreciated for its remarkable plumage.

Such a rich and localised experience of specific nature, perhaps best called 'romantic' for lack of a better short-hand term, seems irreconcilable with the rationalised account of nature by state and market. To cockle fishermen and gas companies, the Wadden Sea is also a resource, holding potential wealth that can be measured in monetary values and then compared to other resources – alternative fishing grounds to harvest, or competing gas fields. In public policy, measured nature acquires universal characteristics that serve to prioritise Habitat protection candidates, or assess the outcome of conservation policy alternatives. The romantic and rationalist account seem irreconcilable in their conflicting underlying values.

On the other hand, these cases also show how, on a pragmatic level, cooperation between these opposite accounts is possible, albeit with a lot of work and careful manoeuvring. These cooperative schemes challenge the idea that agreement on all fundamental values is necessary to proceed with environmental protection. The Wadden Academy can organise joint fact finding and formulate shared research concerns that can help to create a shared management plan. The amateurs cooperate with the translation of romantic nature observations into cold numbers on the pragmatic grounds that these numbers help conservation goals. 'Universalised' indicators of nature are then extended further to indicators of environmental quality, measuring the effect of climate change on biodiversity or feed into assessments of the likely distribution of escaped genetically modified rapeseed.

With respect to priority setting in research, bringing research more closely to societal needs, and informing policy debate, CSO-driven research shows a model to develop research priorities that is proactive. Rather than to wait for public initiatives, science shops and amateur biologists pushed forward with research for civil society interests – supported by public projects where available, but without them if necessary. Especially the PGOs have been able to make use of opportunities where they arose, public or private, expanding from bird atlases to atlases for other organisms, from separate databases to integrated ones, and from simple observations to protocolised censuses. Over the last ten years this expansion has taken its next logical step, with an upgrade to a European level (and with it cooperation on European-wide indicators of environmental quality or agricultural impacts, such as in the decline of farmland birds as sign of the effects of changed agricultural practices and pesticide use). These initiatives are partly responses to policy requests for data, but have also created possibilities for new policies to be articulated as data was made available to policy makers: census data and conservation policy have entered a mutually reinforcing 'dance' of co-production.

Research funding on a project level from governments, both national and European, can fuel such endeavours, but the point is that CSOs also have a responsibility of their own in setting up organisations that can express and articulate stakes in research. It is through such organisations that they can give shape to different understandings of societal problems, agri-environmental issues and sustainable development, as an alternative to the attempt to convince public institutions to champion their agenda for them.

Annex: Dutch volunteer naturalists³

Full-length description of the case as summarised in section 3.3 of the overall report.

1 Public Data-managing Organisations

'Private Data-managing Organisations' (*Particuliere Gegevensbeherende Organisaties*, PGOs) are a set of ten organisations in the Netherlands that observe and register biodiversity in the Netherlands, involving large networks of volunteer naturalists recording wildlife observations to databases. Each of the ten PGOs specialises in a specific group of organisms, such as birds, butterflies, or fungi (see in appendix for a complete list). Volunteer birders, botanists, or entomologists spend their spare time recording organisms, in most cases according to carefully designed observation protocols, based on taxonomical knowledge learned through experience in nature and from their peers. During working hours, they are accountants, welders, teachers, and occasionally professional biologists, but they spend a large part of their spare time observing nature – often while filling out (digital) forms.

The PGOs set up biodiversity monitoring networks. For example, they organise their members to cover bird migration routes and count birds systematically as they journey through the Netherlands. Counting data are gathered in databases, where observations are processed and integrated. Over the last decade, some of these data are integrated on a European level, cooperating with an increasing number of national bio-monitoring schemes, to produce indicators for biodiversity (Gregory et al., 2005), including effects of climate change on biodiversity (Gregory et al., 2009; Noirot, 2010)

The resulting data are used in public policy for nature conservation, in evaluation and development of conservation measures by managers of nature reserves, or in application procedures of town and regional planning decisions, but also for research, or public information and education. The PGOs generate income through the analysis of their data for projects from various public and private organisations involved in nature conservation. In turn, the income is used for the improvement of the data infrastructure, for nature conservation projects, or for projects by and for the volunteers, such as summer camps, courses, meetings, or atlas projects. For the larger PGOs, this involves hiring professionals who manage and process the data – in some cases involving administrative work that the volunteers find uninteresting.

Apart from providing a data stream to centralised databases, PGOs also perform specific monitoring projects, more or less depending on whether a policy actor can be interested in the data. (Sometimes they keep monitoring projects afloat purely with volunteer labour, but most projects involve project-based funding or occasionally philanthropy.) Such specific projects could involve an inventory of species in a specific area, or a project to monitor the progress of a specific set of organisms, such as invading exotic species. The PGOs also answer questions from organisations involved in conservation, which can grow into projects or paid data usage. Occasionally, they perform early warning functions, such as with explosive growth of a threatening species or the looming disappearance of a rare one.

Clearly, the PGOs are more than just data managers and the volunteers are more than data gatherers. Field observation of wildlife often requires a substantial amount of skill and knowledge; not just because some organisms are hard to find, but also because some are hard to identify. Most PGO volunteers will never feature on top of a scientific publication,⁴ but some of their data is used in research. Some of the professional staff at their national offices publish in scientific journals, especially in the PGOs that attract the most projects – usually the ones studying larger organisms that do well in nature conservation, such as the invertebrate PGO.

This taxonomic style of science is not held in very high regard anymore, not even in biology, even though it was almost identical with biology until the end of the 19th century (Kwa, 2005; Pickstone, 2000). Field biology has had to make way for experimental and molecular biology at major research institutions. However, some of the PGO research goes beyond taxonomic work. For example, some of the projects involve studying environmental impacts. The botanic PGO has been involved in counts of rapeseed and colaseed that are relevant for risk assessments of genetically modified plants. There also have been projects involving biodiversity counts as indicators of pollution effects (or recovery from pollution incidents).

³ Acknowledgements: I am very grateful to Sander Turnhout of VOFF for providing me with information and insights and even some first-hand experience of taxonomic work and to Les Levidow for extensive comments.

⁴ Although some do, as Sander Turnhout pointed out to me. One famous example was Kees Uljé, a street paviour who specialised in ink mushrooms after his work crippled him at the age of 45. He discovered several new species and became a renowned specialist, contributing to the authoritative *Flora Agaricina Neerlandica* (Uljé & Noordeloos, 1996).

In addition, PGOs have also developed activities for a wider audience. Most PGOs now publish atlases, displaying the distribution and abundance of species in the country, often illustrated and with information on the species that ranges from interesting trivia such as the etymology of species names to specialist information, such as information on habitat or ecology. The atlases followed an example from British birders in the seventies, but were copied by Dutch birders and have spread from there. Some PGOs are involved in nature education projects, mobilising volunteers for guided tours or courses, sometimes raising some income for the organisation in the process. There are also examples of nature conservation projects running through the PGOs, although these tend to run through affiliated conservation or natural history organisations.

PGOs also offer specific services to members. They organise excursions for members, from short outings to 'summer camps' abroad, even including family holidays in some cases. They provide help with taxonomic determinations, through their websites, through courses, or through special publications. They help members with the management of monitoring projects, with filling out data registration forms. Some also provide training in specialised observation skills such as diving to observe sea life, or use of specialised equipment such as microscopes, or provide materials used in observation such as bat detectors or chemicals for identification of fungi. Most also have a newsletter and ICT tools to allow members to communicate or access the data and knowledge collected.

The precise format of the PGOs varies, depending on their origins. Some started in societies of natural history, some in conservation organisations, and some grew in response to public attempts to set up monitoring schemes. They run some projects with public funding and are sometimes housed by public institutions and in the past some received systematic funding from government (which was not uncommon for civil society organisations in the Netherlands). However, they all have an independent status, clearly signalled in the term '*private* data-gathering organisations'. They are run as legally independent societies, normally structured around volunteer membership, with some form of members' council that is either the highest authority or is at least very influential.

Also because of the variety in precise organisational format, it is hard to put a precise number on the PGO membership or even the budget. Some have formal membership, some a special category of donating members, or an informal network of occasionally contributing volunteers. Rough estimates range their total membership between 15.000 and 20.000. The larger PGOs, such as the birding PGO, manage annual budgets of a few million euros. The total conglomerate of PGOs works with a budget of about 11 million Euro, employing just under 200 staff.⁵

In spite of project-based funding, partly involving public money, they can clearly be considered civil society organisations, involved in research. This raises the question whether their activities are an example of co-operative research, of what tensions and problems are involved in their activities, and what we can learn from these. This report will describe the nature of volunteer naturalist involvement, describe the development of organised volunteer natural history, resulting in the current PGO structures, and then proceed to analyse crucial issues, to conclude with an assessment from the perspective of co-operative research.

As for the other case studies, there are three key questions for this study. First, there is the question of how diverse accounts of nature/the environment are accommodated in the co-operative research of volunteer naturalist organisations. Nature means something else in the volunteer study of nature and in a bureaucratic-rationalist policy regime. We will be able to illustrate this with the development from atlases to biodiversity indicators. Second, Crêpe asks how this co-operative research relates research more closely to societal needs, with an eye on informing policy debate and research priorities in Europe. Here, the Dutch co-operative institutions suggest a number of lessons for such policy learning, related to the gradual negotiation of tensions between volunteer naturalists, policy makers, and professionals. Third, the project aims to suggest alternative solutions to agri-environmental and sustainability issues. Even though volunteer naturalists may not have ready-made alternatives for rationalist policy makers' concerns, at least they do offer a model of deep involvement with these issues that challenges the notion of the citizen as an stubborn subject who needs to be coaxed into responsibility and sustainability. I will return to these questions towards the end of the case report.

2 Volunteer naturalists

In many parts of the world, there are large communities of enthusiasts who spend their spare time studying nature. Every weekend, nature lovers roam around the countryside, looking for birds, plants, dragonflies, traces of mammals, or whatever kind of organism has caught their fancy. Like myself, they may roam around with one of the many pocket-size nature guidebooks, trying to determine the origins of droppings or the name of an eye-catching butterfly. To some, the 'study of nature' involves an experienced naturalist explaining how to recognise bird song or identify rare plants. Some may even travel across the globe to go and marvel at the spectacle of the African 'big five' or of breaching

⁵ Figures Sander Turnhout, VOFF.

whales, catered for by a specialised industry and carefully studied performances of the 'authentic nature experience' (Thompson, 2006). An avalanche of nature shows on TV fans this massive interest in nature. As a result, knowledge of nature now circulates more democratically than ever before, even though the real cognoscenti may scoff at the superficiality of this acquaintance.

Among students of nature, involvement ranges from the occasional excursion to serious life-long commitment. To the large majority of nature lovers the study of nature means the leisurely enjoyment of the outdoors, dotted with taxonomic and ethologic trivia. However, there are also naturalists who go much further. Probably the best known among these, are the committed birders who collect spots for their 'year list' or their 'life list'. Alerted through electronic networks, committed birders rush off to remote places to add a rare vagrant to their list, often spending large amounts of time and money to reach it in time. This kind of birding has a considerable competitive element to it: lists are compared and top lists are recognised records (Obmascik, 2004). Most developed in the avian world, these birders are competitive naturalists.

This report concerns a third range of activities: volunteer monitoring of wildlife and biodiversity. This involves more or less organised, protocolised registration of the occurrence of species in a geographic realm. The immediate objective of the counting practices involved is to register and map the distribution and density of species, in order to map occurrence and compare between locations and between different points in time. With such counts, it becomes possible to represent biodiversity distributions in maps or statistics. This in turn allows threatened species to be put on the agenda (e.g. in 'red lists'), monitoring of biodiversity, evaluation of nature conservation policy or management strategies, as well as for regional planning decisions geared at protecting vulnerable species' biotopes.

Both casual nature observers and competitive naturalists can be involved in these monitoring activities. Casual naturalists may report rare sightings via web sites (often with photos), or participate in popular events such as garden bird counts. For competitive birders, distribution information can assist in the identification of favourable observation locations. However, systematic wildlife monitoring requires high levels of commitment that draw in a specific group of nature enthusiasts. Counting protocols may send observers to less than favourable locations, with very little chance of seeing spectacular wildlife or adding a tick to a rare species life list.

This deep level of commitment characterises what Stebbins has called *serious leisure*, where "the pursuit of an amateur, hobbyist, or volunteer core activity that people find so substantial, interesting, and fulfilling that, in the typical case, they launch themselves on a (leisure) career centered on acquiring and expressing a combination of its special skills, knowledge, and experience" (Stebbins, 2007, p. 5). In addition to the level of commitment, the notion of career and advancing knowledge are central to serious leisure. The key distinction with professionals is not their acquired knowledge or expertise, but rather the fact that professionals are paid. Rather than using the term 'amateur' for these seriously committed naturalists, which has the connotation of superficiality or dilettantism in *amateurism*, I therefore refer to them as volunteers, offering their spare time to an activity that is both enjoyable as leisure, but at the same time 'serious'.

3 Institutionalisation of volunteer natural history

The study of nature as a serious leisure activity has a very long tradition. In fact, it predates profession field biology by far, for example in gentleman-scientists of the 17th century, with notable Dutch men of independent means such as microscopists Antonie van Leeuwenhoek or Jan Swammerdam. Whereas the British Victorian 'amateur naturalists' are well documented, the Netherlands too had a rich world of nature enthusiasm by the end of the 19th century. This involved organised walks, collecting (often with birds at gunpoint), and soon also specialised field guides (Dresen, 2008; Van der Windt, 1995b).

Whereas in the 19th century nature observation was set in a nostalgic and romantic notion of irretrievable loss in the face of modernisation, the dawn of the 20th century signalled a growing awareness among Dutch naturalists that some nature should be actively protected. The 'first deed' (as it was called with a sense of drama) was a private initiative to raise money to acquire the Naardermeer, a wetland area between Amsterdam and Utrecht where a poldering project had failed and that the city of Amsterdam was planning to use as a public refuse dump. For these purposes, a non-profit foundation was set up, the Society for the Conservation of Natural Monuments in The Netherlands, 'Nature Monuments' (*Natuurmonumenten*) for short. To this day, it remains one of the key owners/managers of valuable nature in the Netherlands (Dresen, 2008). The leading figures in the movement to conserve by acquisition, Jac. P. Thijsse and Eli Heimans, were also involved in founding the Royal Dutch Society for Natural History a few years later (*Koninklijke Nederlandse Natuurhistorische Vereniging*), which continues to organise field biology study, education, and conservation activities through its 52 branches all over the country (Koninklijke Nederlandse Natuurhistorische Vereniging, 2010; Lawrence & Turnhout, 2010).

The story is important, not only because it is a canonical foundation story among Dutch conservationists, but also because it established seminal patterns for Dutch nature conservation. First, it involves nature enthusiasts who combine study and protection. The Naardermeer soon became a favourite nature recreation destination for an urbanising middle class, attractive or its exceptional bird populations (Van Zanden & Versteegen, 1993).

Second, from its romantic 19th century roots, the Dutch naturalist community involved both 'amateurs' and professional biologists. It was the beginning of a long history of cooperation and at times also conflict between professional, academic biologists and volunteer conservationists, with tensions often unexpected. For example, when the Bird Protection Act of 1910 made hunting song birds illegal to protect them from gastronomic enthusiasts, professional field biologists protested vehemently, as this made it impossible for them to shoot specimens for their valued collections (Van Zanden & Versteegen, 1993).

Third, *Natuurmonumenten* set the example for private initiative by acquisition. To the extent that nature had been protected, it had been protected for its economic value, mostly involving forests, managed by the state through *Staatsbosbeheer*, the public forest management service, founded in 1899 to start reforestation. However, *Staatsbosbeheer* gradually acquired tasks in nature conservation and recreation also and developed close cooperation with private conservation organisations, since 1998 from the position of a non-departmental public body (Staatsbosbeheer, 2009). Combined with a fundamental principle to Dutch society of cooperation between the state and civil society – often to the level where the distinction becomes blurred – such cooperation created a complex institutional landscape in which the battle for nature conservation is played out. During the 1980s, the Dutch government even started to support environmental and conservation CSOs financially, to help support environmental protection policies.

Specifically in the area of counting and monitoring biodiversity, this involved funding for a variety of conservation and natural history organisations. Part of government departments' interest was not just to organise its own environmental constituency, but also of naturalist organisations responding to requests for information for nature conservation policy. In return for providing conservation and planning policies with biodiversity data, government provided financial support for the CSOs, first structural, but by the end of the 20th century increasingly on a project basis. This allowed some of the PGOs to hire professional staff to manage and process collected data and generally increase the quality of monitoring (Lawrence & Turnhout, 2010).

However, it is important to note that, in spite of the blurry boundary between state and society, private initiative involving ownership and independent control, was set up as one strong pole in this relation. When needed, the independence of civil society could be mobilised against public initiatives – and within the fragmented structure of national government even between different administrations. In spite of frequent cooperation and shared decision making, private ownership and the principled independence of civil society could be effective forces to challenge public initiatives.

Throughout the 1990s, the request for more data integration for policy purposes kept growing. European initiatives, such as the Habitat Directive or Natura 2000, require governments to identify priority areas for nature conservation and one of the means Dutch policy makers intended to support such decisions was through extensive assessments of existing biodiversity. In response to such requests for integrated biodiversity databases the Foundation for Research into Fauna and Fauna (*Stichting VeldOnderzoek Flora and Fauna*, VOFF) was set up in 1996 to provide government with an access point to the PGOs and negotiate access to all their data, but with the specific intention to keep the PGOs in control. VOFF is now structured as a small umbrella organisation of the ten volunteer data organisations, housed on the campus of Nijmegen University in 'Nature Plaza', a building with several PGOs and related organisations. VOFF is administratively managed by one of the bigger ones, RAVON (reptiles, amphibians and fish). It currently holds about 80% of digital nature data in the country (Stichting VeldOnderzoek Flora en Fauna, 2010).

In order to accommodate also public data, gathered outside of the PGOs through public research or public monitoring, VOFF has cooperated with the government department responsible for nature conservation to provide access to biodiversity data through one electronic teller, the *Natuurloket* ('Nature Teller'), since 2000-2001. In order to integrate data further, VOFF works with the University of Amsterdam on the construction of a comprehensive database for wildlife in the Netherlands, the National Database Fauna and Flora since 2004. Meanwhile, government has created the National Authority for Data concerning Nature (*Gegevensautoriteit Natuur*) in 2007, effectively creating the public partner for VOFF in the management of the national database and its *Nature Teller* access point.

Meanwhile, some of the PGOs also looked to Europe, where a combined process of policy demand and activism supported the further integration of data. In 2002, European birding organisations decide to develop biodiversity indicators, after their successful cooperation on a EU-wide bird atlas (Hagemeyer & Blair, 1997). Their cooperation in the European Bird Census Council is housed by the Dutch birding PGO. With the help of the Dutch Statistics agency, these European ornithologists and

volunteer organisations developed the Pan-European Common Bird Monitoring Scheme, with the intention to produce reliable indicators of European biodiversity (Gregory et al., 2005; Gregory et al., 2009). This followed a model of bird census data used in biodiversity policy in the UK, where bird indexes have even been used to formulate conservation policy objectives, and has found applications in other countries, e.g. Denmark (Fox, 2004). The European integration of data allowed conservation organisations to show the degradation of birdlife in Europe, while also allowing for policy applications, for example in the assessment of EU conservation policies. Hence the project is now supported financially by both conservationist organisations such as the Royal Society for the Protection of Birds and the European Commission (Noirot, 2010).

The institutionalisation of volunteer naturalist studies shows a long history of existing next to professional field biology. In the sense of the 'gentlemen scientists' and the large amateur nature study movement of the 19th century, it predates some of the professional field biology, while the professionals have also inspired and assisted a renewed vigour over the last decades. What this overview also shows is a deep-rooted connection between the study of wildlife and a concern for its protection. Conservationist civil society organisations have supported wildlife census schemes and conservation has been an important motivation for volunteer counters in the field. In comparison, the exploration of using census information for public conservation policy is relatively new. In the Netherlands, structural cooperation only started in the 1990s, with a few earlier exceptions.

This relation between volunteers, professionals and policy makers and between their civil society, research, and policy organisations is complex and holds several tensions that participants have tried to resolve. Some of these arise from the specific institutionalisation pattern of Dutch nature conservation, some are more generic tensions in the cooperation between volunteers and professionals, some arise from the tension between volunteer enthusiasm for nature and a model of nature conservation that is increasingly rational-bureaucratic.

4 Tensions

4.1 Negotiating conditional ownership

PGOs sell their data, or more precisely: charge fees for access to their data to governments, nature reserve managers, or building companies looking for data to be used in permit applications.⁶ This has effectively commodified the volunteers' knowledge of nature. However, access and ownership of these data is conditional and complex. The basic principle for PGOs is that the observer is the owner of the data. This means that the observer can also withdraw data, or even modify data, for example as a result of taxonomic renegotiations.

This basic principle follows the general development route of the databases, starting bottom-up with data integration as a service to the volunteers. This is how PGO volunteers were able to manage and integrate the data fit for their own purposes, including the re-contextualisation of observation in the form of atlases (Maes & Van Dyck, 1999; SOVON Vogelonderzoek Nederland, 2002).

However, this distributed ownership of data creates problems once the data are traded as an integrated set and used in comparisons or composite indicators. For example, statistic procedures and mapping software are used to interpolate birding spots: gaps between observations are filled to create geographic maps of *likely* abundance of species (SOVON Vogelonderzoek Nederland, 2009). Individuals correcting or withdrawing their data could lead to different assessments or alter the knowledge base in delicate public decisions. This did not seem to be a major problem when separate PGOs sold access to their data, but the issue became more prominent with data integration in the umbrella VOFF and in preparation of the national database.

The solution that was worked out over the last years, was that data would be owned by its producer, but that verification and integration of data is also production, meaning that the administrators of the databases gain control as soon as they start to process data. From that point on the volunteers still have ownership: they can still decide what to do with the data, how to capitalise on them, and how to spend income, but they do so as a collective. Thus PGOs have had to negotiate the tension between a logic of observations owned by individuals (as copyright), but shared in a community, to a logic of databases owned by organisations that can trade these data with public and commercial organisations.

⁶ These typically show up in activity reports of PGOs as data requests from consultants, e.g. preparing environmental effect reports for application procedures. In 2009, 82 of 106 requests for data from the birding PGO fell in this category (SOVON Vogelonderzoek Nederland, 2009).

4.2 Contextual and standardised account of nature

Several researchers have documented the tension between the rational/bureaucratic account of nature and the experience of volunteer naturalists (Ellis & Waterton, 2004; Hinchliffe, 2008; Lawrence & Turnhout, 2010). The point is not that the volunteer naturalist's account of nature is somehow unmediated. Birders also make take home a bird as 'a spot', a tick on a list possibly documented with a picture. In order to be relevant to the state-rationalised view, an observation must be stripped of some of its local context, be categorized in a taxonomic system that is relatively stable, in order to make nature comparable between places and over time. This is the precondition to be able to make a rationalistic assessment of which nature is more rich or deserving of protection and which conservation measures are most effective. Nature conservation is brought under the same 'results-based' or 'evidence-based' regime of efficiency as other policy fields. As nature conservation internationalises, this means data on nature have to be further transformed to remove idiosyncrasies of the local to be recontextualised in the tabulations of the trans-local.

To the naturalist, there are several issues at stake. The representation of nature may no longer fit to the preferred account of a unique place with a unique community of wildlife, with organisms that hybridise and vary, occasionally defying the deceptively neat boxes of official taxonomy. If the account was an inconsequential story about nature, then the naturalist could merely scoff and the 'misunderstanding' of the rationalistic version and move on. However, such accounts are consequential and may lead to planning decisions or management measures that actually alter the naturalist's prized nature.

In *Seeing Like a State*, Scott describes some more radical consequences for early modern 'scientific forestry'. What begins with an attempt to identify and count trees in forest in order to assess how to produce more timber and fire wood, gradually develops in forests planted so they can be counted and managed more easily, producing mono-culture production forests with ultimately unstable ecologies. Not coincidentally, the main parameters to be counted were the two forest products relevant to the state: tradable timber and taxable firewood (Scott, 1998). Although the example is extreme, for naturalists with a stake in nature conservation there is a similar danger of nature rationalised in terms valued to the state.

Although there is some tension between the more immediate experience of fauna and flora in the wild context and the data in the database, the PGOs seem to have accommodated these tensions. They have done so partly by creating organisational buffers between the volunteers and the users, such as through regional project managers, professional offices, VOFF, and now also the National Data Authority. More importantly, the PGOs pay attention to the motivation of volunteers and make sure their concerns are met, keeping volunteers motivated.

4.3 Motivation and the cause of conservation

Volunteers may count biodiversity without pay, but their activities are rewarded in other ways. There is the intrinsic reward of being in nature, observing and learning about the nature you are interested in. Some PGOs organise excursions, including to places that are hard to access or even normally inaccessible to the public. (This could include a chance to add a species to a year or life spotting lists, although really competitive spotting requires competitors to follow their own course, travelling to opportunities at the most rare spots.) Some PGOs even combine these excursions with summer holidays, accommodating members' families.

In order to have data that provide coverage of the country and its different ecological zones, volunteers have to put aside some of the rewards normally involved in field excursions. For example, an excursion to a unique pond that harbours rare amphibian may have to be replaced to an uninteresting pond that in all likelihood harbours no interesting species at all, just because a monitoring projects requires it be covered. Similarly, the one-hour 'turbo-bird count' for monitoring projects does not correspond to how most birders would normally enjoy nature.

The PGO structures provide other rewards to their volunteers. Integration of observations into databases adds to the sense of 'doing something useful'. 'Turbo-birding' is used for the production of the atlas of breeding birds, a beautifully illustrated and pricy book that received a lot of attention from the press, one of many books published by the birding PGO (SOVON Vogelonderzoek Nederland, 2003, 2009). In addition, many of the usages of these data are sympathetic to the volunteers. They may be used to assist managers of nature reserves, for example to assess the effects of measures such as mowing or grazing on biodiversity or the protection of rare species. They may also be used to identify areas with rare species that require priority protection, or make visible the presence rare or protected species to development projects. In order to keep these motivations going, PGOs have to invest in showing effects of contributions from volunteers. Data entries have to be made visible quickly, even if they require further verification and the connection between observation effort and use has to be made explicit.

However, this also has a potential downside: these same data may be used to argue against protection, perhaps of a patch of nature close to the volunteers involved. Especially in the Dutch PGO construction, where access to data can be bought by any interested party, including real estate developers and building companies, this may effectively mean that volunteer observers are undermining the protection of some nature. This has been a major source of problems for the willingness of UK volunteer naturalists to cooperate with data mining (Ellis & Waterton, 2004). However, the Dutch PGOs have decided that making their data available is better than the unexpected effects of zoning decisions based on inferior data and that this is a better guarantee for the defence of what they consider really valuable nature.

This conviction is reinforced by one last mechanism that motivates volunteers: control over the revenue from the data. Through paid access to data and contracted monitoring projects for specific purposes, PGOs generate income. Part of this income covers professional staff to assist with data registration and database management, but the money is also used in nature conservation projects, acquiring or managing nature that is considered valuable by the volunteers. This provides extra motivation by 'doing something good for nature', not just by relying on trust in improved rationality of public zoning decisions, but also by such independent initiatives.

4.4 Establishing cognitive authority

The authority of volunteer biodiversity data is not self-evident. It has to be established, argued and proven. Because the data are gathered by people not necessarily formally trained as field biologists and because the skill levels vary, the data of volunteers are not always recognised. For policy makers, this means they cannot rely on the cultural authority implied in science, including its underlying certification processes of peer review or stabilised methodologies. Scientists face colleagues who mistrust volunteer data as a source for field research and even for the management of nature reserves their reliability is not self-evident.

Two examples from countries not far from the Netherlands can serve to illustrate this. Denmark has a political system and culture quite similar to the Netherlands, but in spite of its similar coalition government system with a consent-oriented negotiation culture, its volunteer naturalist organisations have not convinced policy makers of the value of their data. Danish nature conservation policy maintains that professional bio-monitoring should form the basis of policy, but also lacks the resources to monitor as extensively as would be possible with an extensive volunteer network (Halffman, 2008).

In Flanders, the Northern region of Belgium, the data from the volunteer networks are considered trustworthy enough to be 'considered' in policy making. Data may be used in zoning and regional planning decisions, or form input for conservation measures, but the data are used as a back-up, 'when better data are lacking', at least according to some civil servants involved. Biodiversity distribution maps and atlases, the crowning product of years of volunteer counting, are available and known, but only feed into policies very laterally. (Halffman, 2008).

In comparison, the status of volunteer biodiversity in Dutch policy making is much higher. There is structural cooperation with public policy, systematic use of data in the public and private management of nature conservation areas, and use in zoning and permit applications for building projects. The difference is all the more remarkable since some of the volunteer organisations stretch across the border, especially where more specialised areas of study are involved. With small groups of enthusiasts and similar ecological systems, a few communities share magazines, meet on joint field trips and share knowledge.

So how have the PGOs managed to achieve this cognitive authority? There are a number of strategies that have been followed. First, the PGOs have carefully accumulated data of field observation, in some cases going as far back as the mid-nineteenth century and covering a wide variety of taxa. This means that no other organisation in the Netherlands has data on abundance and distribution of wildlife that even come close to what the PGOs have. The PGOs will insist on this in their public presentation, quoting number of records or range of coverage. By integrating these data in VOFF; they have been able to further establish and stress that there is no real competition. VOFF can now proudly claim to cover 80% of all data on distribution and abundance in the country. In practice, this means that it becomes hard for other sources of knowledge to challenge the volunteer networks. For example, in recent years, hunters have tried to challenge data on the abundance of wildlife, with an eye on culling programmes, but have failed to dislodge the PGO data. The PGOs simply have better coverage.

Second, PGOs have transformed part of the random, disorganised observations through protocolisation and standardisation into more systematic registrations, increasingly also through ICT and internet applications. For example, all PGOs have developed standard forms on which observations should be noted. These forms require field observers to not only note what species has been observed where and when, but also a range of parameters qualifying the observation. The precise nature of these parameters varies depending on the kind of organisms observed, but they may include the instruments used to observe or weather conditions. Such standardised registration not only makes it easier to add and compare data, but also to assess their reliability.

Third, the PGOs have cooperated with professional statisticians to improve counts and make statistically meaningful extrapolations from these counts. A break-through was the cooperation between the birding PGO and the Dutch national statistics agency, Statistics Netherlands, which began in 1990. Together, they formed a nation-wide network for ecological monitoring. The cooperation with the statistics agency brokered a path to policy application, which provided the data with a utility that in turn further motivated the volunteers; and provided resources for further development of this project, including training and co-ordination of volunteers.

Another example of standardised observation is that PGOs will organise observation projects, asking their volunteers to observe at set times. One method developed by birders is to register all birds for one hour, jokingly called turbo-birding by the field observers. Another is to ask field observers to register on specific times or places, in order to provide good coverage or avoid double counts, such as with waterfowl (SOVON Vogelonderzoek Nederland, 2002).

One last, but crucial, aspect of standardisation involves taxonomy. Through processes such as cross-breeding, whether natural or through cultivation, but also through new understanding of how species relate, taxonomies are not always as stable as one may expect. Even nomenclature is occasionally disputed. For example, feral pigeons have presented a problem for bird counts. The 2002 atlas of Dutch breeding birds insists that birders should make a difference between populations of feral pigeons that live in cities have are subject to natural selection, and postal or competition pigeons that have escaped from their owners. The atlas instructs observers on how to make this difference and on the correct nomenclature (SOVON Vogelonderzoek Nederland, 2002). These standardisations are intended to remove chance observations or variability due to the observer, while providing data that can be integrated into one database (a process with its own complications for the position of volunteer naturalists).

Not all observation falls under one and the same standardisation regime. In some PGOs, there are separate procedures to allow for chance observations of exceptional species. In addition, there are separate channels for non-organised field observers to report observations, such as through websites. Although the structure of volunteer knowledge communities often presents a gliding scale from occasional participants to deeply involved volunteers, this separation of occasional observations from the observations by the more initiate PGO members creates a buffer. This separates not only standardised from non-standardised observations, but also allows PGOs to raise the credibility of these data by pointing at the high level of knowledge and commitment of its producers. Even though membership of PGOs comes in different shades (member, active member, supporting member,...) and even varies between the PGOs, this effectively creates distinctions between occasional volunteers and 'professional amateurs', as Leadbeater has called them (Leadbeater & Miller, 2004). This separation of pro-am from occasional observations and observers is the third process by which cognitive authority is increased. PGOs offer formal or informal learning of observation skills, which allow members to grow along a career from being an uninitiated to experienced observer.

Fourth, once data are submitted to the databases, entry systems now have automated checks. For example, an observation of a butterfly species in an unlikely territory or unlikely time of year may raise a warning indicating to the operator that there may be a problem with this observation. Database managers will then typically resort to other sources of cognitive authority to check this entry, such as photographs, confirmation by experienced observers, or simply telephone contact with the observer to assess the likelihood of the observation.

Fifth, several of the PGOs employ professional field biologists, typically at their head office. They typically assist with data input and assessment, but also with standardisation and validation of observations, setting up or assisting with volunteer monitoring projects, or performing projects commissioned by government or conservation organisations (often in close cooperation with regional volunteer co-ordinators). Formally, these professionals are hired by these PGOs, mostly membership societies, in service of volunteer nature observation, but logic of project-based, client-oriented work has given rise to some parallel administrative structures in which the professionals are not necessarily directly answerable to an assembly of members. Some PGOs, such as the birding one, also involve scientists in advisory functions such as an advisory board, in order to improve the scientific quality of the data gathering.

Last, the cooperation of PGOs with professional researchers in joint projects improve data quality and data processing. For example, the birding PGO has cooperated with the national statistics agency and universities to improve protocols for monitoring projects and for the calculation of indicators and trends (SOVON Vogelonderzoek Nederland, 2003) and now cooperates with academic researchers to model bird flock hazards to air traffic. Research in direct cooperation with academic researchers also increases cognitive authority because it leads to academic publications.

Standardisation and verification practices, combined with a large accumulation of observation data and a gradual professionalisation of the PGOs are some of the key processes that have help the PGOs to acquire cognitive authority. This has created opportunities to mobilise these data for

conservation research, policy and management, but has also created some difficult tensions that these organisations have had to articulate. One of these is the issue of data ownership.

5 Volunteer naturalists as co-operative research

The Stirling report describes co-operative research as “a form of research

process, which involves both researchers and non-researchers in close co-operative engagement [which] requires constant attention to ‘transdisciplinary’ engagement with stakeholders and public constituencies in order to explore the driving aims and purposes, the alternative orientations, and the wider social and environmental implications of research and innovation” (Stirling, 2006, p. 32). A key distinction from other similar terms, such as collaborative research, is that the cooperation occurs not merely between disciplines or experts, but involves citizens. In the case of the PGOs volunteer naturalists, a community in which a university diploma is no guarantee for expert status, this trans-disciplinary character is clearly guaranteed and there is little doubt that what the PGOs do qualifies as research, even though some of this research is of low on the current academic status ladder, i.e. of a taxonomic nature (Pickstone, 2000).

In addition, the Stirling report suggests that co-operative research requires both this participation in research, but also engagement in the governance of this research. Here too PGOs clearly qualify: volunteer members of PGOs are organised into assemblies that in most cases form the highest authority in the organisations. In spite of the prominence of professional staff, preparing procedures for data gathering and processing, the members are formally in charge and in many cases deeply involved in the governance of their research process – at least within the PGOs.

Along the edges of the PGOs, where they engage in research projects with academics and government agencies, or where data is used in public decision making, the direct influence of members is lower, competing with the logic of public office and the research world. For example, PGOs have no significant influence on how ecological research funds are allocated, or on how public money for nature conservation research is spent, although some of the people involved in the PGOs have functions in research policy. As such, the Dutch PGOs do not feature in a co-operative research *policy*.

The citizen participation in research found here is extensive – the VOFF secretary Sander Turnhout hence calls it *citizen science*, following Alan Irwin (Irwin, 1995). This is clearly also CSO involvement in research, in co-operation with professionals, either working for the CSOs or in public or academic positions. There is also a lot of social learning in and around these organisations: volunteers learning skills from each other, volunteers learning from professionals and vice-versa, policy makers learning from the PGOs, or professionals learning about policy needs.

However, what is perhaps most striking about the PGO example is its level of formalisation and bureaucratic rationalisation. Data gathering is highly organised, follows projects with standardised observation, forms for data reporting, protocols for selection of observation locations, etc. This requires some level of hierarchical organisation, where local branches agree to cooperate with a national monitoring project. Members have a say in the way projects are defined and organised, and in the format of the protocolisation, but ultimately have to agree to subject themselves to the organisation’s regime.

The Stirling report already signals that not all co-operative research need to conform to the most idealised, egalitarian, direct democracy upper rungs of Arnstein’s ladder of political participation (Arnstein, 1969; Stirling, 2006). The participation involved in these schemes of co-operative research also does not conform to ideals of egalitarian community, with all actors bringing knowledge to an open deliberation on public issues. In stead, we find complex organisations, with shifting governance structures, partly involving commodified knowledge traded in financial terms, regulated by contracts and statutes. In this case, it is these very structures that allow for co-operation between such varied (and normally opposing) interests such as real estate developers and nature conservationists – indirectly, at a distance, mediated by organisations and governance schemes, but accommodating learning and collective decisions based on that learning nevertheless.

In conclusion, we can compare Dutch volunteer naturalists’ organisations to the key features of co-operative research as described in the Stirling report:

- i. “The process of co-operative research is as important as the outcomes. It is through the experience of co-operation – or of seeing authentic co-operation on the part of others – that contending social interests come to develop greater confidence in the governance of the research process as a whole.” (Stirling, 2006, p. 33)

The PGOs have clearly learned from the process of cooperation with professional researchers, policy makers and conservation organisations and this has indeed resulted in more confidence, but it should be noted that this has taken the form of institutional trust, through a complex set of trust-mediating organisations, including processes that guarantee cognitive authority.

- ii. “The ‘framing’ of co-operative research is autonomous. This extends more restrictive notions of the autonomy of the professional science community alone, to include communities of interested and affected social actors. It recognises the important lesson discussed earlier, to the effect that public engagement in science is not just about participation within a pre-ordained structure, but also implies the freedom to re-structure the framing and focus of deliberation (...). As such, the extended autonomy of co-operative research allows an ‘opening up’ of processes of science and innovation to reveal (and allow exploration of) a wider range of social purposes, conditionalities and implications.” (Stirling, 2006, p. 33)

We see this process of framing and re-framing in the articulation of research and monitoring projects in response to public policy or research requests, but here too it should be noted that this co-ordination of framing is highly mediated by organisations. In addition, there remain important disjunctures in framing (e.g. between localised nature and abstract nature indicators), that nevertheless do not preclude learning: learning (at least in the sense of exchange of knowledge that is mutually considered authoritative) apparently does not require complete agreement on framing – not even in co-operative research.

The ‘wider range of social purposes’ are not so clear in this case. An important motivation to cooperate on biomonitoring has been to assist well-reasoned nature conservation, adding insights on a wider variety of species and environmental effects, but then nature conservation is not only based on collective reasoning focused on increased environmental protection, as governments may choose to simply lower priorities in that area.

- iii. “Co-operative research embodies at its core an intrinsically symmetrical understanding of the relationship between different bodies of knowledge. Although knowledges may differ in their salience from case to case and issue to issue, co-operative research avoids generalised or systematic assignments of privilege to one form of knowledge over another.” (Stirling, 2006, p. 33)

The different knowledges involved in the PGOs does have some ‘intrinsic symmetry’, but it should be noted that it has equally important asymmetries. On the data gathering side, the volunteers are clearly more prominent, while of the side of data processing and indicator development, we find more professionals. Also, the relations in the monitoring networks are in some respect hierarchical: at some point, observers have to accept the rules of protocols and standardisation in order to participate. Nevertheless, there are important checks to these hierarchical structures, such as through member assemblies, and the spirit of PGOs is very much one of celebration of field biology knowledge that is much less appreciated in mainstream biology. Nevertheless, I would prefer to characterise this as an example of a matured knowledge democracy, rather than merely knowledge symmetry.

- iv. “Co-operative research integrates and addresses equally, processes of design, implementation and dissemination. As a consequence of this, co-operative research displays an important benefit in relation to more fragmented approaches, in that it provides inherently for the more effective transfer of productive knowledge and outcomes between different social communities. In this way, it helps address the often prohibitive challenge of moving from scientific or social research to technological or organisational innovation.” (Stirling, 2006, p. 33)

The PGOs clearly have learned how to accommodate conservation policy needs and how to disseminate (or perhaps better ‘valorise’) their knowledge. There is a lot of direct personal contact involved, but at the same time this has also required organisations with a complex division of labour, for example with the creation of VOFF and the Data Authority in order to mediate between the PGOs and policy makers.

- v. “Accordingly, co-operative research includes a wide variety of specific approaches to inclusive engagement at different levels in science governance. These extend across the full range of procedures discussed at this workshop (such as consensus conferences, participatory modelling, science shops, citizen’s panels, stakeholder commissions, transdisciplinary teamwork, focus groups and deliberative committees and polls). The key point here is one of flexibility in configuring the process to the purpose of autonomously-defined ‘useful outputs’.” (Stirling, 2006, p. 33)

Perhaps volunteer naturalist networks could be added to the examples mentioned.

- vi. “Co-operative research highlights and clarifies the essential role of science. As part of this more pluralistic process, the role of natural science itself moves from being the single most highly valued output (as a particular body of knowledge) towards recognition as a crucial process. Rather than being invoked prescriptively as a source of definitive ‘sound scientific’ prescriptions for policy, science is recognised as the set of disciplines through which to ensure rigour, transparency and general responsibility in communicating and

substantiating what will inevitably remain multiple, contending and uncertain knowledge claims.” (Stirling, 2006, p. 33)

This is more problematic for the PGOs, as the general spirit remains one of finding out the one and precise state of nature.

- vii. “Co-operative research embodies a richer and more positive understanding of the role of social science. Rather than serving as a ‘bolt on’ activity to examine implications, assess reactions or ensure compliance or acceptance after research has taken place, social science fulfils a more integrated and formative role in co-operative research (...). Recognising the distinction between ‘expertise of’, and ‘expertise on’, social actors, social science also moves – like natural science – from being primarily addressed as a substantive repository of knowledge, towards being engaged as a source of expertise and experience on the kinds of processes through which diverse social knowledges can be elicited and integrated into science governance.” (Stirling, 2006, p. 33)

This aspect too is not well represented in the PGOs, as they are clearly lodged in field biology, involve no social science, and in many respects seem comfortable to function as a ‘repository of knowledge’.

In sum, while PGOs may not be the perfect example of co-operative research (see vi and vii on the Stirling list), they clearly do qualify under the overall criteria of CSOs co-operating in research. Looking back at an experience of decades, resulting in refined observation practices and a complex organisational structure, their experience is both hopeful and sobering. Hopeful, because they show how co-operative research is possible and can be sustained over large projects, with many people, and over extended periods of time. Sobering, because such endeavours may not always correspond to egalitarian assumptions and expectations about unmediated communities of social actors meeting face-to-face to learn from each other open-mindedly.

6 Wider implications

6.1 Cooperation and the standardisation of nature

Returning to the key questions for the overall project, there are some interesting lessons to be learned from the case of Dutch PGOs. First, with respect to the occurrence of different accounts of nature, the cooperation between volunteer naturalist CSOs, professional researchers and policy makers shows different accounts, but more importantly also a route to cooperation.

The volunteer naturalist experience of nature is one that is local and imbued with emotion and passion. In contrast, the account of nature in biodiversity indicators is abstracted, trans-local, and presented as rational and dispassionate (Lawrence & Turnhout, 2010). For the naturalist in the field, the ongoing concern is for *this* location, *this* observation of a wondrous organism, in the unique setting of *this* favoured spot of nature. Even though part of the game is to recognise an organism and call it by its name by putting it in an abstract taxonomy, sharing a lifeless category with many other organisms, the naturalists’ experience and account then proceeds to stress the uniqueness of the organism – its unusually bright flower, remarkably large size, or awkward malformation. This can be observed in written accounts by and of naturalists, it has been studied at length with naturalists in the field (Ellis & Waterton, 2004; Schulte Fischechick, 1995), and probably finds its most grotesque form in the anthropomorphic accounts of the nature documentary on TV.

This does not mean that the enjoyment of nature produces no abstract accounts – on the contrary. The popularity of nature observation is intimately linked (presently and historically) to the production of field guides, for use by the naturalist in the field, in order to find, recognise, and name an organism, pointing out what is notable or remarkable. The field guide provides an icon of a bird or organism, even with exaggerated features, therefore highly abstract (Law & Lynch, 1988; Lynch & Law, 1998). However, these abstract accounts are produced with the specific aim to increase the localised enjoyment of nature, in the field, in its specificity. Another example are the beautifully illustrated books about nature in the naturalist tradition, going back to classics such as John J. Audubon’s *Birds of America* (Audubon, 1827-1838), but even to bird atlases.

In contrast, the bird counts of a bird census are a process that removes the peculiarities of the specific bird, in order to produce a tabulated number. It is this number that makes nature comparable; first on a local scale, with inventories of species in a nature reserve to compare over time. Next, on a national scale, where the value of a nature reserve on one side of the country is made comparable to a nature reserve on the other side, in order to prioritise nature conservation goals at maximum efficiency. Eventually, nature is made comparable internationally, e.g. across Europe (Waterton, 2002), through data integration and composite indicators, in order to map the progress of biodiversity loss, climate change, or policy impacts.

Our analysis has stressed less the existence of this localised and passionate experience in contrast to the rationalised account of public policy, but the fact that it can be (and is) translated into the

dispassionate rationalised account of nature in public policy. Observations are standardised, forms are filled out, and at least some birders are willing to spend part of their field experience in a way that does not come natural, turbo-birding, or going to uninteresting locations to count uninteresting organisms. What is remarkable is not the fact that accounts of nature are different, but that they actually managed to cooperate (Star & Griesemer, 1989).

This cooperation could be construed as the product of volunteers being subject to the rationalising force of the state, but it is also a conscious acceptance by naturalists of abstracted counts as an instrument to further the conservation of nature. In fact, it is the expectation that data are used to protect nature that keeps volunteers motivated and engaged (although there are concerns of recreation and enjoying nature that have to be balanced). The birding atlases that started in the 1970s are a nice example of the duality of this project: on the one hand, atlases have the ambition to provide detailed distribution data for use in conservation policy, but at the same time they are *beautiful*, illustrated and full of peculiarities concerning specific birds species and specific places (e.g. Maes & Van Dyck, 1999; SOVON Vogelonderzoek Nederland, 2002).

In the Dutch case, this rationalisation has proceeded even further in the construction of the fairly complicated institutional structures that trade data and mostly data analysis with conservation policy actors. This accommodation of two nature accounts is fragile and has required long-term negotiation of conditions such as data ownership, the construction and governance of intermediate organisations and their governance, or the building of cognitive status. The Dutch example shows that, at least in the setting of its peculiar institutions, this is possible.⁷

6.2 Relating research to societal needs and (research) policy

The case of Dutch volunteer nature study organisations shows one model of cooperation between professional scientists, civil societies and policy makers. It is a model that has come about through two decades of negotiation and articulation and that no doubt will go through further modifications. The key features of the current institutional solution are:

- Specification of the conditions of data and observation ownership: volunteers remain in control of their observations (e.g. with a right to correct) until further operations on these data put the PGOs in control, who can then trade data and data analysis, in return for resources that flow back to conservation and the volunteer study of nature.
- Standardised observation, modifying nature observation in return for use of observations in the construction of data and indicators useful for nature conservation and conservation policy, but also nature education.
- Cooperation with professional researchers, including statisticians at government agencies and academic biologists, in order to process data and increase quality.
- The construction of specialised organisations that buffer and negotiate concerns of policy, research, and naturalists, with volunteers largely in control of their data collecting organisations.

This close cooperation is less a forum where societal needs (in this case citizens' concern for nature) can be articulated. Rather, it is the shared concern for nature conservation that has created these institutions, starting with atlases and developing into integrated databases and compound indicators. Fuelled by project-based public funds and support from conservation organisations, nature study organisations have managed to create institutions that generate knowledge of nature that supports the concern for conservation that would otherwise not be affordable.

As for research priorities in this system, it should be noted that these are de facto negotiated between the volunteer organisations and their clients. Monitoring projects are more easily constructed with public funding, but then often require cooperation of the volunteers who have to find them meaningful (especially when extra observation is required). Inversely, volunteer organisations may proceed with monitoring projects on a more modest scale because of their own concerns.

6.3 PGOs: solutions to sustainability issues

The Dutch PGO model does not offer radical, alternative solutions for nature conservation or sustainability in general. In fact, one could even argue that 'romantic' nature has accommodated a rationalised management model: it is 'reformist' rather than 'radical'. (This is precisely why in some other countries – and even some quarters of Dutch conservationists – there is refusal to cooperate on counts that are used to protect priority nature, but also to legitimate giving up non-priority nature to real estate development.)

⁷ But see more conflict in the UK (Ellis & Waterton, 2004; Lawrence & Turnhout, 2010)

However, the volunteer naturalists do challenge the discourse of the citizen as a stubborn subject that needs to be coaxed into caring for the environment. Dutch PGOs and their tens of thousands of volunteers are part of a much wider network of conservation organisations, their members⁸, and their education and information projects. Although policy makers may be tempted to see them as a conduit for conservation policy, they are just as much an articulation of such concerns. Through their extension networks citizens are able to express concerns for nature, allowing for a combination of nature study with enjoyment and protection. The PGOs offer a avenues for this commitment to be developed further in the direction of systematic study collaborating on instruments for nature conservation policy and even research. In this sense, they provide a career for 'amateurs of nature' to develop into 'serious amateurs'. As such, these organisations form the biggest, radical, and deeply rooted network for the public understanding of science imaginable, even if it is 'only' field biology, currently less prestigious in the academy.

⁸ *Natuurmonumenten* and *WWF* both have around 900.000 members, the Dutch bird protection CSO *Vogelbescherming* about 150.000. About one in three Dutch households is a member of a nature conservation organisation(Statistics Netherlands, Netherlands Environmental Assessment Agency, & Wageningen University, 2010).

Table: Private Data-managing Organisations (PGOs)

Private Data-managing Organisations (<i>Particuliere Gegevensbeherende Organisaties</i> , PGOs)	
<p>ANEMOON Analysis, Education and Marine Ecological Research (<i>ANalyse, Educatie en Marien Oecologisch Onderzoek</i>)</p>	<p>Monitoring of the marine environment (underwater, tidal zones and beach) species, atlas, and research projects, e.g. on environmental impact; 379 registered volunteers; active since 1993. www.anemoon.org</p>
<p>BLWG Bryology + Lichenology Working Group of the KNNV (<i>Bryologische + Lichenologische Vereniging van de KNNV</i>)</p>	<p>Looks for and studies mosses and lichens occurrence and distribution. Set up within the Royal Dutch Society for Natural History (KNNV) to organise counts in 1946; 420 members. www.blwg.nl</p>
<p>EIS European Invertebrate Survey (<i>Stichting European Invertebrate Survey Nederland</i>)</p>	<p>Knowledge about distribution, ecology, and management of invertebrates, with specialised working groups, eg on dragon flies, in database with 2 million records. Initiated at Naturalis, museum of natural history in Leiden, with government and foundation money around 1975 in response to an international initiative. Now independent, but bureau hosted by Naturalis with six staff, some of whom publish in journals; 50 separate working groups (Stichting European Invertebrate Survey Nederland, 2008). www.naturalis.nl/eis</p>
<p>FLORON Foundation for Floristic Research Netherlands (<i>Stichting Floristisch Onderzoek Nederland</i>)</p>	<p>Researches and registers plant life. Set up in 1989 to co-ordinate existing efforts, such as in the scientific Royal Botanical Society of the Netherlands (1845). Cooperates with the national herbarium in Leiden. 'Hundreds' of volunteers with a small professional office; 23 district groups. www.floron.nl</p>
<p>NMV Dutch Mycological Society (<i>Nederlandse Mycologische Vereniging</i>)</p>	<p>Fungi and mushroom research; 800 members, ranging from beginner to professional. Founded in 1908. Collects distribution data and mushroom atlas and organises photo competitions. www.mycologen.nl</p>
<p>RAVON Reptile, Amphibiand and Fish Conservation Netherlands (<i>Reptielen Amfibieën VissenOnderzoek Nederland</i>)</p>	<p>One of the larger PGOs with 1500 volunteers and 1000 contributors. Professional staff of 35. Research, but also strong conservation profile. Works on a new distribution atlas and performs (paid) research projects. Manages observation data of working groups centrally since 1999. www.ravon.nl</p>
<p>SOVON (<i>Vogelonderzoek Nederland</i>)</p>	<p>Studies distribution and abundance of breeding birds and winter guests, providing data for conservation and research. Works on breeding bird atlases since 1973. Organises about 7000 volunteers with a paid staff of about 25. Largest of the PGOs. Performs projects for government. Cooperation ranges from bird protection organisation to the national statistics agency.</p>

	www.sovon.nl
TINEA Tinea Foundation (<i>Stichting Tinea</i>)	Researches moth and small butterfly fauna. Provides information on determination, distribution, but also infestation since 1986, but manages data going back to the mid-19 th century. Among its participants are volunteers and professional entomologists. www.kleinevlinders.nl
Dutch Butterfly Conservation (<i>Vlinderstichting</i>)	Studies butterflies and dragonflies abundance and distribution since 1983. Performs projects for research and conservation purposes, as well as education and advice for conservation. Professional staff of 35, with 2000 volunteers and 5000 paying members with a magazine and a butterfly atlas project. National monitoring network in cooperation with the national statistics agency. www.vlinderstichting.nl
Dutch Mammal Society (<i>Zoogdiervereniging</i>)	Naturalist society founded in 1952, gradually professionalized to research mammals, ultimately aimed at mammal protection. Contributes to mammal counts via working groups, with about 1500 members. National office with 20+ paid staff. Runs a magazine and scientific journal. www.zoogdiervereniging.nl
VOFF Foundation for Research into Fauna and Fauna (<i>Stichting VeldOnderzoek Flora and Fauna</i>)	Umbrella organisation of the other ten; small office of two staff; hosted by RAVON. Coordinates data integration and contacts with government, representing the total membership of PGOs (between 15.000 and 20.000 volunteer naturalists).

References

- Alma, C. (2006). Wie wil wat met de Wadden? *Noorderbreedte*, 30(2).
- Arnstein, S. (1969). A ladder of citizen participation in the USA. *Journal of the American Institute of Planners*, 35, 216-224.
- Audubon, J. J. (1827-1838). *The Birds of America from Drawings Made in the United States and Their Territories*. London: J.J. Audubon.
- Carson, R. (1962). *Silent Spring*. Boston: Houghton Mifflin.
- De Bok, C., & Mulder, H. (2004). Wetenschapswinkels in de kennissamenleving. *Tijdschrift voor Hoger Onderwijs*, 22(3), 123-139.
- Dresen, L. (2008). Van Schollervaarseiland tot Naardermeer. *De Negentiende Eeuw*, 32(4), 271-293.
- Ellis, R., & Waterton, C. (2004). Environmental citizenship in the making: the participation of volunteer naturalists in UK biological recording and biodiversity policy *Science and Public Policy*, 31(2), 95-105.
- Farkas, N. (2002). *Bread, cheese and expertise: Dutch science shops and democratic institutions*. Unpublished PhD thesis, Rensselaer Polytechnic Institute, New York.
- Felt, U. rapporteur (2007) *Taking the European Knowledge Society Seriously*.
- Fischer, C., Leydesdorff, L., & Shophaus, M. (2004). Science shops in Europe: the public as stakeholder. *Public Understanding of Science*, 31(3), 199-212.
- Fokkink, A., & Mulder, H. A. J. (2004). Curriculum Development through Science Shops. *Environmental Management and Engineering Journal*, 3(3), 549-560.
- Fox, A. D. (2004). Has Danish agriculture maintained farmland bird populations? *Journal of Applied Ecology*, 41, 427-439.
- Gregory, R. D., Strien, A. v., Vorisek, P., Gmelig Meyling, A. W., Noble, D. G., Foppen, R. P. B., et al. (2005). Developing indicators for European birds. *Philosophical Transactions of the Royal Society B*, 360, 269-288.
- Gregory, R. D., Willis, S. G., Jiguet, F., Voříšek, P., Klvaňová, A., Strien, A. v., et al. (2009). An Indicator of the Impact of Climatic Change on European Bird Populations. *PLoS ONE*, 4(3), e4678.
- Hagemeijer, W. J. M., & Blair, M. J. (1997). *The EBCC Atlas of European Breeding Birds - their distribution and abundance*: T & A D Poyser for the European Bird Census Council.
- Halfman, W. (2008). *States of Nature: nature and fish stock reports for policy*. The Hague: Netherlands Consultative Committee of Sector Councils for research and development.
- Halfman, W., & Hoppe, R. (2005). Science/policy boundaries: a changing division of labour in Dutch expert policy advice. In S. Maasen & P. Weingart (Eds.), *Democratization of expertise? Exploring novel forms of scientific advice in political decision-making* (pp. 135-152). Dordrecht: Kluwer.
- Halfman, W. and van Hemert, M. (2009) Knowledge for Action: Report of a workshop held at Soesterberg, The Netherlands, 21 September 2009, CREPE WP5, http://crepeweb.net/?page_id=191
- Hinchliffe, S. (2008). Reconstituting nature conservation: towards a careful political ecology. *Geoforum*, 39, 88-89.
- Hinchliffe, S., Kearnes, M. B., Degen, M., & Whatmore, S. (2005). Urban wild things: a cosmopolitical experiment. *Environment and Planning D: Society and Space*, 23, 643-658.
- Huseman, J. (2004). Waddenvereniging in nood. *Noorderbreedte*, 28(2).
- Irwin, A. (1995). *Citizen Science: a study of people, expertise and sustainable development*. London: Routledge.
- Koninklijke Nederlandse Natuurhistorische Vereniging. (2010). KNNV website. Retrieved 1 November, 2010
- Kwa, C. (2005). *De ontdekking van het weten: een andere geschiedenis van de wetenschap*. Amsterdam: Boom.
- Law, J., & Lynch, M. (1988). Lists, field guides, and the descriptive organization of seeing: Birdwatching as an exemplary observational activity. *Human Studies*, 11(2-3), 271-303.
- Lawrence, A., & Turnhout, E. (2010). Personal meaning in the public sphere: The standardisation and rationalisation of biodiversity data in the UK and the Netherlands. *Journal of Rural Studies*, 30, 1-8.
- Leadbeater, C., & Miller, P. (2004). *The Pro-Am Revolution: How enthusiasts are changing our economy and society*. London: Demos.
- Leydesdorff, L., & Ward, J. (2005). Science shops: a kaleidoscope of science-society collaborations in Europe. *Public Understanding of Science*, 14(4), 353-372.
- Lynch, M., & Law, J. (1998). Pictures, texts, and Objects: The literary Language Game of Bird-Watching. In M. Biagioli (Ed.), *The Science Studies Reader* (pp. 317-341). New York: Routledge.
- Maes, D., & Van Dyck, H. (1999). *Dagvlinders in Vlaanderen: ecologie, verspreiding en behoud*. Antwerpen: Stichting Leefmilieu, Instituut voor Natuurbehoud, Vlaamse Vlinderwerkgroep.

- Mulder, H. A. J. (2004). From Technical Advice to Mediation. *International Journal of Community Based Research*, 2, 9-10.
- Mulder, H. A. J., & de Bok, C. F. M. (2006). Science shops as university-community interfaces: an interactive approach in science communication. In D. Cheng, J. Metcalfe & B. Schiele (Eds.), *At the Human Scale – International Practices in Science Communication* Beijing: Science Press.
- Noble, D. F. (1979). Social Choice in Machine Design: The Case of Automatically Controlled Machine Tools. In A. Zimbalist (Ed.), *Case Studies on the Labor Process* (pp. 18-50). New York: Monthly Review Press.
- Noirot, I. (2010). The birds are speaking to Europe *Research EU*, 62, 38-39.
- Obmascik, M. (2004). *The Big Year: A tale of Man, Nature, and Fowl Obsession*. New York: Free Press.
- Pickstone, J. V. (2000). *Ways of Knowing: A new history of science, technology and medicine*. Manchester: Manchester University Press.
- Piersma, T., Gils, J. A. v., & Olf, H. (2009). *METAWAD: de Waddenzee als zwakke schakel in een internationaal meta-ecosysteem*. Leeuwarden: Waddenacademie.
- Schulte Fishedick, K. (1995). *Practices and Pluralism: A Socio-Historical Analysis of Early Vegetation Science, 1900-1950*. Unpublished Doctoral dissertation, University of Amsterdam, Amsterdam.
- Scott, J. C. (1998). *Seeing like a state : how certain schemes to improve the human condition have failed*. New Haven, Conn.: Yale University Press.
- SOVON Vogelonderzoek Nederland. (2002). *Atlas van de Nedelandse Broedvogels 1998-2000, Verspreiding, aantallen, verandering*: Nationaal natuurhistorisch Museum Naturalis, KNNV Uitgeverij, European Invertebrate Survey - Nederland.
- SOVON Vogelonderzoek Nederland. (2003). *Jaarverslag 2003*. Beek-Ubbergen: SOVON.
- SOVON Vogelonderzoek Nederland. (2009). *Jaarverslag 2009*. Beek-Ubbergen: SOVON.
- Staatsbosbeheer. (2009). *Jaarstukken 2009*. Driebergen.
- Star, S. L., & Griesemer, J. (1989). Institutional Ecology, 'Translations', and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939. *Social Studies of Science*, 19, 387-420.
- Statistics Netherlands, Netherlands Environmental Assessment Agency, & Wageningen University. (2010). Natuurcompendium. Retrieved 20 November, 2010, from <http://www.compendiumvoordeleefomgeving.nl/>
- Stebbins, R. A. (2007). *Serious Leisure: a perspective for our time*. New Brunswick: Transaction Books.
- Stichting European Invertebrate Survey Nederland. (2008). *Stichting EIS 33,3 jaar! Jaarverslag EIS-Nederland*. Leiden: EIS.
- Stichting VeldOnderzoek Flora en Fauna. (2010). Website VOFF. Retrieved 1 November, 2010, from <http://www.voff.nl>
- Stilgoe, J., Irwin, A., & Jones, K. (2006). *The Received Wisdom: Opening up expert advice*. London: Demos.
- Stirling, A. (2006). *From Science and Society to Science in Society: towards a framework for co-operative research. Report of a European Commission Workshop, 24-25th November 2005*. Brussels: Governance and Scientific Advice Unit of DG RTD, Directorate C2, Directorate General Research and Technology Development.
- Swart, J. A. A., & Andel, J. v. (2008). Rethinking the interface between ecology and society. The case of the cockle controversy in the Dutch Wadden Sea. *Journal of Applied Ecology*, 45, 82-90.
- Thompson, G. (2006). *The Guide's Guide to Guiding* (3rd edition ed.). Auckland Park: Jacana.
- Turnhout, E. (2003). *Ecological indicators in Dutch nature conservation*. Unpublished doctoral thesis, Free University, Amsterdam.
- Turnhout, E., Hisschemöller, M., & Eijsackers, H. (2008). Science in Wadden Sea policy: from accommodation to advocacy. *Environmental Science & Policy* 11, 227-239.
- Uljé, C. B., & Noordeloos, M. E. (1996). Type studies in coprinus subsect. Alachuani. (Communicated by Prof. J.T. Wiebes at the meeting of May 20, 1996). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen : biological, chemical, geological, physical and medical sciences*, 99(1-2), 105-124.
- van der Avoird, T. (2006). *De betekenis van het Landelijk Overleg Wetenschapswinkels*.
- Van der Windt, H. (1995a). The amoëbe als verbeelding van de natuur. *Kennis en Methode*, 19(3), 251-276.
- Van der Windt, H. (1995b). *En dan: Wat is natuur nog in dit land? Natuurbescherming, 1880-1990*. Meppel: Boom.
- Van Nieuwstadt, M. (2006, 28 March). Veel wetenschapswinkels in Nederland bedreigd. *De Volkskrant*.
- Van Zanden, J. L., & Verstegen, S. W. (1993). *Groene geschiedenis van Nederland*. Zeist: Spectrum.

- Wachelder, J. (2003). Democratizing science: Various Routes and Visions of Dutch Science Shops. *Science, Technology, and Human Values*, 28(2), 244-273.
- Waddenvereniging. (2006). *Jaarverslag*.
- Waterton, C. (2002). From Field to Fantasy: Classifying Nature, Constructing Europe. *Social Studies of Science*, 32(2), 177-204.
- Wilsdon, J., & Willis, R. (2004). *See-through science: why public engagement needs to move upstream*. London: Demos.
- Wolff, W. J. (1997). Development of the conservation of Dutch coastal waters. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 7, 165-177.
- Wynne, B. (1996). May the sheep safely graze? A reflexive view of the expert-lay knowledge divide. In S. Lash, B. Szerszynski & B. Wynne (Eds.), *Risk, environment and modernity: towards a new ecology* (pp. 44-83). London: Sage.