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Overview of citizen science reporting for biodiversity in Europe

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1 Introduction

1.1 Purpose of the report

The purpose of this report is to assist the European Environment Agency (EEA) in scoping the biodiversity component of the Eye on Earth project (NatureWatch) (EEA, 2011a), by addressing the potential and benefits, as well as constraints and shortcomings of citizen participation to biodiversity knowledge. Based on concrete examples of citizen science biodiversity observation projects in Europe, the report will provide the EEA with background information on where these types of projects have been put in place and thereby reveal their potential in terms of helping to improve knowledge on biodiversity.

This report builds upon a preliminary report prepared by Mora Aronsson, Åsa Hedin, and Mikael Svensson from the Swedish University of Agricultural Sciences (SLU), which was mainly focused on the Swedish experience in citizen science species monitoring programmes. A few examples from other European countries were added as result of a questionnaire sent to all partners of the European Topic Centre on Biological Diversity (ETC/BD) (see Annex 7.1 Questionnaire). The report was further enlarged by Marcus Zisenis, ETC/BD partner ECNC-European Centre for Nature Conservation, with an extensive Internet search on national and European initiatives on citizen science biodiversity knowledge, as well as by integrating relevant scientific references, and carrying out a detailed analysis of EU citizen science supported species observation schemes based on the EuMon project database on species and habitat monitoring schemes in Europe (EuMon, 2011). The draft report went through consultation for comments, in particular of the 32 member and seven cooperating countries of the European Environment Information and Observation Network (Eionet) of the European Environment Agency (EEA, 2012).

The report is structured as following:

- Overview of examples of initiatives on citizen science biodiversity knowledge (mainly species observation) schemes at European level and in different European countries (Chapter 2).
- Detailed overview of the Swedish situation of species monitoring programmes, which rely in their data substantially on citizen volunteers (Chapter 3).
- For further deep analysis, the EuMon database on species and habitat monitoring schemes in Europe (EuMon, 2011) was used for distribution, coverage, priorities, and methods of 160 registered species and habitat observation schemes on International, European, national, and regional levels with more than five volunteers involved in mainly the EU (Chapter 4).
- Conclusions are drawn for the application of citizen science biodiversity knowledge projects in general and for the EEA Eye on Earth project (NatureWatch), applied to Invasive Alien Species (IAS) in particular (Chapter 5).

Recent developments on an EEA NatureWatch focused on Invasive Alien Species (IAS)

NatureWatch, an EEA pilot initiative, is the first of its kind at European level, which will bring together citizen science reporting on Invasive Alien Species (IAS) in partnership with Member States and communities. *NatureWatch* will provide a tool to assist Member States in fulfilling possible requirements on detection and reporting on IAS that may be proposed in the future EU regulation on IAS. It can also be seen as a complement to environmental monitoring. *NatureWatch* will also be instrumental in raising public awareness of the threats of IAS and enable citizens to actively become involved in helping to stop the spread of IAS.

The *NatureWatch* system enables citizen scientists to identify, observe, and report on IAS through communities and Member State nodes. Reports to *NatureWatch* are made to an online portal, either through a mobile application or personal computer. Reports from participating communities and Member States are collected in *NatureWatch* to provide a Pan-European picture. *NatureWatch* also provides citizen communities with space to host their own community website. Here they can organise their observation data and share additional information such as trends, reports, and maps. IAS data from

NatureWatch can further be shared within *Eye on Earth*, a global public information service developed by EEA and its partners.

Fifteen Invasive Alien Species have initially been selected, through a survey among European experts, to be especially monitored. Countries are free to select additional species to be followed. Links to fact sheets on IAS and their impacts, identification keys, and online games will benefit both the quality of the reports and increase interest in learning more about the threat of IAS.

Countries and communities may participate either by using the *NatureWatch* application directly or by exporting their data to *NatureWatch*, if they already have or are in the process of developing their own citizen science reporting system. The pilot phase of *NatureWatch* entails the EEA working in partnership with a few countries such as Denmark, Norway, Hungary, Estonia, and Slovenia to implement and test the system. User testing of the system has been done in summer of 2012.

1.2 How is the term citizen science used for this overview report?

The concept of citizen science is interpreted and applied differently depending on people, organizations, authorities, and countries. For example, the meaning of citizen science is different in North America as compared to Europe. In North America the term is also used for observing ecosystem functions and environmental quality, apart from mainly collecting data on species and habitat occurrences as in Europe (Conrad and Hilchey, 2011). In this report, the term citizen science is applied as defined by the EEA (EEA, 2011b) based on Wikipedia:

'Public involvement in projects or ongoing programmes of scientific work, by which individual volunteers or networks of volunteers, many of whom may have no specific scientific training, perform or manage research-related tasks such as observation, measurement or computation.'

Chapter 2 shows examples of citizen science species observation schemes in different European countries, as well as on European level. The overview of initiatives intends to do not repeat common observation schemes of species on national level, which are already mentioned in the European section, in particular of birds, butterflies, and bats.

1.3 What does selected scientific literature tell us about conceptual design and governance of citizen science schemes for enhancing biodiversity knowledge in Europe?

Citizen science related to biodiversity can have multiple functions according to Couvet et al. (2008). It can contribute to: (i) monitor biodiversity, (ii) frame indicators of the state of biodiversity, and (iii) build science-policy scenarios for management.

Schmeller et al. (2009) point out that volunteer contributions can be very valuable for biodiversity monitoring in Europe, despite the need of data quality control by professional researchers. 'Biodiversity monitoring entails 3 activities: collecting monitoring data, such as occurrence or abundance indices in a target area over an appropriate timescale; analysing the spatial and temporal patterns of biodiversity components, including diagnosing the causes of change as robustly as possible; and deriving results oriented toward policy makers, such as status and trend assessments or management evaluations.' (Schmeller et al., 2009)

Devictor et al. (2010) conclude that '...citizen science is particularly useful to address issues spanning large temporal and spatial extents', for which an extensive field work force/load is needed. Thus, it can be particularly helpful in conservation biogeography, also regarding Invasive Alien Species (IAS). Citizen science biodiversity knowledge schemes should cover different ecological levels ranging from species to ecosystem processes, as well as their changing impact drivers (Devictor et al., 2010).

Furthermore, citizen science does not involve citizens only as data collectors, but as active participants in science for biodiversity knowledge, and decision-making, based on gathered information (Conrad and

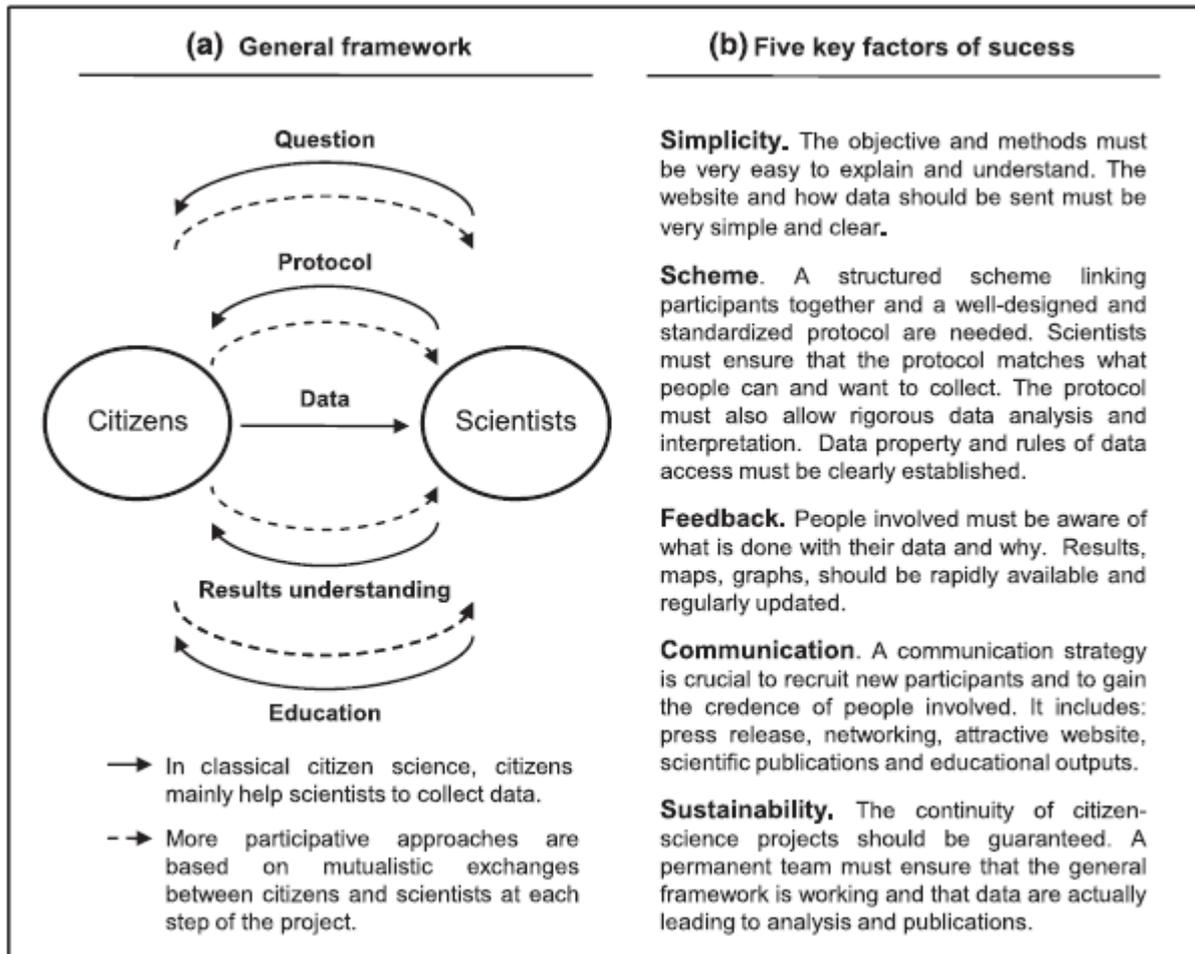
Hilchey, 2011). Citizen science shall serve for ‘...increasing public participation in science and technology decisions, securing a more adequate representation in science, vitalizing citizen and public deliberation in science or even installing a democratic governance of science’ (Bäckstrand, 2003).

Moreover, the quantity of collected data is not decisive for species monitoring, for example, but rather the targeted quality of survey and analysis (Couvét et al., 2008).

There is significant work load involved in training citizens and in the treatment of incoming data errors to ensure data quality, as shown in an analysis of citizen science supported Invasive Alien Species (IAS) observations (Crall et al., 2011). For example, sources of error in citizen science biodiversity knowledge projects can be species identification and the heterogeneity of species detectability (Devictor et al., 2010). In this respect, it is important when designing a citizen science knowledge based project on IAS, to distinguish between the demands, work load, and capacity for surveillance, i.e. just the detection of new non-native species, or monitoring their populations, which needs much longer and higher data input and data quality assurance (EC, 2011a). Gallo and Waitt (2011) give a practical example of citizen science supported IAS detections on grid size level in Texas of the United States. Steps include when designing citizen science biodiversity knowledge schemes: i) establishing procedures for establishing goals, ii) recruitment and marketing for identifying and reaching target communities, iii) training participants, iv) retaining participants, v) establishing and maintaining data collection and organization, vi) establishing and giving feedback of results, and vii) management recommendations (Cooper et al., 2007). Particular methodologies for citizen science biodiversity knowledge schemes need to be developed together with professional researchers (Cooper et al., 2007).

Participatory scenarios of different science-policy options for biodiversity management can significantly enhance their quality and support, which cannot be achieved solely from the viewpoint of the social group of scientists. In addition, they contribute in their participative manner in identifying the responses of a wider range of different social groups to biodiversity changes, and their interactions (Couvét et al., 2008). Furthermore, participatory environmental monitoring schemes on local scale significantly speed up the time needed from data collection to decision-making compared to monitoring executed by scientists (Danielsen et al., 2010). Devictor et al. (2010) point out that, ‘Involving local people in data collection or even in specific conservation plans offers a good route to integrate public views and values concerning what conservation actions should be taken, why and how.’ (Figure 1.1).

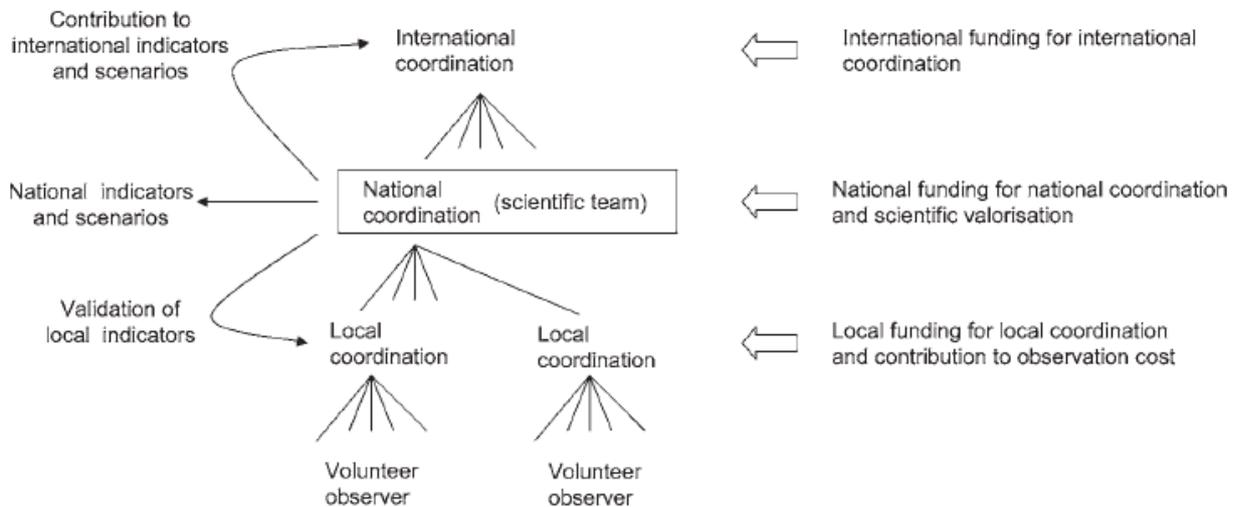
Figure 1.1 ‘Conceptual framework and key factors of success of a citizen science programme. (a) A general framework generates a reciprocal connection between scientists and citizens from the question being asked to the educational benefit. This framework can range from top-down projects (black arrows) to more bottom-up and participatory approaches (dashed arrows) depending on whether and how citizens are involved (adapted from Cooper et al., 2007). (b) To ensure that the framework is actually working and maintained requires several key factors that encourage success.’ (Devictor et al., 2010)



In organizational governance, there is however currently often a ‘...top-down model of environmental problem-solving grants power to networks of scientific experts, specialists, and bureaucrats in environmental science’ (Bäckstrand, 2003). Thus, the aim of citizen science ‘...to democratize science is a more challenging issue that goes beyond the issue of stakeholder representation and participation...by aspiring to transform the institutions of science to incorporate democratic principles’ (Bäckstrand, 2003). Democratization is an essential factor of trustful and participative cooperation in citizen science biodiversity knowledge observation projects in Western and Eastern (post-communism) countries (Vandzinskaite et al., 2010).

The organizational value of different coordinating levels in citizen science for biodiversity knowledge in Europe is shown in Figure 1.2.

Figure 1.2 Different important coordination levels ranging from local, (regional), national, to internal of Citizen science biodiversity knowledge projects in Europe (Couvet et al., 2008)



Bäckstrand (2003) argues that ‘...the science-politics interface needs to be reframed to include the triangular interaction between scientific experts, policy-makers and citizens.’ for the democratic role of citizens as being not only a passive recipient of science-policy decisions, but an active component in science-policy making’. The manual for assessment practitioners of the Millennium Ecosystem Assessment (MEA) provides guidelines and examples how this participative ecosystem approach in (democratic) science-policy cooperation with citizens shall be carried out (Ash et al., 2010). Such a more democratic citizen science supported ‘...policy process should be open, transparent and institutionalize self-reflection.’ (Bäckstrand, 2003). Thus, the citizen science approach for enhancing biodiversity knowledge in Europe needs to adapt to the changing demands of the society, as well as to the interrelated conditions of biodiversity.

Regarding Invasive Alien Species (IAS) in particular, the European Commission’s Working Group 2 on IAS concludes, ‘The development of a EU Citizen Science Reporting System for Invasive Alien Species would be valuable for gathering information on the distribution of IAS and for raising public awareness of the threat by IAS to biodiversity, ecosystem services, health and socioeconomic values (see also report 1.5). A Citizen Science Reporting System is a complement to formal environmental monitoring and surveillance. A Citizen Reporting System could focus on key indicators or target IAS that are easy to identify, pose a threat to biodiversity, ecosystem services or health and that reflect major pathways of introduction and certain deteriorations of ecosystems.’ (EC, 2011b).

1.4 Citizen science versus Lay, Local, Traditional Knowledge

In June 2011, an EEA workshop was held in Copenhagen dealing with the ‘Lay, Local, Traditional Knowledge and Citizen Science: Their Roles in Monitoring and Assessment of the Environment’. The themes and issues covered during the workshop included: the goals and benefits of the lay, local, traditional knowledge (LLTK) and Citizen Science (CS); examples of good practice of citizen science projects; discussions on the methods to cope with challenges related to data handling, quality assurance and effectiveness evaluation; and the endurance of citizen scientists and citizen science projects (EEA, 2011c). During the workshop, an attempt was made to capture the wide variety of interests and activities covered by Lay, Local, Traditional Knowledge and Citizen Science in the form of the ‘Rainbow’ (Figure 1.3)

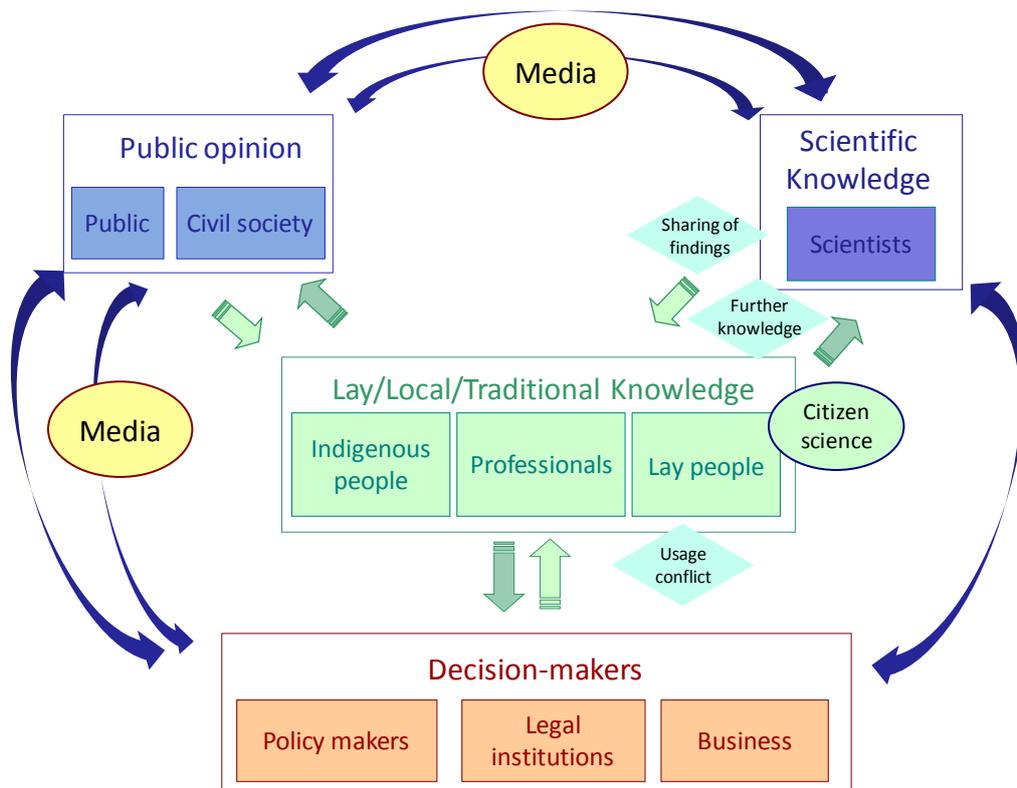
Figure 1.3 Rainbow of Lay, Local, Traditional Knowledge (LLTK) and Citizen Science (CS) activities (EEA, 2011c)



Some of the conclusions of the EEA workshop were that ‘...increasing the motivation and adequate training of citizen scientists is crucial as well as involving citizen scientists and indigenous people during project design, giving feedback regularly and maintaining good communication via various tools.’ Another conclusion was, ‘Plurality and diversity of knowledge, including scientific and lay, local, traditional knowledge can be valuable for good policy-making. Multi-dimensional approach (environmental, economic and social) and multi-stakeholder participation works better and improves trust in the interaction between lay, local, indigenous people and the scientific communities, policy makers and other various stakeholders’ (EEA, 2011c).

The Scoping Report for the EEA workshop suggests, regarding environmental issues, ‘Policy-makers need information about available options and their impacts, as well as information about potential preferences of those impacted by the decisions, information to which LLTK could contribute’ (Mudgal et al., 2010). A synthetic framework illustrates the different interlinkages and the position of LLTK and Citizen science within public opinion and scientific-knowledge on one side, and as decision-makers on the other side, as well as the connective role in particular of the media (Figure 1.4).

Figure 1.4 'Some relationships between Lay/Local/Traditional Knowledge, scientific knowledge and decision-makers' (Mudgal et al., 2010)



2 Overview of examples of biodiversity observation schemes involving volunteers in European countries¹

There are many different monitoring schemes in place in European countries involving individual or networks of volunteers in contribution to biodiversity observation schemes. They have different principles, goals and ambitions. In some programmes, contributors receive a symbolic financial compensation, for example, to cover travel costs for fieldwork, while in others there is even no payment at all.

Species monitoring can be done at different levels (national, regional, local) and organised by several types of organisations: non-governmental organizations, private persons, national agencies, universities, museums, etc. The information collected can cover different information on populations and biodiversity such as species occurrence, phenology, or even health matters. Some of the schemes have rigorous manuals to allow some kind of standardisation of the data reported for their proper use in further assessments of biodiversity state and trends. In other cases, methodological guidelines can be minimal when the observation schemes are mainly targeted to public awareness.

Online reporting systems of species observations are today becoming established in more and more countries. In the time of social media like Facebook and Twitter, there is an increased wish to share observations with others like-minded people online. Of course, these observations vary widely in terms of quality. Validation of the data reported is crucial, if they are to be used for biodiversity assessments in

¹ Bell et al. (2007) provide further examples with descriptions of volunteers' supported species observation schemes in the EU.

support of policy decision, scientific research or companies, for example, involved in impact assessment surveys.

The following overview, not intended to be complete, presents examples of initiatives at European and national level in different countries for a more qualitative than quantitative overview. If there are European schemes for coordinating biodiversity based observations involving volunteers, such as various national initiatives on birds, butterflies, and bats, these national schemes are often not repeated in section '2.2 Examples of national biodiversity observation schemes in Europe' if they do not have a particular focus or methodical approach. The emphasis is on other not covered taxa, and different or specific observation schemes for obtaining an impression of the diversity of subjects and approaches to biodiversity based observation schemes involving volunteers in Europe. A structured overview by theme/taxon of the examples mentioned in sections 2, and 3 is provided in Annex 7.2.

2.1 Selected examples of European and global biodiversity observation schemes

2.1.1 Projects coordinated by NGOs

The **European Bird Census Council (EBCC)** coordinates European wide bird census initiatives, which leads to the publication of European and national status of common bird monitoring and atlas work reports.

<http://www.ebcc.info/what.html>

EuroBirdwatch is going on for 22 years already (1993-2015). Annually, BirdLife partners in 17 to 40 countries participate in this initiative. Up until now more than 1,1 million of people joined more than 36 000 events to admire and learn more on the impressive migration of birds to the South. The observations are reported via the respective national centres of the BirdLife organization to the European Centre of a BirdLife partner. The results are listed online per country.

<http://www.eurobirdwatch.eu/>

'**Spring Alive**', supported by BirdLife International and its partners, encourages children and adults around Europe, Central Asia and Africa to register first sightings online of the cuckoo, barn swallow, swift, bee-eater, and white stork in spring. Resulting observation statistics per country and maps are available on the Internet.

<http://www.springalive.net/>

Butterfly Recording Europe is an online recording scheme of Butterfly Conservation Europe which unifies governmental and non-governmental network partners throughout Europe to record butterfly and moth observations.

<http://butterfly-recording.eu/>

Conservation of Key Underground sites is an initiative by the Agreement on the Conservation of Populations of European Bats (EUROBATS) which has collected information on about 1500 underground bat sites in Europe with professional and voluntary support, which are presented as a point on an Internet accessible European map, as well as on a location list with a national map per country for download.

http://www.eurobats.org/activities/intersessional_working_groups/underground_sites

BioBlitz is an initiative by e.g. NGOs, and city councils to survey all wildlife that can be found by the wider public in different locations.

<http://en.wikipedia.org/wiki/BioBlitz>

2.1.2 *Projects coordinated by scientific institutions*

Evolution MegaLab was a citizen science project in 15 European countries mainly in 2009, managed by a European wide scientific institutional consortium, which involved the wider public of thousands of people in collecting information on the geographical pattern in changing colours of banded snail shells. The project was based on the assumption that environmental influences such as climate change have an evolutionary influence on the colours of the banded snail. In the study, the observations were compared with historical data. The data gathered with a recording sheet could be added to the Internet platform and downloaded for users from a European map.

http://www.evolutionmegalab.org/en_GB/

The **Open University** runs an Internet portal for people to observe wildlife, climate, water, and air, which results, *inter alia*, in maps and photo visualizations.

<http://www.ispot.org.uk/surveys>

The Mediterranean Science Commission (CIESM) has set up a **JellyWatch** programme with jellyfish observatory focal points around the Mediterranean Sea, including notified observations of jellyfish by the wider public.

<http://www.ciesm.org/marine/programs/jellywatch.htm>

Project Noah is an initiative to explore and document wildlife by using the smartphone app, which is an approach gaining popularity in many fields. It is also a platform to harness the power of citizen scientists from all over the world. The name ‘Noah’ is an acronym that stands for networked organisms and habitats. It was launched out of New York University’s Interactive Telecommunications Program (ITP) in early 2010. The idea behind it was to see, if it would be possible to build a fun, location-based mobile application to encourage people to reconnect with nature and document local wildlife (Project Noah, 2012).

<http://www.projectnoah.org/>

Anymals started as an open and community based project dedicated to biodiversity of planet earth. Anyone could participate by using a free Android based app for a smartphone to browse and log sightings. Additionally, it is possible to download guides for various species groups. Currently it grew into animals+plants portal and it has apps for Android, iOS and Windows phones. The apps can be customised for different groups of species, different levels of expertise, different languages, and more. The app is directly linked to GBIF.

<http://www.anymals.org/>

2.1.3 *Projects coordinated by the United Nations Environment Programme (UNEP)-World Conservation Monitoring Centre (WCMC)*

Earthdive is a private global initiative with Global Dive Log database of indicator species and human induced pressures supplied by divers and snorkelers.

<http://www.earthdive.com>

Protected Planet is a world database on protected areas, run by UNEP-WCMC with support of several governmental and private organizations, where people can rate photos, update Wikipedia articles, and make suggestions to improve the information on protected areas.

<http://protectedplanet.net/about>

2.2 Examples of national biodiversity observation schemes in Europe

2.2.1 Austria

The purpose of the project **Naturbeobachtung** is to produce distribution maps of selected species and to raise awareness. The Naturschutzbund Österreich coordinates the project. The project covers all of Austria, and it includes 129 selected species of birds, mammals, amphibians, reptiles, fish, crayfish, beetles, butterflies, grasshoppers, dragonflies, spiders, molluscs, plants, and lichens. Recently, all birds and butterfly species could be included. The Annexes of the EU Birds and the EU Habitats Directive have been taken into account in choosing the species. There is so far no systematic validation of records that are entered by citizens. To date, up to 391,740 records have been submitted from 3685 providers. The data is stored in a database in Germany (www.science4you.org).

<http://www.naturbeobachtung.at>

BirdLife Austria runs several kinds of volunteer projects. For example, people count sighted wintering birds in their garden during one hour of the scheme ‘**Hour for Garden Birds**’ (‘Stunde der Gartenvögel’).

<http://www.stunde-der-wintervoegel.at/>

2.2.2 Belgium

Waarnemingen.be is an initiative and a web portal of Natuurpunt Studies and the Nature Information Foundation for collecting observations of various plant and species groups. The portal is fed by observations of many volunteers and working groups. As part of the portal, the regional governments of Flanders, Wallonia and Brussels have opened volunteer observations’ based early warning and rapid response system for Invasive Alien Species (IAS). The aim is to streamline the process of observation and reporting to land managers and relevant authorities for intervention in relation to IAS.

<http://waarnemingen.be/>
http://waarnemingen.be/invasive_alert_view.php

2.2.3 Czech Republic

The largest amateur mapping activity is run on the independent non-commercial website **BioLib**. BioLib was originally intended as an international encyclopaedia of plants, fungi, and animals, based on a taxonomic system supplemented by extensive photo galleries, glossary and vernacular names dictionary. The mapping of mammals began in 2005, soon followed by the mapping of amphibians, reptiles, and selected species of invertebrates. The mapping is organised as a collection of records (a structured form has to be filled in), which are then controlled and validated by experts. The system is accessible for both registered and unregistered users. Only verified and confirmed data is then published in the form of on-line grid maps (the grid is in KFME system, Central European grid system). The records can be (for problematic species it is obligatory) documented by a photo. All records are georeferenced (by publicly accessible systems); the grid is calculated automatically. The range of species is complete for mammals, amphibians and reptiles. The invertebrate selection is based on determinable taxa and accessibility of experts. Until now, more than 200 species of spiders, beetles, butterflies, dragonflies, harvestmen, bugs, medicinal leech, crayfish, branchiopods or medusa have been mapped. More than one million records have been collected so far.

The collaborators are experts based at the Agency of Nature Conservation and Landscape Protection, the National Museum, and the Herpetological Society. The collected data is regularly and automatically transferred to the Species Occurrence Database (official national species diversity database) operated by ANCLP.

<http://www.biolib.cz/en/main/>

Similar projects are mostly aimed at other systematic species groups. For birds, the **Czech Ornithological Society** runs a system for collecting observations, (until now, approximately one million records). The data of registered ornithologists is being collected.

<http://www.birds.cz/avif/obs.php>

To recent date, 26 vascular plant species have been mapped on a voluntary basis, based on sending rather less structured emails.

botany.cz

The **Czech Butterfly Conservation Society** (Společnost pro ochranu motýlů (SOM)) organizes butterfly mapping per grid cells in the Czech Republic, with the support of volunteers. The gathered data are published online.

<http://www.lepidoptera.cz>

2.2.4 Denmark

In Denmark a number of portals exist, where it is possible to register observations of different organisms. These are all run by NGOs and mostly focus on one group of organisms (e.g. birds, fungi or butterflies). The Danish Ornithological Society/BirdLife Denmark is an NGO working for the protection of birds and nature, as well as the procurement of knowledge on birds. Anyone can search for information on birds in the **DOFbasen** database. However if you want to provide the DOFbasen with data, you need a password. Data can then be entered either directly via the web or via a small program which can be downloaded from the website.

<http://www.dofbasen.dk/observationer/index.php?english=yes>

Danish Birds and Nature (Fugleognatur.dk) is the largest website of its kind in Denmark, existing since November 2001. It has more than 32 000 registered users and more than 1.5 million observations of the Danish flora and fauna. The goal of the website is to gather information about Danish flora and fauna and to promote the popular natural surveillance as a powerful reference tool for people interested in nature. The website is run in cooperation with the Aarhus Natural History Museum.

<http://www.fugleognatur.dk/>

2.2.5 Estonia

The Estonian Naturalists Society runs, in cooperation with the Estonian Environment Information Centre, an **Estonian Nature Observations Database** of species in Estonia with a map application of the information gathered supported by volunteers of the wider public. After checking the data notifications, the protected species information is sent to the Estonian environmental register. Results are presented, *inter alia*, via an Internet map application. Since spring 2011, the University of Tartu and Estonian Society of Lepidopterologists are also cooperating on developing the Estonian Nature Observations Database. The Atlas of Estonian birds, the Atlas of Estonian mammals and lepidopterological data include more than 175,000 observations in the Estonian Nature Observations Database, which is also based on data from volunteers.

<http://loodus.keskkonnainfo.ee/lva/LVA.aspx?lang=eng>

Species observations on animals, fungi, plants, protists, and bacteria can be also registered via the **eBiodiversity** web interface. The system contains more than 100,000 observations from volunteers with more than 25 000 indications of different species in 2015.

<http://elurikkus.ut.ee/index.php?lang=eng>

2.2.6 Finland

The **Finnish Environment Institute (SYKE)** supports a scheme for volunteers and professionals for **monitoring of butterflies in Finnish agricultural landscapes**. This scheme contributes to other butterfly monitoring schemes in more than 12 other European countries.

http://www.environment.fi/en-US/Nature/Species/Species_monitoring/Monitoring_butterflies_in_Finnish_agricultural_landscapes

A research project at the University of Helsinki, Department of Applied Biology, Faculty of Agriculture and Forestry, carries out nation-wide **field experiments of dung beetles and other decomposers** with support of volunteers from the Finnish 4H Federation. The 2011 project was focused on studying the effects of the reduced diversity of dung beetles on decomposition rates and if certain species play a crucial role in it.

http://www.helsinki.fi/foodwebs/research/dungbeetles_developments.htm

The NGO Nature League organizes a **Spring Follow-Up** for watching wildlife and reporting observations during spring-time. Spring monitoring by the Finnish Nature League has taken place since the 1960's. There are about 50 species (birds, mammals, plants, reptiles, amphibians) for which sightings are requested plus annual thematic species, for instance, in the year of forests. In addition, the following species can be observed: *Populus tremula*, *Calophrys rubi*, *Luzula pilosa*, *Microstoma protracta*, *Phylloscopus sibilatrix*. A person does not have to report all of them, one species might be enough. The sightings can be reported through an online form, through sending a paper form or through a text message. Results are presented, *inter alia*, through listing of sightings and a map on the Internet.

<http://www.luontoliitto.fi/toiminta/kevatseuranta>

The Finnish National History Museum provides the opportunity for everyone to join its **phenology research scheme**. It covers certain species of mammals, birds, fishes, reptiles and amphibians, plants, mushrooms, as well as berry sightings in spring and autumn, plus snow and ice conditions. The reporting form can be filled in online or by sending a paper form. Reports for the period 2008-2011 are available on the website.

<http://www.luomus.fi/en/node/114>

There are numerous other data gathering activities, in which qualified bird watchers, fishermen, hunters, hobby naturalists and other members of NGOs give their valuable contribution to the professional partners. Some examples include bird ringing (main partner: the Finnish Museum of Natural History); bird monitoring (partners: the Finnish Museum of Natural History and Birdlife Finland); and butterfly/ moth/ dragonfly/ mushroom / vascular plant etc. monitoring (partners: various NGOs).

The list of activities below gives a number of examples in which the 'laymen' have a crucial role in data and information gathering. The websites provide the methodology and protocols for data gathering and the forms that can be downloaded, filled in and sent to the Finnish Museum of Natural History:

Winter bird census 'Talvilintulaskennat':

<http://www.luomus.fi/seurannat/talvilintulaskennat/index.htm>

Nest record scheme 'Pesäkortit':

<http://www.luomus.fi/fi/pesakorttitutkimuksen-ohjeet>

Winter feeding site count 'Ruokintapaikkaseuranta' (also mammals are counted):

<http://www.luomus.fi/fi/ruokintapaikkaseuranta>

Breeding land bird point counts (annual changes) ‘Pesivän maalinuston pistelaskenta’:
<https://www.luomus.fi/fi/linnustonseuranta>

Census of breeding waterfowl ‘Vesilintulaskenta’:
<http://www.luomus.fi/fi/vesilintujen-laskentaohjeet>

Archipelago bird census ‘Saaristolintulaskenta’:
<http://www.luomus.fi/fi/saaristolintulaskenta>

The survey of Finnish herpetofauna ‘Sammakkoeläin- ja matelija-atlas’:
<http://laji.fi/sammakot-ja-matelijat?locale=en>

Insect survey ‘Hyönteiskartoitus 81’:
http://it.hatikka.fi/public_query2.php?queryid=0.1740

The National Butterfly Recording Scheme in Finland (NAFI) ‘Päiväperhosseuranta’ (Hatikka, Etelä-Karjalan Allergia- ja Ympäristöinstituutti ja Suomen Perhostutkijain Seura):
<http://www.luomus.fi/nafi/>

Seal observations ‘Hyljehavaintojen ilmoituslomake’:
<http://www.rktl.fi/riista/hylkeet/hyljehavainnot/>

Wildlife triangle scheme:
http://www.rktl.fi/riista/ohjeet_lomakkeet/riistakolmiot/

Field triangle scheme:
http://www.rktl.fi/english/news/wildlife_monitoring_in.html

Baltic Sea Alien species observations ‘Itämeren vieraslajihavaintojen ilmoituslomake’:
<http://www.riistakala.info/vieraslajit/index.php>

Crayfish observations:
<https://www.webropolsurveys.com/Answer/SurveyParticipation.aspx?SDID=Fin208862&SID=3d1864ea-ed6f-4b91-9b1c-fd2a5db73777>

Fish tagging ‘Kalamerkin palautus’:
http://www.rktl.fi/kala/kalavarat/kalamerkinta/palauta_kalamerkit/

2.2.7 France

Vigie-Nature is a French citizen science programme, which has the intention to monitor the condition of ordinary nature at national scale while using specific species groups as indicators, and to understand the impact of human activities and climatic change on biodiversity. It is coordinated by a research unit based at the National Museum of Natural History (MNHN) in Paris. Vigie-Nature was launched in 1989. Twenty years later, it brings together monitoring programmes of different species groups (common birds, butterflies, pollinators, plants, snails, butterflies, wild pollinators). The monitoring programmes all depend on networks of volunteers (about 10,000 people in total), who collect biodiversity data close to their homes. Protocols and sampling plans are specifically designed to obtain structured datasets, which allow comparisons over time and space, and matching volunteer profiles (naturalist amateurs, novice individuals, natural resource managers) regarding their constraints and expectations.

Each programme part of Vigie-Nature is based on a partnership with one or several non-profit organisations, which are responsible for the leadership of the network of volunteers. The MNHN is responsible for the design of the monitoring schemes and the data processing (datasets are stored at the MNHN). Annual accounts are sent to volunteers that summarize the most recent scientific results of the Vigie-Nature research team. Training sessions and local gatherings are organized when possible.

The data collected by Vigie-Nature is published on the French species information system by the INPN (Inventaire National du Patrimoine Naturel: <http://inpn.mnhn.fr/isb/accueil/index?lg=en>).

www.vigienature.mnhn.fr

As part of the general portal of biodiversity information in France (Inventaire National du Patrimoine Naturel – INPN), a contribution by citizens was organised for the observation and monitoring of the *Vespa velutina nigrithorax* (**the yellow-legged hornet**) which is an active predator of the honeybee. It has been unintentionally introduced to France before 2004 through the horticultural trade. A part of this monitoring project is coordinated by the French Museum of National Natural History (MNHN). It aimed at monitoring the spread of *V. v. nigrithorax* in France through public warning. A downloadable spreadsheet and an Internet form is available at: http://inpn.mnhn.fr/fichesEspece/Vespa_velutina_fichiers/Fiche_signalement_Vespa.pdf. The spreadsheet has been distributed to state and regional services, firemen and municipal services, private wasp controllers and individual public, as well as through networks of naturalists and beekeepers. A photo of the nest or its inhabitants is requested for each reporting. Indeed, despite the distinctive colour of *V. v. nigrithorax* among European insect fauna, almost 30% of identifications are wrong (Rome et al., 2011). Verification of the data is thus essential, while being very time consuming (extending over almost 6 months every year). All verified data is stored in an online biodiversity database held by the MNHN (INPN/CardObs, <http://inpn.mnhn.fr>). A map showing the yearly spread of *V. v. nigrithorax* is accessible on this website.

Climatic suitability models have been used to predict the potential invasion risk of *V. v. nigrithorax* from the records collected of the invasive range and from the native range. They show that the potential expansion of *V. v. nigrithorax* concerns almost all European countries (Villemant et al., 2011). The page dedicated to *V. v. nigrithorax* on the INPN website is regularly updated. In 2010, a Spanish version was added (the hornet has been reported for the first time in Spain in late 2010). This page provides general information about the invasion, possible confusion with other insect species and recommendations about its control. Several articles and fact sheets, and a slideshow are also downloadable.

<http://inpn.mnhn.fr>

The French National Hunting and Wildlife Department (Office National de la Chasse de la Faune Sauvage – Oncfs) collects information on the occurrence of **large carnivores (wolf, lynx, and brown bear) in France** with support of experts, and the wider public of individual sightings, which result, *inter alia*, in a distribution map.

<http://www.oncfs.gouv.fr/Grands-carnivores-loup-lynx-ours-ru245/Grands-carnivores-Docs-telechargeables-ar469>

The online network **Visionature** has been launched in 2007 by the French Bird protection league (LPO). It enables any registered citizen to share georeferenced observation data on fauna, mainly on birds (more than 90% of data), but also on other species groups. Different regional websites, and a national website, store about 10,000,000 observations. An interactive map shows data entries on a real time basis. These datasets are used to produce presence maps and atlas.

<http://www.ornitho.fr/>

A similar logic underlies the action of **TelaBotanica – The French botany network**, the association of French speaking botanists (15,000 members), with its online database, the ‘online notebook’ (Carnet en Ligne), that gathers about 100,000 data on flora, mainly in France but also in other countries.

<http://www.tela-botanica.org/site:accueil?langue=en>

The **Seasonal Observatory**, run by TelaBotanica, encourages people to observe the climate change impacts on fauna and flora while contributing with phenology observation data to an Internet supported tool.

<http://www.obs-saisons.fr/about>

Founded by the National Museum of Natural History (MNHN) and TelaBotanica and supported by governmental and non-governmental organizations, the public scheme '**sauvages de ma rue**' (**wildness of my road**) encourages citizens to observe wildlife and to send in the information with the help of a form. The results are used, inter alia, for an accessible list of detected species on the map on the Internet.

<http://sauvagesdemarue.mnhn.fr/sauvages-de-ma-rue/presentation>

A range of other voluntary **citizen science biodiversity knowledge projects in France** can be found at:

<http://www.jagispourlanature.org>

2.2.8 Germany

The **German Association of Ornithologists** (Dachverband Deutscher Avifaunisten (DDA)) coordinates bird census projects in Germany with the support of many volunteers, in cooperation with the Ländergemeinschaft der Vogelschutzwarten (LAG-VSW), the German Agency for Nature Conservation (BfN) and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Results are presented in regular reports on the status of birds in Germany.

http://www.bfn.de/0304_vogelmonitoring-pdm.html

The Naturschutzbund Deutschland e.V. (NABU) organized together with the Dachverband Deutscher Avifaunisten (DDA) a nationwide survey of the Common Cuckoo (*Cuculus canorus*) in 2008. The results are intended to contribute to the **Atlas of German Breeding Birds**.

<https://www.nabu.de/tiere-und-pflanzen/aktionen-und-projekte/vogel-des-jahres/2008-kuckuck/07228.html>

The Naturschutzbund Deutschland e.V. (NABU) encourages the wider public in Germany to count during a designated '**hour for garden birds**' ('Stunde der Gartenvögel').

<http://www.nabu.de/aktionenundprojekte/stundedergartenvoegel/index.html>

In 2005, the Helmholtz Centre of Environmental Research (UFZ) initiated a **nationwide butterfly sightings** scheme in cooperation with Butterfly Conservation Europe. The sightings scheme is carried out by volunteers, with scientific support and data handling by the UFZ, and the assistance of regional coordinators.

<http://www.tagfalter-monitoring.de/>

Sightings of the non-native species **Common Ragweed** (*Ambrosia artemisiifolia*) can be registered via an online form to a scientific project on ragweed. The results are used, *inter alia*, to produce an online distribution map in Germany.

<http://www.ambrosiainfo.de/kontakt.html>

Using the **Ambrosia Scout**, people can actively participate in the fight against the **Common Ragweed** (*Ambrosia artemisiifolia*) in Germany. With the smartphone app, it is possible to report the locations of

ragweed. These data are stored in a central database at the Free University of Berlin, in the so-called **Ambrosia Atlas**. This helps the authorities to detect and eliminate occurrences of ambrosia. People are also welcome to destroy the plants on site themselves.

<http://alphablind.com/portfoliomenu/ambrosia-scout/>

The **German Hunting Association** ('Deutscher Jagdschutz-Verband e.V. (DJV)') monitors wild game species (e.g. red fox, brown hare, European rabbit, badger, carrion crow) with the voluntary support of e.g. landowners in the Federal States of Germany, *inter alia*. The results of the monitoring are used for producing distribution maps.

<http://www.jagdverband.de/content/wild-monitoring>

The **German Phytodiversity Network (Netzwerk Phytodiversität Deutschland NetPhyD)** coordinates census projects on the Flora of Germany, which are supported and carried out by many volunteers organized in regional non-governmental organizations. NetPhyD cooperates with the German Agency for Nature Conservation (BfN), where all census data are collated on national level. The floristic data is made public, and it is provided to GBIF via the portal FloraWeb, which is maintained by the BfN.

www.floraweb.de

The North Rhine-Westphalian State Agency for Nature, Environment and Consumer Protection runs an Internet portal called 'Neobiota-Portal Nordrhein-Westfalen', where people can report and view sightings of alien species introduced after 1492 ('Neobiota'). The results are used, *inter alia*, to produce online distribution maps. The Neobiota-Portal also informs about invasive and potentially invasive species in North Rine Westphalia.

<http://neobiota.naturschutzinformationen-nrw.de/site/>

The GBOL project has the goal to capture the diversity of German animals, fungi and plants based on their genetic DNA barcodes (fingerprint). This will contribute to the 'DNA barcode library of life' gathering the data for the whole world. As of December 2011, there are more than 1.5 million DNA barcodes of more than 145,000 described species already recorded in the BOLD database (<http://www.boldsystems.org/>). GBOL is a German wide network of various natural history museums and other biodiversity research institutes. However, professional taxonomists rely also on the active support and cooperation of volunteer collectors from all over Germany.

<https://www.bolgermany.de/gbol/was-ist-gbol>

2.2.9 Greece

COMBER (Citizens' Network for the Observation of Marine BiodivERSity) is a pilot project within the EU Seventh Framework Programme (FP7) financed Virtual Biodiversity Research and Access Network for Taxonomy (ViBRANT) project. COMBER intends to engage citizens in science, in particular divers and snorkelers, in sharing their observations of coastal marine biodiversity. This project, operating originally in the Cretan Sea and Southern Aegean of Greece since 2011, could potentially be extended to the entire Mediterranean Sea or Europe. The web site functions as a communication, and data collection tool. COMBER also aims to provide coastal marine biodiversity data to large biodiversity species registries such as GBIF or OBIS and to be published by electronic media such as PENSOFT. The focus is on fish species. The payable BIOWATCH underwater fish card (<http://www.bio-watch.com>) is

used as identification support. Training has been carried out for voluntary participants. Drupal (<http://www.drupal.org>) is used as free Content Management System (CMS) to operate the observation data management system.

<http://www.comber.hcmr.gr>

<http://www.pensoft.net/journals/zookeys/article/2149/abstract/>

2.2.10 Hungary

The state governed **Hungarian National Biodiversity Monitoring System (HBMS)** collects data with the support of experts and volunteers on the biodiversity of fauna and flora in Hungary. The results are used in maps and reports.

<http://www.termesztvedelem.hu/nbmr>

2.2.11 Ireland

The **National Biodiversity Data Centre** run a series of recording schemes, including mammals, dragonflies, larger moths, water beetles, ladybirds and molluscs. Most recording schemes operate on an All-Ireland level, in collaboration with CEDaR in Northern Ireland. Since the establishment of the National Biodiversity Data Centre in 2007, much effort has gone into providing coordination of biological recording initiatives at the all-Ireland level. This approach was adopted to benefit from collaboration, assist identification of knowledge gaps and to avoid duplication and dissipation of effort.

Of particular note, is the **Irish Butterfly Monitoring Scheme** established in 2007 and run in conjunction with Butterfly Conservation in the UK and Butterfly Conservation Europe. On average some 50,000 butterflies are recorded each year, by more than 100 volunteers who walk a fixed transect within a specified grid square each week from 1 April to 30 September each year.

<http://butterflies.biodiversityireland.ie/>

In addition to the butterfly monitoring there is a **bumblebee monitoring scheme** that operates to a similar model of volunteer participation.

<http://pollinators.biodiversityireland.ie/>

A scheme to encourage the general public to watch out for and submit sightings of Alien Invasive species has also been launched by the National Biodiversity Data Centre.

<http://invasives.biodiversityireland.ie/spot-the-alien/>

Ireland's annual **Bioblitz** brings together professional, amateur and student recorders (more than 220 in 2014) in a fun race to identify the most species from a specific area over a 24 hour period.

<http://bioblitz.biodiversityireland.ie/>

The Centre releases a suite of online recording forms that enables volunteers and professionals to submit observations of any species directly to the Centre, thus greatly expanding the support system available for citizen science projects.

Ireland's National Bat Monitoring Programme includes several separate projects which involve data gathering by volunteers. These schemes, which are run by an NGO, **Bat Conservation Ireland**, with

funding from the government, provide basic training to non-specialist members of the public to allow them to gather reliable data. Data collation and analyses is then completed by professionals.

<http://www.batconservationireland.org/what-we-do/monitoring-distribution-projects>

Examples of other surveys which have also been largely based on public records include national lizard and smooth newt surveys, organised by the **Irish Wildlife Trust**.

<http://iwt.ie/>

The **Irish Peatlands Conservation Council**'s frog spawn survey is largely aimed at schools and schoolchildren. It is focusing on the Common Frog (*Rana temporaria*). Children are invited to go into the nature and record information on the frogs in their localities. The forms and the instructions on how to collect data are supplied on the website.

<http://www.ipcc.ie/help-ipcc/hop-to-it-national-frog-survey-irelandcard/>

The **Irish Whale and Dolphin Group** has a facility for members of the public to submit casual sightings of cetaceans. They also hold frequent whale watching public events at prime locations.

<http://www.iwdg.ie/content.asp?id=18>

BirdWatch Ireland in collaboration with the National Parks and Wildlife Service and others, manages a series of bird sightings schemes for Ireland. A full list can be found on the following website:

<http://www.birdwatchireland.ie/Ourwork/Volunteersurveys/tabid/1217/Default.aspx>

Of particular relevance is the new **SpringAlive** survey: a simple birdwatching survey where people can register their first sightings of Swallow, Cuckoo, Swift and White Stork.

<http://www.springalive.net/en-ie>

Also important is the recently completed **Bird Atlas** project, which was run in collaboration with the British Trust for Ornithology where it was possible for citizens to submit their records.

<http://www.bto.org/volunteer-surveys/birdatlas>

The **Golden Eagle Trust** and **Irish Raptor Study Group** encourage visitors to the website to report sightings of raptor species online.

<http://www.goldeneagletrust.org/>

Members of the **Irish Whooper Swan Study Group** record and monitor Irish sightings of whooper swans, together with details of flock sizes and habitat use the website **Biology.ie** is an interactive tool for inviting the wider public to record sightings of Irish wildlife directly into a map.

<http://www.biology.ie/>

The **iSPYnature website**, run in collaboration with the National Parks and Wildlife Service and aimed specifically at school children has been a particular success. The children could choose the group they are interested in surveying, (e.g. trees, wildflowers, ferns, mosses, birds, butterflies etc.). Guides and field sheets are available on the website. It is also possible to add the sightings to the map directly on the website.

<http://ispynature.com/>

2.2.12 Italy

The ‘**Divers for the Environment: Mediterranean Underwater Biodiversity Project**’ was a state supported project, which involved professional and voluntary divers in surveying certain marine species in Mediterranean Sea in Italy from 2002 to 2005. The project resulted, *inter alia*, in online maps of the abundance of the red coral, the macroalgae *Posidonia*, and the fish species Dusky Grouper along the Italian Mediterranean coast.

<http://www.marinesciencegroup.org/SPA/indexITA.htm>

2.2.13 Luxembourg

The Natural History Museum in Luxembourg is actively working with citizen scientists and the Ministry in collecting and storing data. The citizens can enter their observations on vertebrates, plants, and insects directly into the Data Portal on the museum website, including the locations — either by marking them on the map or by entering GPS coordinates. It is also possible to see the map with all the observations.

http://data.mnhn.lu/en/maach_mat

The **Luxembourg Naturalist Society** was founded in 1890, and it has 400 members. It has three working groups: botanical, entomological and mycological. The botanical working group brings together Luxembourg botanists interested in vascular plants. The activities mainly comprise excursions, the publication of floristic notes in their bulletin, and collection of data to publish an atlas of the endangered plants of Luxembourg. People interested in the study of the insect fauna of Luxembourg and surrounding areas get together at the Entomological Working Group. Their main objectives are gathering an inventory, the follow-up, a hierarchical categorization, and the conservation of the entomological fauna. They regularly publish the results of their research, in particular in their bulletin. The mycological working group brings together people interested in the study of the fungi of Luxembourg. The goal is to seize the observations in a database, to preserve specimens in herbaria, to describe the recorded fungi, and to publish the results of the research activities.

<http://www.snl.lu/the-luxembourg-naturalist-society/#botanical-research-group-of-the-snl>

2.2.14 Malta

The University of Malta coordinates together with the International Ocean Institute and support of the Malta Tourism Authority, a ‘**spot the jellyfish campaign**’. People can enter sightings online, by sms, or by e-mail. A summary map of jellyfish sightings, accessible on the Internet, is one of the results. More than 450 sightings of 13 different jellyfish species have so far been noted by the public.

https://www.um.edu.mt/news_on_campus/researchinitiatives/archive/spotthejellyfish2011

The **Biological Conservation Research Foundation (BICREF)** monitors marine species in the seas and coasts of Malta with the contributions of observations or sightings of citizens. Citizens are invited to submit their observations and sightings of various species out at sea or along Maltese coast by email.

<http://www.bicref.org/sighting-reports/>

The **Department of Biology of University of Malta** conducts research on marine biodiversity within the Central Mediterranean Region around the Maltese Islands (from coastal to offshore) including on: turtle, dolphin, whale, and jellyfish blooms sightings. Mariners are requested to cooperate and support the research by reporting sightings.

<http://news.transport.gov.mt/tag/dolphins/>

2.2.15 *The Netherlands*

The **FLORON** project (Flora Onderzoek Nederland, Flora Research the Netherlands), the national flora inventory in The Netherlands – aims at mapping the distribution change of all naturally occurring vascular plant species in The Netherlands. The FLORON project is coordinated by the FLORON Foundation. The project fully covers the entire country of The Netherlands.

A related project focuses on the distribution and monitoring of ‘typical plants’. It includes all plant species listed in EU Habitats Directive Annexes in Natura 2000 areas.

The data is stored at the FLORON national bureau (FlorBase), which is integrated in the National Database of Flora and Fauna (NDFFF). Data is used for national distribution maps; local occurrence/distribution trends over time (for selected squares or Natura 2000 areas). Aggregated data can be requested from the national bureau. Occasional articles are published in specialized journals.

The most positive outcome of the project is that there is a nationally harmonized and facilitated approach with distributed share of work. Not all plants are covered over the entire country on a regular basis. Therefore targeted projects (e.g. ‘typical plants’ and ‘selected km-squares’) focus on filling data gaps and prioritizing data collection.

<http://www.floron.nl>

The **National Network Butterflies** (‘Landelijk Meetnet Vlinders’) aims to monitor the abundance trends of diurnal butterflies in The Netherlands for research, management, conservation, awareness, and policy purposes. The project is run by the Dutch Butterfly Conservation (Vlinderstichting).

About 700 butterfly counting transects all over The Netherlands are monitored. Some of the transects are located in Natura 2000 sites. Some regions of the country are underrepresented due to lack of volunteers in those regions. All naturally occurring diurnal butterflies are counted and since 2011 13 day active moth species are also counted. The data is stored at the Dutch Butterfly Conservation, Vlinderstichting, which is integrated in NDFFF. The data allows trend analysis for each species on national and regional level, as well as per habitat. The data is also an important input to the Red Lists and as such policy advice (for example, to be presented to parliament). Public awareness and conservation measures are also important outcomes.

<http://www.vlinderstichting.nl/vlinders.php?id=91>

This online reporting system ‘Observation.Com’ allows citizens to share their observations with others, to show the biodiversity of The Netherlands. It is very accessible to a wide audience and there are many applications for users to see their own and other people’s observations. The project is run by the team of waarneming.nl as part of Foundation Natuurinformatie. There is full coverage of the Netherlands (expanded to global coverage via sub sites and observado.org) and all species groups. The dataset allows indicative distribution of species and a list of species per selected area unit or per selected time unit. It is not known whether there is any data validation and there is an overrepresentation of rare species.

<http://www.waarneming.nl>

Telmee invites the wider public to record plants and animals in The Netherlands, which can be entered via an Internet tool. Results are also presented on an online map.

<http://www.telmee.nl/index.php?c=portal&m=home>

2.2.16 *Poland*

Invasive Alien Species:

The **Institute of Nature Conservation of Polish Academy of Science** (<http://www.iop.krakow.pl/>) — a leading body for collecting and disseminating information on alien species via the Internet in Poland, has produced an Internet data base containing a list of Invasive Alien Species in the Polish fauna.

<http://www.iop.krakow.pl/gatunkiobce/default.asp>

The Polish Society for the Protection of Birds (<http://www.otop.org.pl/>) is one of the leading NGOs dealing with environmental protection in Poland. It is the Polish partner of BirdLife International. They are in possession of data concerning invasive alien bird species observed within the framework of several projects. The most interesting project is **ornitho.pl**, which uses a citizen science approach. This is a website designed for sharing, collecting and illustrating ornithological observations for the whole Poland. Observations can be submitted through this website or NaturaList mobile application.

<http://www.ornitho.pl/>

Some observations of alien species are registered in the framework of **Bird Monitoring**, which is a part of the State Environmental Monitoring System coordinated by the Chief Inspectorate for Environmental Protection.

The **Avifaunistic Commission — the Polish Rarities Committee** (<http://komisjafaunistyczna.pl/>) is a team of experts in the field of ornithology, assigned to verify reports of bird species recognised as ‘faunistically important’ to a certain area and period. Acceptance by the Committee is a prerequisite for consideration of a record’s validity, thus for its acknowledgement as a scientific fact at the international level. The Committee also receives information on invasive species.

An Internet service allowing citizens to report observations of the **Red-eared Slider** (*Trachemys scripta elegans*), an Invasive Alien Species, is being developed by the Polish Society of Nature Protection Salamandra and will soon be active.

<http://www.salamandra.org.pl/obcekampania.html>

Other examples:

The Database on monitoring of birds compiles the data collected within the bird monitoring programs conducted in the framework of State Environmental Monitoring System on behalf of Chief Inspectorate for Environmental Protection. It gives access to data on trends in indices of abundance of selected species, data from individual controls taken in sample plots and information about the distribution of sample plots.

The Mammal Research Institute of the Polish Academy of Sciences (MRI PAS) conducts together with the Association for Nature WOLF (AfN WOLF), and the Institute of Nature Conservation (PAS) a **wolf and lynx census** in Poland with support of volunteers since 2000.

<http://www.polishwolf.org.pl/large-predators>

The Institute of Nature Conservation of the Polish Academy of Science (PAS), together with the Zoology Museum and Institute of the PAS, Mammals Biology Institute of PAS and Systematic Zoology Department of Adam Mickiewicz University created an on-line database **Atlas of Mammals of Poland**. This atlas contains maps of distribution of all the mammal species in Poland, including alien species. Maps are updated through the e-mail notifications on new sightings. E-mails, sent by professionals as well as nature enthusiasts are verified by experts who then update the database.

<http://www.iop.krakow.pl/ssaki/>

2.2.17 Portugal

BioDiversity4all is an Internet platform supported by mostly scientific organization and NGOs, where people can report, via an online form, species sightings of various taxa in Portugal. Inputs are validated by experts.

<http://www.biodiversity4all.org/index.cfm?p=48F2A1D1-1DE0-5C8B-DF96BC3E0D8D1520>

2.2.18 Romania

School children and teachers documented traditional knowledge and use of the **Rodna Mountains National Park** as a citizen science project in 2006 for park management purposes. Biodiversity related data was collected with the support of students and organized by the park administration. Also 'Friends of Rodna Mountains' clubs were founded around the protected site.

<http://www.eci.ox.ac.uk/research/humaneco/downloads/rodna/romania-policybrief.pdf>

2.2.19 Spain

The EU Life programme supported **Life Cubomed** science project encourages the wider public to report on jellyfish sightings along the Spanish Mediterranean coast via e-mail.

<http://www.lifecubomed.eu/en/>

2.2.20 Sweden

Swedish citizen science biodiversity knowledge projects are discussed in detail in Chapter 3.

2.2.21 Switzerland

The Swiss **Biodiversity Monitoring Programme** collects biodiversity information, especially of plant and animal species, with professional and volunteer support for reporting the biodiversity status, pressures, and development in Switzerland.

<http://www.biodiversitymonitoring.ch/en/home.html>

The **National Inventory of Swiss Bryophytes (NISM)** is supported by volunteers and professionals and contains about 190,000 datasets recorded in a database located at the University of Zurich, Institute of Systematic Botany with financial support of the Federal Office for the Environment (FOEN).

<http://www.nism.uzh.ch/index.php>

2.2.22 Turkey

KuşBank is an Internet-based spatial database about birds, their science and their distribution, which allows users from anywhere in the world to input and query Turkish bird data. The system provides the facility to download data to an Excel sheet and to analyse them for personal requirements. There are about 300,000 observations registered today. The nature association Doga Dernegi in Turkey, universities, the Turkish government, Birdlife International, and RSPB are responsible for managing the database.

<http://www.kusbank.org>

2.2.23 United Kingdom

The **National Biodiversity Network (NBN)**, which is supported in its data collection by the UK government agencies, NGOs, and volunteers, shares wildlife information through an NBN Gateway. The NBN cooperates on national level with the Biological Records Centre of more than 15 million records of more than 12,000 species in their database, as well as a network of local records centres.

<http://www.nbn.org.uk/>

The **National Bat Monitoring Programme** is funded by JNCC, but run by an NGO – the Bat Conservation Trust, and heavily reliant on volunteers. The aim of the project is to monitor the status of bat species in the UK. The scheme provides the representative samples that allow Article 17 reporting, and records bats as features on protected sites. Data is also used as the basis for other reporting needs e.g. the UK biodiversity indicator and UK BAP reporting. The effort for coordination of the project are circa £146 000 per annum. The scheme covers the United Kingdom.

For some species, reliable country level trends are also produced. Long-term trends and adequate surveillance are made for 11 of 17 UK resident species: greater horseshoe, lesser horseshoe, Daubenton's, Natterer's, whiskered/Brandt's, common pipistrelle, soprano pipistrelle, serotine, noctule, brown long-eared. Trends may be available in the longer term for Leisler's bat and Nathusius' pipistrelle (through the Bats and Roadside Mammals Survey) and Barbastelle (through the Woodland survey).

A systematic survey for mapping the distribution of Bechstein's bat ran from 2008-2010. One species, the grey long-eared bat, has no structured surveillance due to its rarity, restricted range and difficulty to survey. The scheme also records bats as features on Natura 2000 sites and so is used in assessment of these sites.

The scheme relies heavily on volunteer effort. It is extremely good value for money whilst being based on robust science. Approximately 2000 volunteers contribute 24,000 hours a year, at a value of over £800,000 (i.e. over 5 times the coordination cost). The scheme produces reliable trends for 11 bat species, contributes to UK biodiversity indicators, and is vital to meet reporting requirements, for example Habitats Directive.

On the negative side there are multiple methods for recording a species (e.g. colony counts and field surveys) which may produce different results and then interpretation harder. Also there is not enough data to get country level trends for all species and some species are not well covered by the scheme.

Volunteer participation is at the heart of the NBMP and surveys have been designed to be as inclusive as possible, with a range of surveys that require varying levels of expertise. The programme is reliant on having a force of skilled volunteers completing surveys annually. Training volunteers is a key activity of the NBMP. The NBMP Training Strategy is prepared and reviewed each year to maximise the opportunities for volunteers to receive training. Workshops aim to provide volunteers with the bat detector skills they need to complete Field and Waterway surveys, and are centrally managed by the NBMP team and organised and run by a team of Regional Bat Detector Workshop Leaders (RBDWLS). Additional training resources including online training are also available to help encourage additional volunteers to take part in surveys. The programme of training workshops is targeted in each season towards filling any gaps and increasing volunteer participation and retention in areas where it is low or turnover is high.

The data is stored on a database held by the Bat Conservation Trust, and data are made available via the National Biodiversity Network Gateway: <http://data.nbn.org.uk/>. Distribution data is made available via the NBN Gateway (February each year). Results of the NBMP surveys and analysis are reported on an annual cycle:

- NBMP Online Annual Report, which includes individual species trends as official statistics (May each year). This report also includes recommendations for the future direction and progress of the NBMP.
- Summary maps of sites completed for each survey are placed on the website (following the end of each survey season)
- A summary report of findings is also produced for non-specialist audiences e.g. The State of the UK's bats (summer, not always annually)
- Presentation of NBMP results at BCT National Bat conference (Sept)

<http://www.bats.org.uk/pages/nbmp.html>

The **GB Non-Native Species Information Portal (GB-NNSIP)** allows citizen data reporting of selected non-native species via online recording web pages. The project aims to capture new records of 'Alert species' from members of the public in Great Britain to track their arrival/spread, thus allowing timely action to be taken. The users can also access useful information such as species distributions, date of first arrival, strategies and action being taken. There is also a database of non-native species projects in GB to aid communication between people working on non-native species. The Portal was developed by a consortium of partners including the British Trust for Ornithology and the Marine Biological Association, and led by the Biological Record Centre within the Centre for Ecology & Hydrology (CEH) and funded by Defra. The GB-NNSIP is hosted by the Great Britain Non-Native Species Secretariat (NNSS). The annual effort equate to 1 month per year of staff time just for maintaining the GB-NNSIP as up-to-date as possible (this does not include the volunteer effort). There are additional costs in terms of additional development.

Distribution data are provided directly by the **NBN Gateway (The National Biodiversity Network - database containing distributional data for species in the UK)**. The GB-NNSIP is intended to cover all non-native species in GB and provide access to distribution data for over 3000 non-native species in GB. It also includes detailed information on many species, including those which have not yet arrived in GB, but which are likely to do so in the future. A sub-set of species which are having /are likely to have a strongly negative impact have been identified as 'Alert species'. The website allows members of the public to submit records of these species and of 14 easy to identify non-native species (preferably along with a photograph to allow verification), through an online reporting form. Records submitted via the GB-NNSIP web pages are verified by taxonomic experts and submitted to the NBN Gateway so they contribute to the national distribution maps, which are displayed in the species web pages on the GB-NNSIP. The GB-NNSIP relies heavily on species records submitted to the NBN-Gateway by voluntary schemes and societies (led by taxonomic experts), statutory bodies and local record centers. It would be extremely difficult and prohibitively expensive to have this spatial and temporal resolution of records without relying on these groups and the wider public. Experts within voluntary schemes and societies are involved in validating records, and also completing the fields within the GB-NNSIP species register and checking existing entries. Feedback is provided to Individual contributors of records by email. Information is held in three separate databases at CEH. A species register holds names of species together with basic data on where they came from and whether they are established in England, Scotland and Wales, and a factsheet database holds more extensive information on species of particular interest (both on a server at CEH). Distributional data (GB) are held on the NBN Gateway (also held on the CEH server). NBN Gateway data is provided to GBIF so it is readily available at a European scale. The dataset is useful in identifying which non-native invasive species are within GB, where they are within GB, and alerting people to their presence so that appropriate action can be taken by statutory organizations. The GB-NNSIP also feeds into GISIN – the Global Invasive Species Information Network, and DAISIE – Delivering Alien Invasive Species Inventories for Europe.

<https://secure.fera.defra.gov.uk/nonnativespecies/factsheet/index.cfm>

The **Open Air Laboratories (OPAL)** network is a UK-wide citizen science initiative. It is funded by the Big Lottery Fund and it began in 2007, operating across England. Since January 2014, it has been expanded to Scotland, Wales and Northern Ireland thanks to a further grant., It encourages people from

all backgrounds to be directly involved with nature. It conducts, for example, a biodiversity, bugs, water, and soil and earthworm survey. People's records can be entered online. The distribution of carried out surveys is shown as one result on a map of the UK.

<http://www.opalexplorenature.org/surveys>

The **National Amphibian and Reptile Recording Scheme (NARRS)** involves more than 1,400 volunteers, coordinated by the NGO Amphibian and Reptile Conservation (ARC) organisation, for carrying out national amphibian, and reptile surveys.

<http://www.narrs.org.uk/whatisnarrs.htm>

The Botanical Society of the British Isles (BSBI) involves volunteers in their vascular plants and charophytes species distribution surveys in Britain and Ireland such as the **BSBI plant Distribution Maps Scheme**.

http://www.bsbi.org.uk/maps_and_data.html

The **British Bryological Society** organizes recordings of mosses and liverworts with volunteers' support, which results, *inter alia*, in a map description of the findings per county of Britain and Ireland.

<http://rbg-web2.rbge.org.uk/bbs/bbs.htm>

The **British Mycological Society** has many local fungus recording volunteer groups throughout the country, which carry out mapping and description of fungus occurrences.

<http://www.britmycolsoc.org.uk/mycology/recording-network/>

The Centre for Ecology & Hydrology (CEH) Biological Records Centre coordinates together with universities a **UK Ladybird Survey** online for people's sightings of ladybirds, but also of the invasive harlequin ladybird, which results in distribution maps and other outcomes.

<http://www.ladybird-survey.org/>

<http://www.harlequin-survey.org/>

Nature's Calendar is a platform where volunteers can contribute with seasonal (phenological) observations of wildlife. As a result, seasonal species occurrence online maps are produced for the UK among other outcomes.

<http://www.naturescalendar.org.uk/>

The Rothamsted Insect Survey operates two national networks for monitoring insect populations in the UK. A suction trap network, run with the help of the Scottish Agricultural Science Agency and trap operators at sixteen sites, is used primarily to monitor aphids. A light trap network, run with the help of volunteers at about 80 sites in the UK, is used to monitor the larger (macro) moths. Daily samples are taken throughout the year, and altogether over 430 sites have been sampled. The earliest moth records date back to 1933 from a trap on Rothamsted Farm and a national network was in full operation by 1968. The data from both networks have a range of applications in fundamental and applied aspects of insect population dynamics and ecology.

<http://www.rothamsted.ac.uk/insect-survey/>

Butterfly Conservation has access to a massive amount of data about butterflies gathered by volunteers. Butterfly Conservation's general recording scheme is known as **Butterflies for the New Millennium** or **BNM**. It covers all species of butterfly across the British Isles. It is run in conjunction with the national Biological Records Centre (part of the Centre for Ecology and Hydrology) in the UK, and the Dublin Naturalists' Field Club in the Republic of Ireland. BNM was launched when it became clear that butterfly distributions had changed substantially since the previous national survey in the 1970s.

They also organise other volunteer based data surveys, such as **big butterfly count**. The big butterfly count is a nationwide survey aimed at helping us assess the health of our environment. It was launched in 2010 and has rapidly become the world's biggest survey of butterflies. Over 44,000 people took part in 2014, counting almost 560,000 individual butterflies and day-flying moths across the UK

<http://butterfly-conservation.org/111/Butterflies-fortheNewMillennium.html>

<http://www.bigbutterflycount.org/>

Further UK citizen science supported wildlife sightings can be found at the BBC's 'breathing places – a place for nature near you' homepage:

http://www.bbc.co.uk/breathingplaces/wildlife_survey/

3 Detailed example of species monitoring schemes involving volunteers in Sweden

Sweden has a long experience in species monitoring by skilled volunteers. Much of the data collected is stored in a web-portal called The Species Gateway (SG) (www.artportalen.se) regardless of the purpose for the data collection or who collected it. Today, the SG stores more than 30 million observations, including some historical data as well. The Species Gateway is run by The Swedish Species Information Centre of the Swedish University of Agricultural Sciences (SLU) with the support of the Swedish Environmental Protection Agency.

The Swedish example shows that it is possible to gather a lot of high quality data, just because people enjoy using the system. Of course, there is always a demand by private persons and authorities to further develop the system and therefore a need for rigorous maintenance by a dedicated team of skilled people.

Ongoing species monitoring schemes in Sweden with significant participation of volunteers are presented in this chapter. These include both Swedish national monitoring schemes and NGO-organised surveys, monitoring and citizen data reporting.

3.1 National Swedish monitoring schemes with significant participation of volunteers

3.1.1 *Swedish Bird Survey*

A predecessor to the Swedish Bird Survey was started in 1975, with the aim of monitoring the Swedish bird fauna. The project is run and coordinated by Department of Biology at the University of Lund and it is part of the national environmental monitoring scheme since 1980.

The Swedish Bird Survey administers four different monitoring schemes: summer point counts, winter point counts, summer fixed routes and nocturnal species point counts. Fixed routes are spread all over the country in a systematic sample (716 routes); whereas the point counts methods show a strong geographic bias towards more densely inhabited parts of Sweden. About five hundred volunteers are involved

annually. In total, high quality data is gathered for about 150 of the 250 nationally breeding bird species. Loosely connected to the Bird survey are counts of waterfowl (ducks and geese), also administered by the University of Lund.

Species-specific trends are calculated and up-dated yearly. Data is reported in annual reports and on the Internet. Population trends for several species are combined into biodiversity indicators. At the national level, bird indicators are used to assess the progress towards achieving the environmental objectives set by the Swedish parliament. Data is used internationally by the European Bird Census Council (EBCC) to produce the Wild Bird Indicator of the European Union.

<http://www.fageltaxering.lu.se/>

3.1.2 Swedish Butterfly Monitoring Scheme

The Swedish Butterfly Monitoring Scheme is a cooperative project involving the Entomological Society of Sweden, the Swedish Environmental Protection Agency, Lund University, the Swedish University of Agricultural Sciences (SLU), and the Swedish County Administrative Boards.

The project started in 2010 and aims at monitoring changes in the number of Swedish butterflies. In 2010 about 59 fixed-route walks and 108 point sites were visited by 117 volunteers, numbers that are significantly increased during 2011. Surveyed areas are concentrated to the southern third of Sweden, with only five surveillance plots in the northern half of the country. During 2010, almost 30,000 observations were recorded of in total 83 species of butterflies, burnet moths and forester moths (i.e. about three quarters of the Swedish species). All data is reported to, and stored in The Species Gateway.

Nothing much is known about the applicability of the data at this early stage of the project. Presently it is planned to calculate and analyse trends on a national level, and data will also be used internationally within Butterfly Conservation Europe to calculate trends at the European scale.

<http://www.dagfjarilar.lu.se/>

3.1.3 Faunawatchers – Fauna guardians

The Faunawatchers is developed and operated by the Species Information Centre in collaboration with the Swedish Entomological Society, to contribute knowledge and data on Sweden's endangered insects. The main purpose of the project is to engage people to take part in an organized monitoring of threatened insects and spiders, and raise awareness of what data collected in a standardized way can be used for. The choice of species is initially limited to about 75 species distributed mostly among butterflies, moths, beetles, dragonflies and spiders. Some of the species are listed in the Annexes of the Habitat Directive. In the future the scheme may be responsible for monitoring of some of those species.

The Species Information Centre has produced manuals and information sheets on the monitored species. There is also a page on Facebook where members can discuss and share their own photos and observations. It will probably take a couple of years before the program is fully running and the data collected can be used in analyses.

<http://www.artdatabanken.se/>

3.1.4 Swedish National Phenological Network

The aim of the Swedish Phenological Network is to collect phenology data for about 50 different vascular plants. The data is then used by authorities in monitoring, for example climate change. The data is also used by the general public and journalists and to some extent by scientists. The project consists of 250 private individuals that report events in nature, such as flowering or defoliation of a particular species. There are four different levels of phenology watchers:

1. Private persons that submit their reports with their own names (67 % of the reports)
2. Professional reporters (i.e. field stations) (7 %)
3. Private persons that submit their reports with their own names but not necessarily follow the manual (19 %)

4. Anonymous reporters (8 %).

Geographically the project covers the same area as where people live. This means that most of northern Sweden is not covered. The aim is to recruit more observers in the future. There is also an ongoing cooperation with Swedish weather observation stations to obtain better coverage.

The site Naturens kalender is run by the Swedish Phenological Network and supported by SLU's program of Environmental Monitoring and Assessment (SLU FOMA), the Environmental Protection Agency and Formas Research Council.

<http://www.naturenskalender.se/>

3.1.5 Swedish Museum of Natural History

The Swedish Museum of Natural History (NRM) administers several programs involving a large number of volunteers.

The Bird Ringing Centre administers all scientific bird ringing in Sweden. Since 1911, more than 12 million birds have been ringed. Field work is carried out by about 700 licensed bird ringers and annually about 300,000 birds are ringed. A vast majority of the ringers are volunteers. Data is stored at the Museum of Natural History. Results, statistics and interesting recoveries are presented in annual reports and on the web.

Several scientific research programmes at the Swedish Museum of Natural History take advantage, and in some extent depend, on cooperation with the public. The Department of Contaminant Research is appointed by the Swedish Environmental Protection Agency to monitor contaminants in the Swedish natural environment and their deleterious effects on the fauna. Environmental specimens collected and stored in The Environmental Specimen Bank Samples (e.g. carcasses, skulls) are to a large extent collected by the public and sent to the Museum. Data on the occurrence of seals (Grey seal, Harbour seal and Ringed seal), Harbour porpoise and Otter are gathered from the public, either by written reports or by sending a web form.

http://www.nrm.se/en/frontpage.16_en.html

3.1.6 Ottenby Bird Observatory – bird ringing scheme

The standardised bird ringing at Ottenby Bird Observatory is part of the national environmental monitoring scheme run by the Swedish EPA. The bird ringing scheme is partly financed by the Swedish EPA, contributing to a full time employed warden. Ringers and ringing assistant are granted a small allowance to cover food and daily expenses. A photographic guide, meant to facilitate bird ringers in ageing and sexing birds (primarily passerines) of the Scandinavian countries, has been developed and is available online.

<http://www.birdlife.se/start-1.0.81.1/>

3.1.7 Swedish Association for Hunting and Wildlife Management

The Swedish Association for Hunting and Wildlife Management is the largest of the Swedish Hunting associations, with more than 180,000 members. Since 1938 the Swedish Association for Hunting and Wildlife Management has been nationally responsible for the development of hunting and game management, for which it receives funding from the Ministry of Rural Affairs.

The Swedish Association for Hunting and Wildlife Management is in charge of collecting and analysing bag statistics. Reporting is done on a voluntary basis involving tens of thousands of hunters. In addition, individual members and local and regional clubs conduct surveys of important game, notably moose, deer and wild boar. Hunters constitute the largest and most important group of field workers when it comes to surveying large carnivores such as wolf, brown bear and lynx. Bag statistics and game observations are reported to www.viltdata.se a web portal run by the association. Results and statistics are rendered and presented in real time.

<http://jagareforbundet.se/>

3.2 NGO-organised surveys and monitoring

There are five relatively large non-profit organizations in Sweden involved to various degrees in Swedish nature conservation work. The monitoring scheme that involves the most people is the Flora Guardian Network, which started in 1987. Other organizations that are active in conservation work are the Swedish Mycological Society and the Swedish Ornithological Society.

3.2.1 *Swedish Ornithological Society*

The Swedish Ornithological Society (SOF) is the national BirdLife International partner. Today SOF is as a national organisation, acts side by side with a large number of regional and local organisations. The ornithological societies are in charge of the national and regional annual bird reports. Since 1946, members of the society have done countless bird ringing and counting operations (See sections 3.1.1, 3.1.5, and 3.1.6). Today several thousand ornithologists from all over Sweden submit their reports to www.artportalen.se, from which the reporting committees gather data for analysis and presentation. This compilation of faunistic data is done on a completely voluntary basis involving several hundred ornithologists from all over the country. A special case is rare species, where all observations are scrutinised by a Rarities Committee. This is done on voluntary basis to guarantee a high quality reporting. Annual reports are presented in printed form and on the web.

Every year the Swedish Ornithological Society selects one (or maybe two) species of special interest and calls for search and reporting of these species. Normally, species that are known to be underreported are chosen (e.g. sand martin, marsh harrier) with the aim of obtaining better knowledge of their occurrence. Several species have been subject to these inventories on several occasions and this data now provides the best record of population trends and status.

<http://www.sofnet.org/>

3.2.2 *Entomological Society of Sweden*

The Entomological Society of Sweden compiles annual reports of interesting finds of large and small butterflies in the Swedish Butterfly Monitoring Scheme (See sections 3.1.2, and 3.1.3). The reports are published in the Swedish Entomological Journal. The reports are based on member observations reported to the society and partly on observations reported to The Species Gateway. The aim is to gain knowledge of the Swedish butterfly fauna and especially on species that are new to the country and provinces. Even finds of red-listed species and other interesting species are documented in the annual reports. The reports have a 40 year long history and are considered to be the official Swedish CITES reference points.

www.sef.nu

3.2.3 *Regional Entomological societies*

3.2.3.1 Surveys of atlas squares

In the early 2000s entomological interested volunteers in cooperation with County Board and the regional entomological association initiated a number of so-called Atlas Grid Projects “atlasruteprojekt” in southern Sweden. The aim of the project is to look for as many species of butterflies and/or dragonflies as possible within each atlas square (5 x 5 km).

The aim of the dragonfly project is to survey all species of dragonflies in the provinces of Skåne and Östergötland. More than 100 persons have been involved in the survey. All observational data is stored in The Species Gateway and provides useful information on species distribution patterns. The project also produces annual reports and analysis.

<http://www.trollslandor.se/>

3.2.5 Swedish Botanical Society

3.2.5.1 Species of the year – single species reporting

Every year one or a few “species of the year” are targeted for surveillance and reporting by members and the general public on The Species Gateway. The selected species are often rather rare species for which information is weak.

3.2.6 Regional Botanical Societies

3.2.6.1 Regional vascular plant atlases

The main goal of many regional botanical societies is to map vascular plants in their floristic province. In the last 30 years, 16 regional atlases have been published and more are to come. Today the mapping unit is 5 x 5 km grids, but normally the exact position of each species is collected.

3.2.7 Vascular Plant Atlas of Sweden

The Vascular Plant Atlas for Sweden project was initiated in 2008, with the aim of producing a digital atlas by 2018. The Swedish Botanical Society leads the project, in cooperation with all regional botanical societies and the Swedish Species Information Centre. The Species Gateway is the main repository for the distribution data. The main sources are the regional atlases that are developed by the regional botanical societies (see section 3.2.5.1), together with all other projects that collect distribution data with high enough quality. In the first years of the project, the main topic has been to digitalize and import older data from 1980s and 1990s into The Species Gateway.

3.2.8 Flora Guardian

The Flora Guardians is a network of people who are interested in, monitor and raise awareness about threatened plants in Sweden, primarily vascular plants. It currently involves about 400 people. The project was started as an initiative of the Species Information Centre and WWF Sweden. Today the project is coordinated by Swedish Botanical Society, combined with accompanying financial contribution from the Environmental Protection Agency and the Species Information Centre. Currently, the network oversees 10 000 sites with red-listed vascular plants.

A Flora Guardian follows “his/her” species in one or more sites from year to year through regular visits. At an appropriate time, e.g. when the species in bloom, the site is visited in order to count how many individuals there are, take note if there is any threat to the habitat or the plant (desiccation, overgrowth, or anything that may threaten the site) and possibly look for more sites in the vicinity. How often a site should be visited varies from annually to every fifth year.

The Flora Guardian reports their results to The Species Gateway where all data is stored and made available so that the analysis and assessment can be done and that the county councils and other agencies become aware of the present situation. Through regular reports on the species, it is possible to follow the trend of the species and determine, if it is necessary to take action to preserve a species and its habitat. This knowledge of the species is used in nature conservation and flora care work in society. Compilations of Flora Guardians' information is an important input for the assessment of the vascular plants that will be red-listed in Sweden. The information is also used for environmental monitoring, to assess if the national environmental objectives can be achieved and for international reporting.

<http://www.sbf.c.se/>

3.2.9 The Species Gateway in Sweden

The Species Gateway is currently a reporting system used by the public, non-profit organizations and authorities to store data on observations of the species. The Species Gateway is run and coordinated by the Swedish Species Information Centre. It is now possible to report sightings of nearly all species groups. Use of the Species Gateway has gone from merely supporting the needs of birdwatchers to developing databases of bird observations into a system with multiple actors, both professionals and amateurs. Today there are more than 30 million observations in the database. To be able to report sightings you must register your name and receive a password. Each observer will have their names

connected to the observations and so owns the data. This makes validation much easier. Not to have the possibility to report anonymously gives a higher quality of the reports, as you must stand behind the report with your own name. This triggers quality.

Specific validation groups validate and quality assure some of the data reports submitted. Because nearly all data is public (only some highly protected species are not public), there is a continuous validation done by the public. This public validation consists mostly of species determination (photos can be uploaded) and geographical correction. It is extremely efficient; more than 90% of mistakes and misidentifications are identified at this stage before the scientific validation takes place. Validation is based largely on volunteer work. In order to validate the data, it is important that the data is traceable to a person so the he or she can get feedback on the observations that were incorrect (audit trail). In Table 1 a summary is given of what has been reported in 2011 and how much has been reported by individuals in total.

Table 1 Number of observations per group in the Swedish Species Gateway by 18 August 2011 (www.artportalen.se)

	Total	2011	Total %
Birds:	22 478 736	2 340 273	74,5%
Plants and fungi:	5 629 484	408 547	18,7%
Bugs and moths	1 918 760	312 388	6,4%
Rest of vertebrae:	47 673	5 891	0,2%
Fishes:	14 937	8 229	0,0%
Marine invertebrates:	48 462	1 192	0,2%
Summary:	30 151 452	3 076 520	100%

Recent scientific evaluation (Snäll et al., 2011) of the data has shown that citizen-based data on wild-bird populations can be reliable for specific purposes and should be used to complement existing monitoring techniques. Providing that the limitations of the data are fully understood and treated with care, the scientists suggests that maintaining a healthy citizen science data network for use in future assessments of the state of wild bird populations could potentially lead to more targeted and efficient conservation efforts.

Reporting in The Species Gateway species can be seen as the foundation for citizen science. But for it to be used in scientific evaluations, requires that the data is used in a structured way and that the people using the data have accurate knowledge of the background and limitations of the data for just that specific use.

4 Main analysis results of the EuMon project database

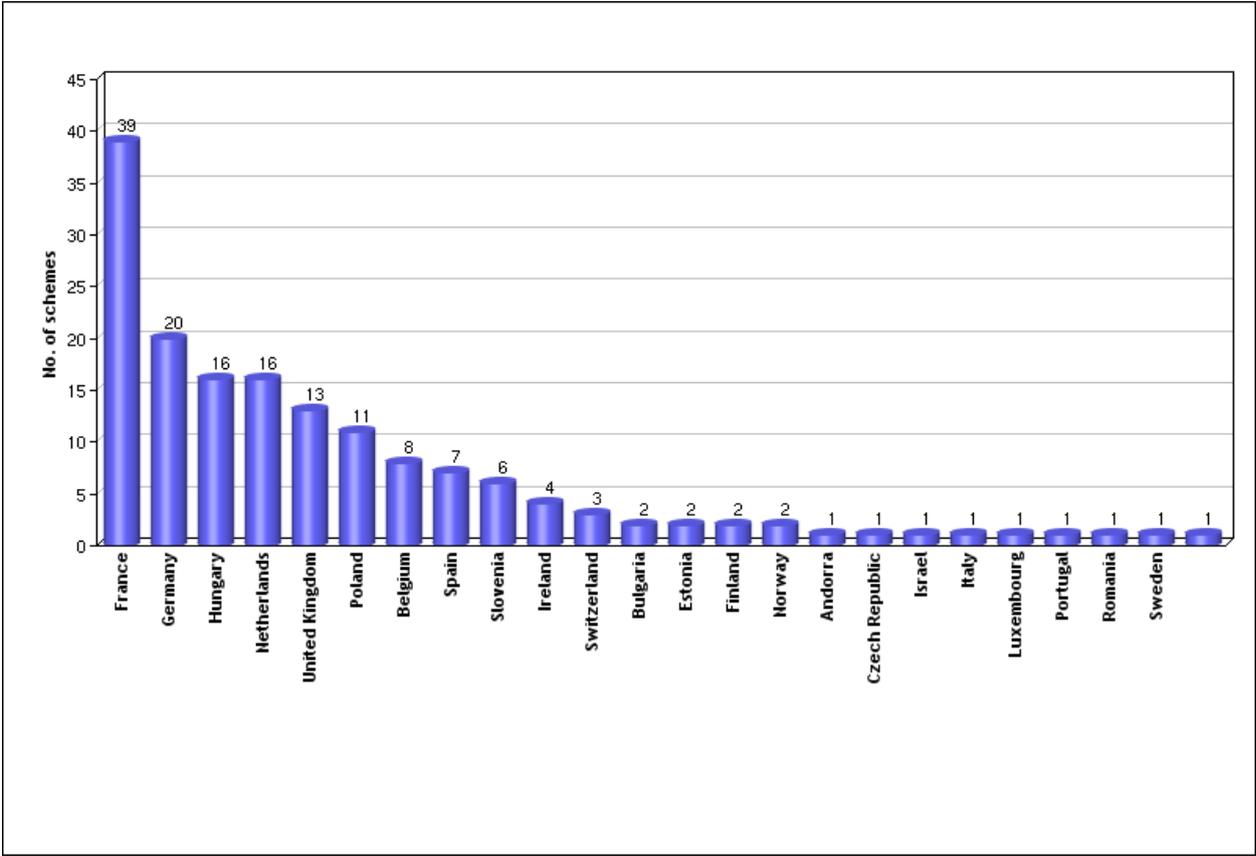
The ‘EU-wide Monitoring Methods and Systems of Surveillance for Species and Habitats of Community Interest’ (EuMon) was a research project funded by the EU Sixth Framework Programme 2004-2008 (CORDIS, 2008). The EuMon consortium constructed an Internet database called ‘DaEuMon’, for collecting and analysing information on monitoring schemes of species and habitats in Europe. It is still open for entries by monitoring scheme coordinators through the EuMon Internet Portal (Framstad et al., 2008). Thus, it contains examples, but it is not a comprehensive database. The database is based on voluntary inputs, which do not necessarily include quality control of the listed EuMon projects. The ‘DaEuMon’ entries are limited to the EU Member States, with a few additional countries, such as Switzerland (EuMon, 2011). By exploring the search function ‘DaEuMon-Search’ (EuMon, 2011) and the

'EuMon BioMAT Tool' (BioMAT, 2011), the EuMon database shows 160 registered species and habitat observation schemes on international, European, national, and regional levels with more than five volunteers. Mainly schemes from the EU are included (BioMAT, 2011; Figure 4.1).

Only two of the citizen science observation schemes deal with habitats of 'forests and woodlands' and just one with 'freshwater habitats', 'natural and semi-natural grassland formations', and 'raised bogs, mires, and ferns' (BioMAT, 2011). As citizen science observation schemes of habitats are only six in total (BioMAT, 2011), the following analysis is only carried out for species observation schemes.

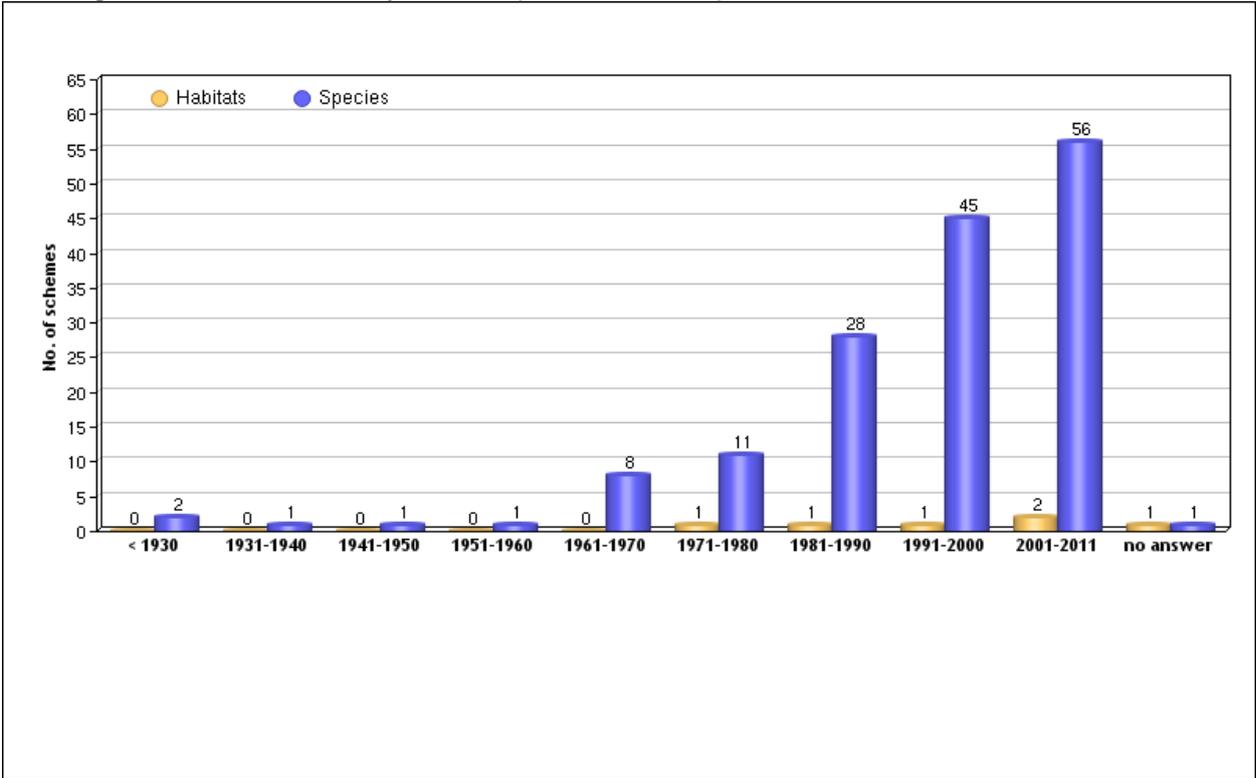
The geographical scope of these citizen science species and habitat observation schemes is mostly national (96 of 160), followed by regional (53), international (8), and only three EU wide (BioMAT, 2011). The search did not include local schemes.

Figure 4.1 Number of registered citizen science species and habitat observation schemes per country with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



Most registered citizen science species and habitat observation schemes (101 of 160) started during last 20 years (Figure 4.2).

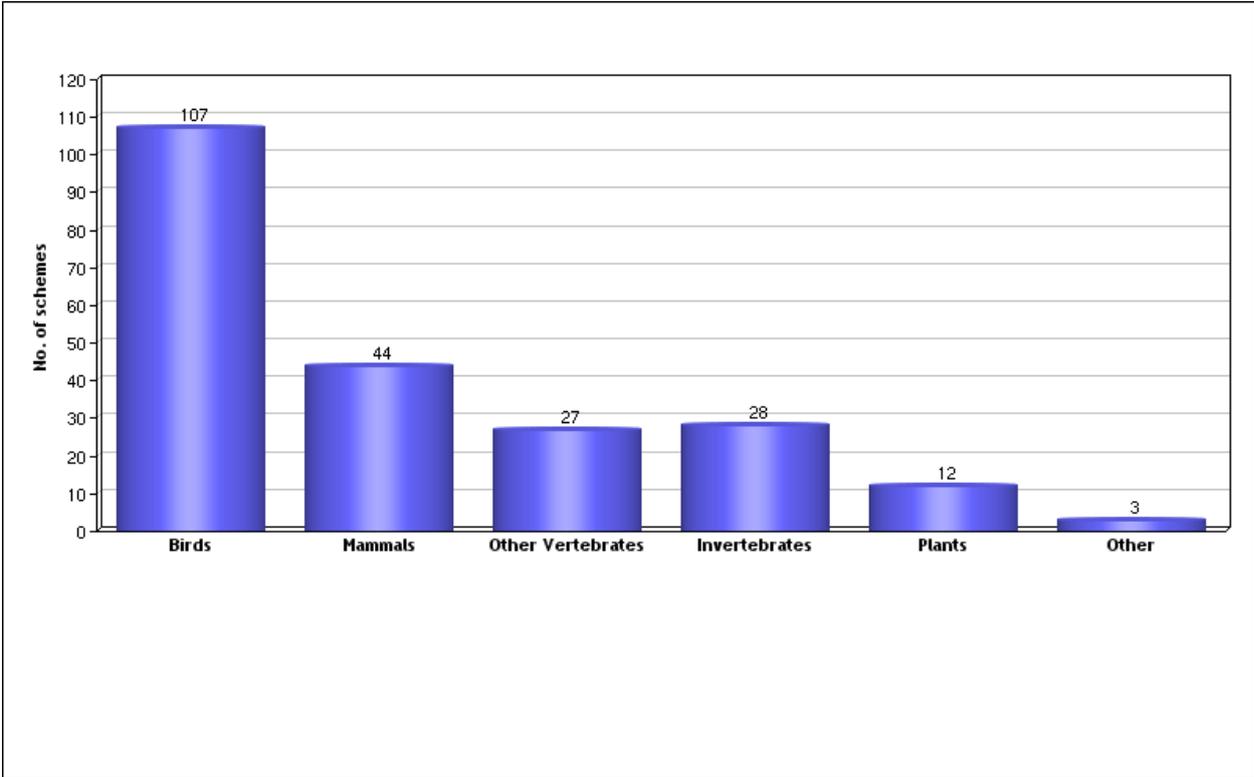
Figure 4.2 Starting decade of registered citizen science species and habitat observation schemes per country with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



Only two of them deal with habitats of ‘forests and woodlands’, and just one with ‘freshwater habitats’, ‘natural and semi-natural grassland formations’, and ‘raised bogs, mires, and ferns’ (BioMAT, 2011).

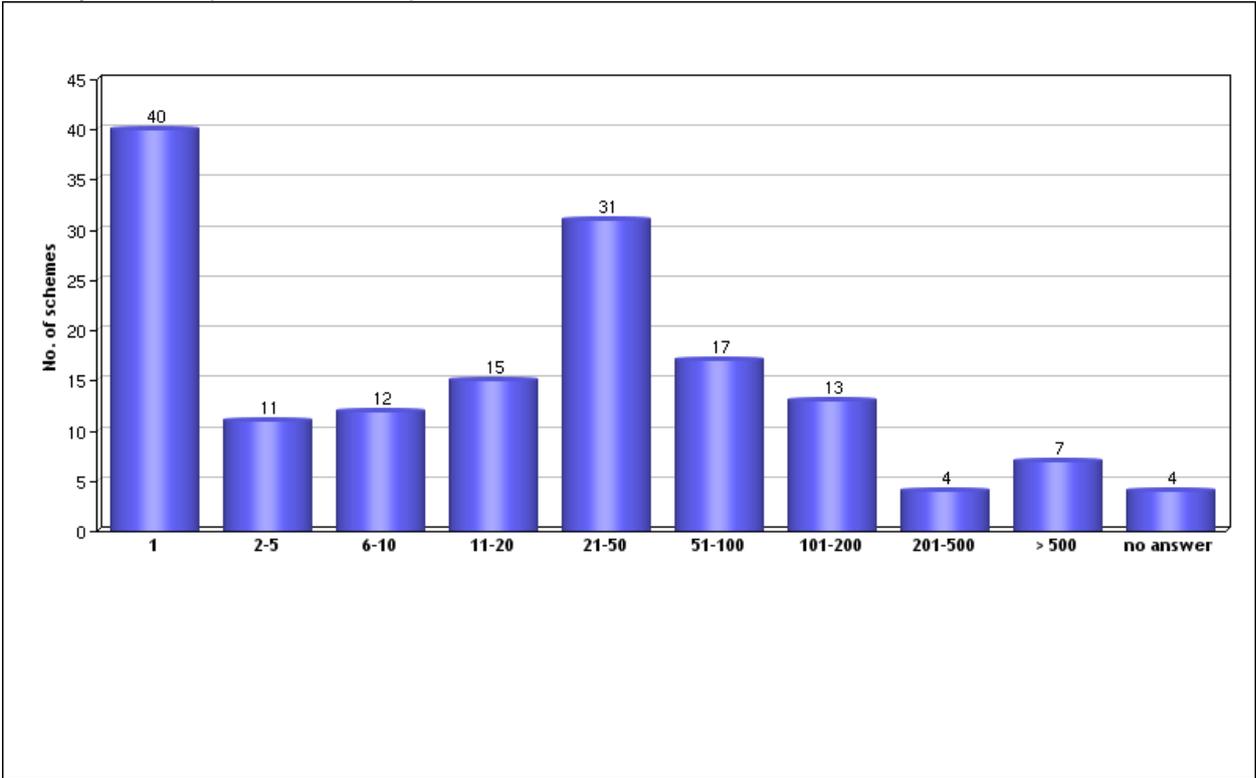
Whereas citizen science observation schemes of species dominate in total (Figure 4.3).

Figure 4.3 Number of citizen science species observation schemes per taxonomic species group with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



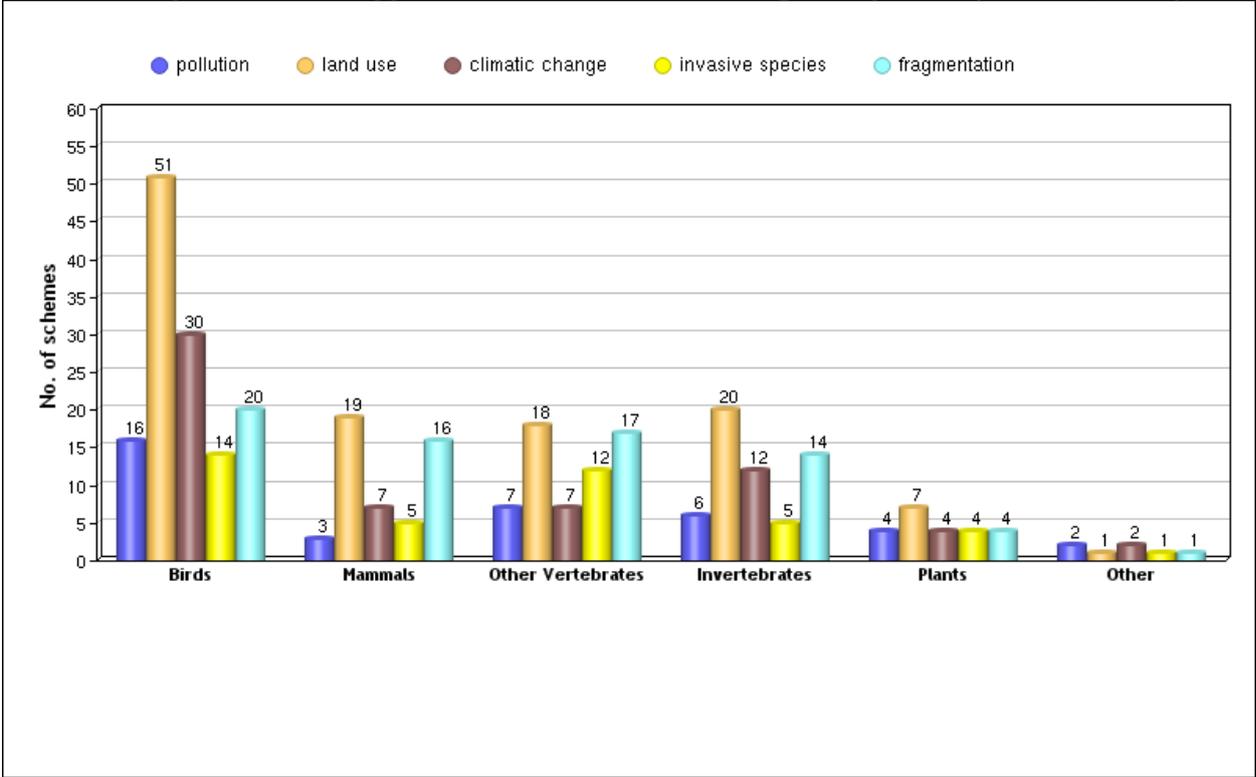
About 40 of these citizen science supported species observation schemes cover only one species, followed by 31 species schemes within the class of 21-50 species (Figure 4.4).

Figure 4.4 Number of species observed in citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



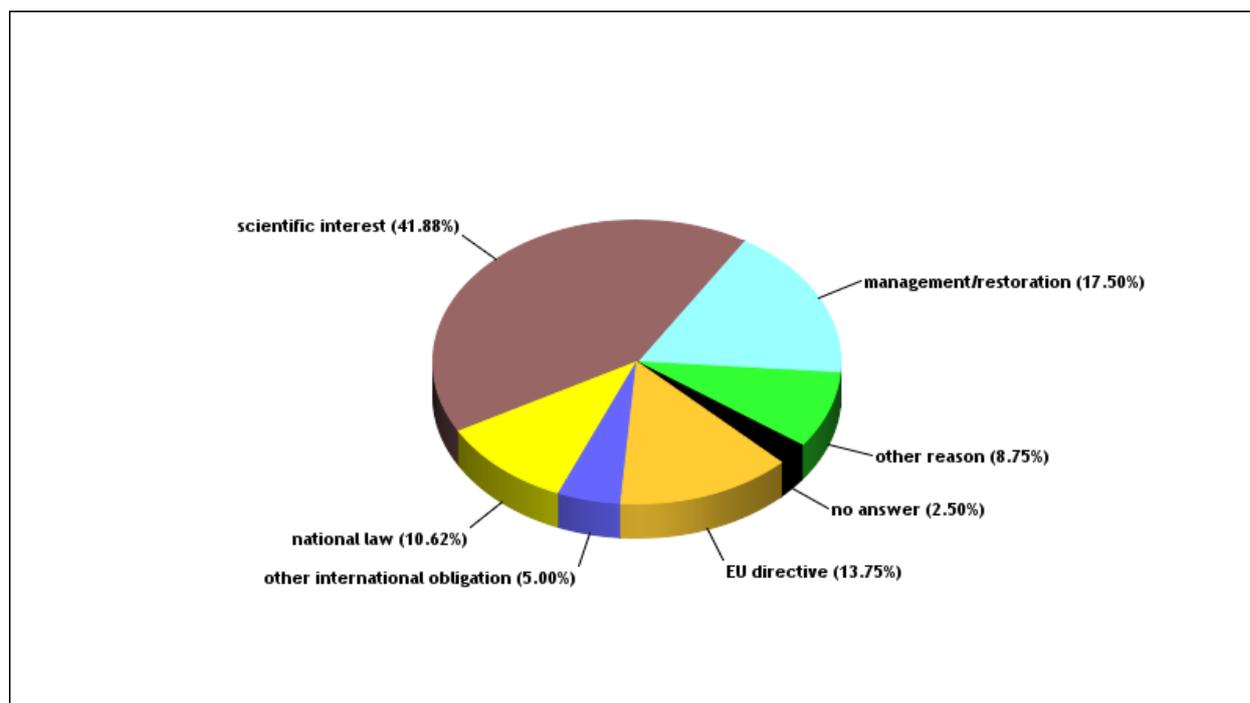
Reasons for the change of species are observed, with citizen science support, mostly regarding ‘land use’, followed by ‘fragmentation’, and ‘climatic change’ equally to ‘pollution’ (Figure 4.5).

Figure 4.5 Number of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU, which survey main driver types of reasons for the change of species (BioMAT, 2011)



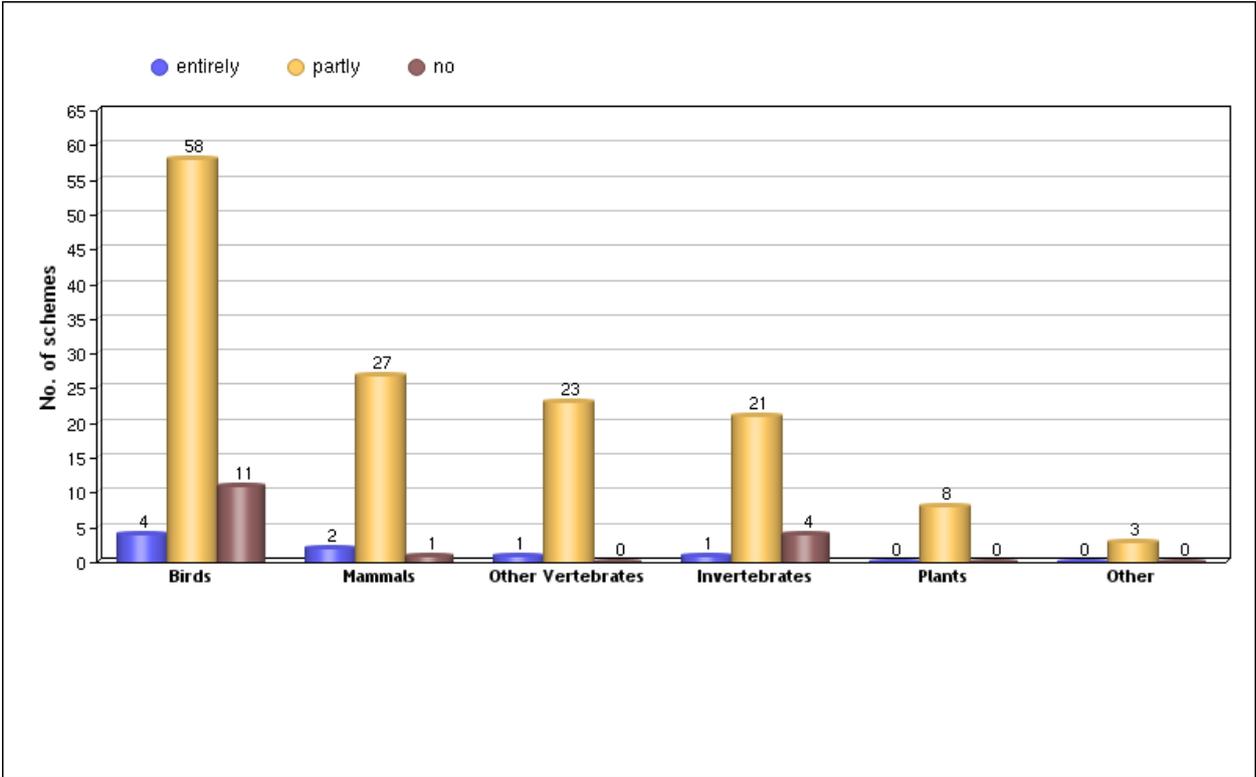
Looking into the interests for launching these citizen science species and habitat observation schemes, 'scientific interest' is the main driver (42%) for launching citizen science species and habitat observation schemes, which is followed by 'management/restoration' (18%) (Figure 4.6).

Figure 4.6 Proportion of interests for citizen science species and habitat observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



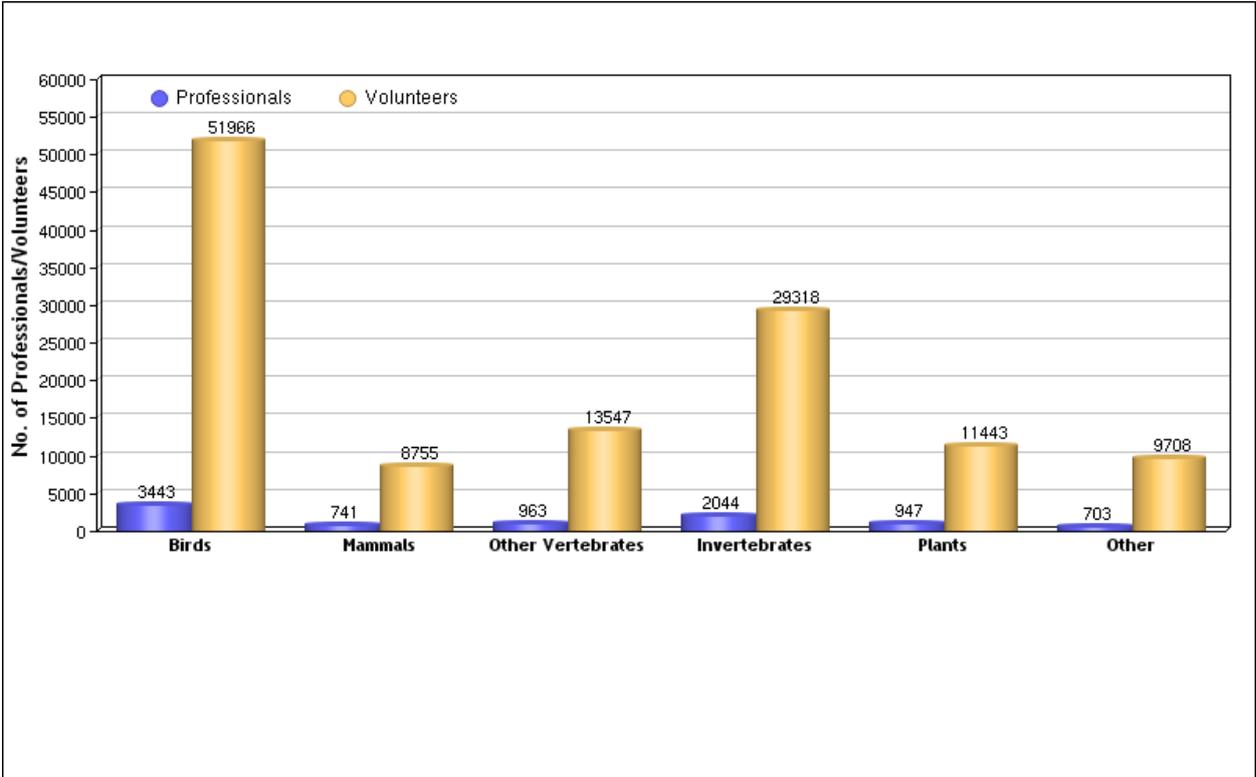
Most of the citizen science species and habitat observation schemes sampling sites are partly located in legally protected areas (Figure 4.7).

Figure 4.7 Number and percentage of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU, which are located in legally protected areas (BioMAT, 2011)



It is interesting to note the small number of professionals (< 9%) versus the number of volunteers, which are involved in these citizen science species observation schemes (Figure 4.8).

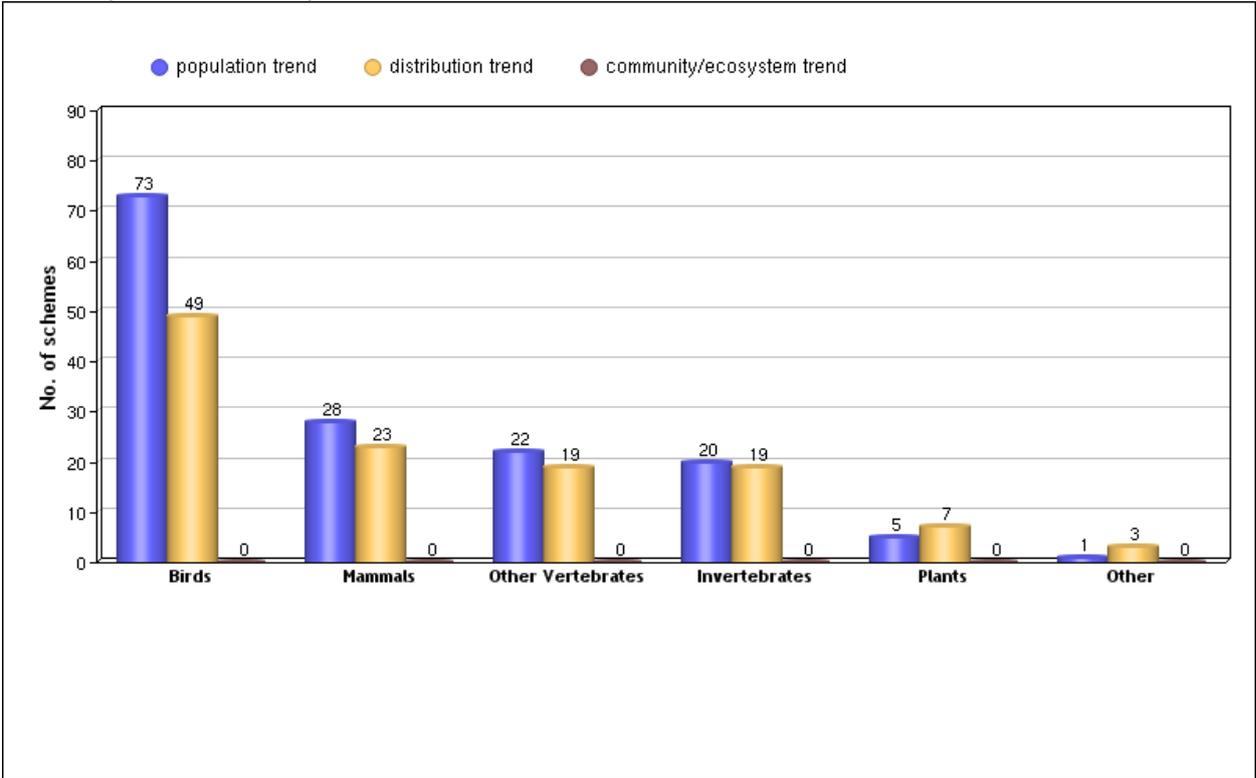
Figure 4.8 Number of professionals and volunteers in citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



More than 2/3 of these citizen science species observation schemes require some type of training and expert knowledge (BioMAT, 2011).

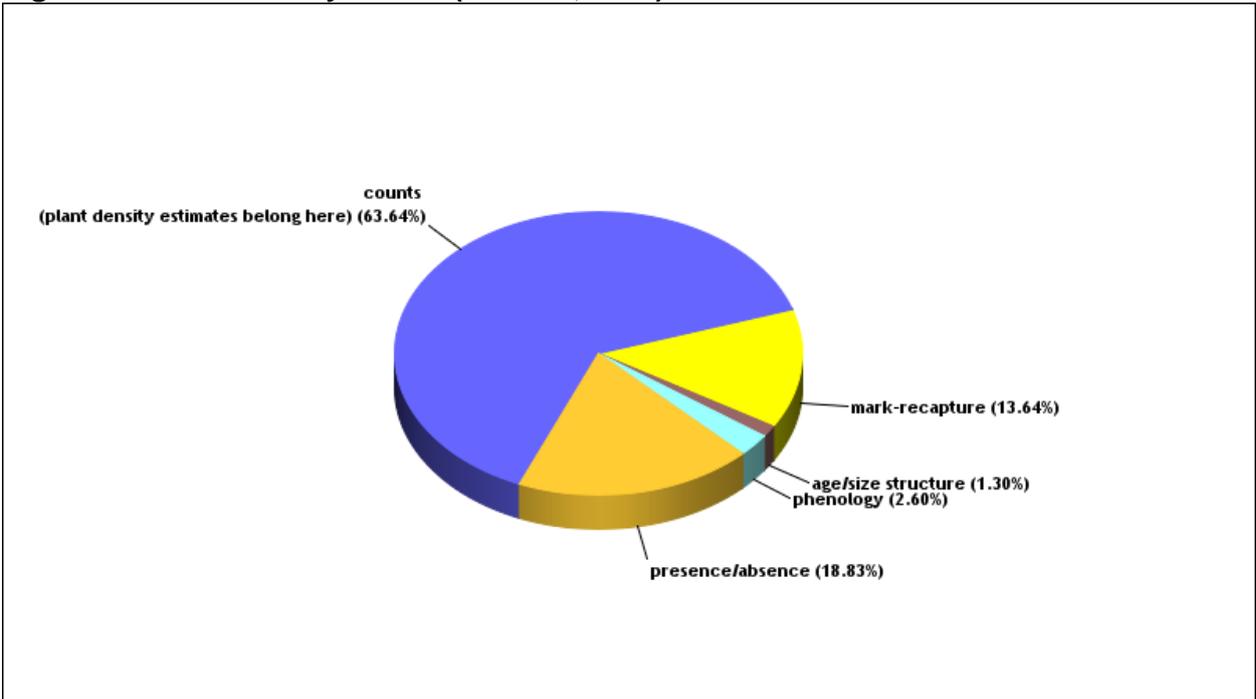
Population, and distribution trends are in focus of these citizen science species observation schemes, while community/ecosystem trends are not particularly envisaged (Figure 4.9).

Figure 4.9 Number of citizen science species observation schemes focus type with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



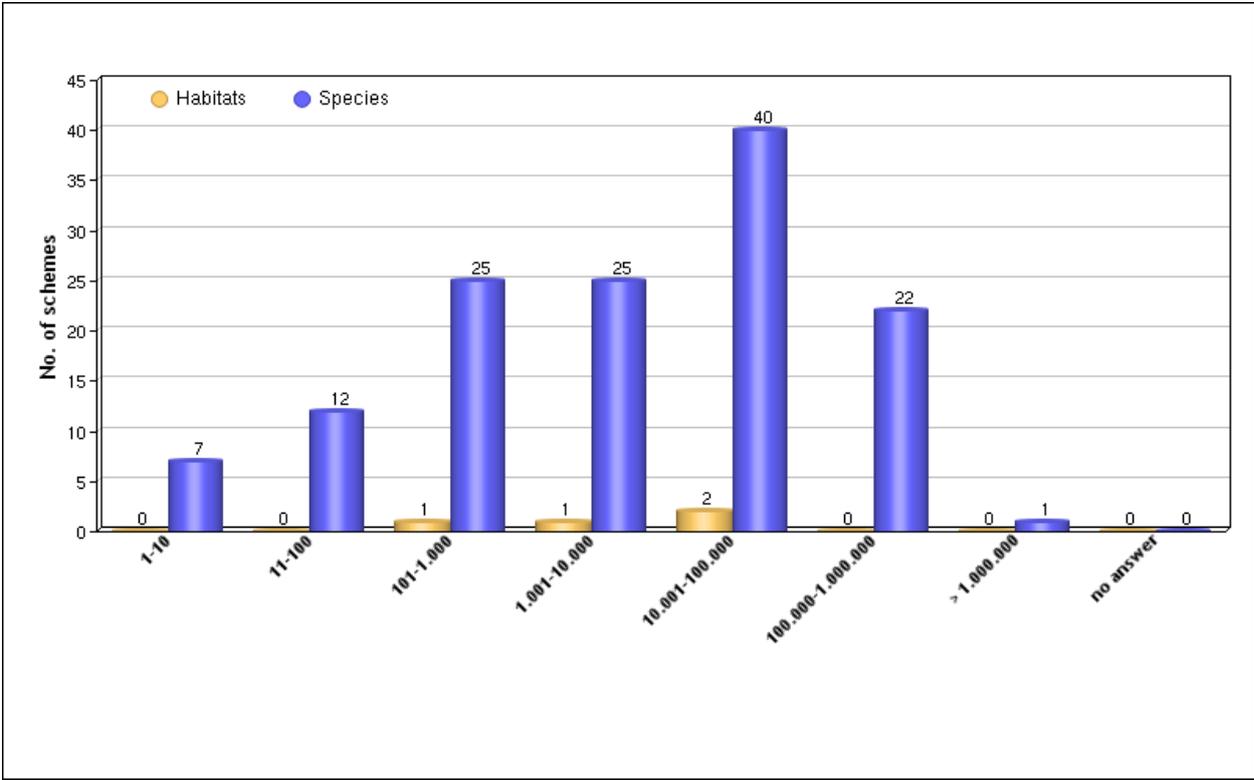
These citizen science species observation schemes are mostly ‘counts’ (64%), including plant density estimates, ‘presence/absence’ (19%), and ‘mark/recapture’ (14%) (Figure 4.10).

Figure 4.10 Proportion of collected data type of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



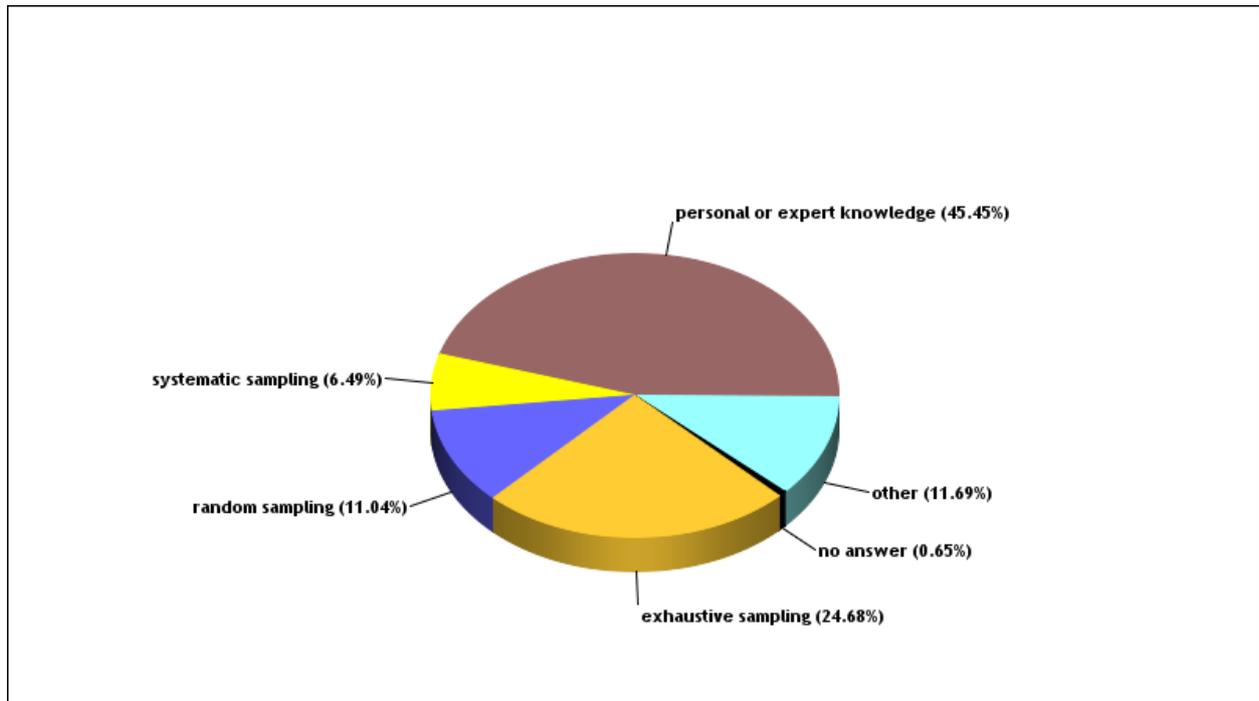
Most of these citizen science species observation schemes covered an area from more than 10 ha up to 100 ha (Figure 4.10).

Figure 4.11 Area classes covered by the number of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



Methodologically, the survey sites of these citizen science species observation schemes are mostly selected by ‘personal or expert knowledge’ (46%) (Figure 4.12).

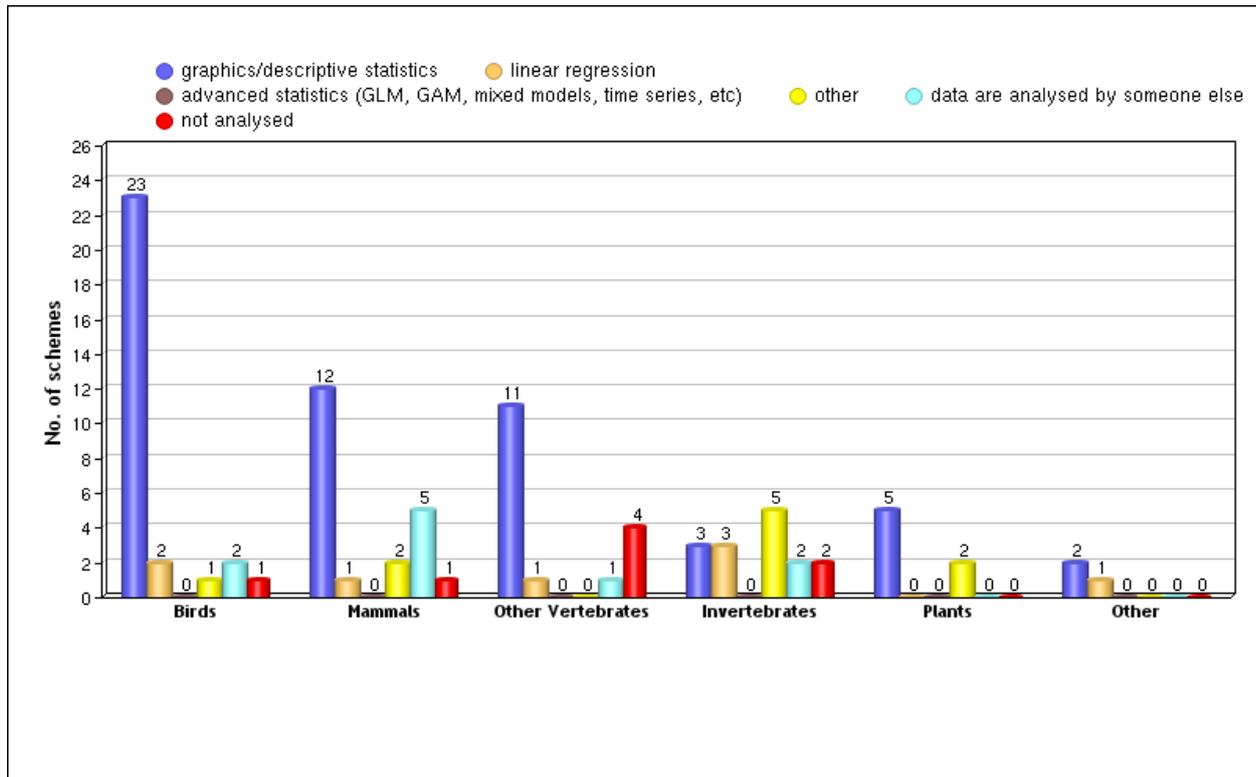
Figure 4.12 Proportion of survey sites' selection type of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



The great majority of the citizen science species observation schemes are carried out 1-10 times every year (131 of 154) (BioMAT, 2011). The species data gathered is mostly analysed through 'graphics/descriptive statistics' (Figure 4.13).

However, the proportion of citizen science species observation schemes, which account for the detection probability of species, is rather low (35%), while most of them (56%) do not consider this important aspect (BioMAT, 2011).

Figure 4.13 Proportion of survey sites' selection type of citizen science species observation schemes with more than five volunteers on international, European, national, and regional levels in mainly the EU (BioMAT, 2011)



5 How can citizen science be used for conservation of biodiversity

5.1 Potentials and benefits of citizen science reporting schemes for biodiversity

- As easily recognised in the projects described in Chapters 2 and 3, a great amount of work is done by volunteers. Without the information on biodiversity the volunteers collect, we would not know as much and be likewise able to take action to conserve biodiversity. Citizen science biodiversity knowledge projects allow gathering information on biodiversity to a much larger extent than the available work force of professional scientists (Figure 4.8).
- Projects similar to the Swedish 'Flora and Fauna Guardians', also occurring in several European countries, collect a substantial amount of information on rare species, which in most cases would never have been collected without voluntary participation. In addition, these projects aim to promote public engagement with the research, as well as with science in general (Chapters 2 and 3).
- Citizen science biodiversity knowledge projects for observing species and habitats can be found throughout Europe (Chapter 2; Figure 4.1). There is strong national focus (94 of 160 projects) and less focus on a regional scale (49 projects). Local schemes were not included in the search (BioMAT, 2011). Especially bird observation schemes are strongly developed (Figure 4.3) and standardized for analysis on European level (Section 2.1).
- According to the EuMon database, the preferred survey method in citizen science species observation schemes' is counting, including plant density estimates (Figure 4.10). The survey sites are mainly (46%) selected by personal or expert knowledge (Figure 4.12). Annual citizen

science species observation schemes are very frequent (131 of 160) (BioMAT, 2011). This allows species population fluctuations to be followed, especially during the last 20 years (Figure 4.2). To a certain extent, reasons for species changes, such as fragmentation, climate change, and pollution, are observed in citizen science species observation schemes (Figure 4.5). Information for management and restoration purposes are also intended to be gathered (Figure 4.6). Depending on the citizen science species observation scheme, apart from distribution, population trends can be calculated based on the voluntary data input provided (Figure 4.9) which also partly cover legally protected areas (Figure 4.7).

- Citizen science related to biodiversity is, however, restricted to a portion of the public. People need to have an interest in nature and/or species to care enough to become involved. According to estimations in Sweden, that portion of the population does not count for more than 20%. Among these people, the commitment and knowledge varies a lot, as well the extent of participation. Some 'Flora Guardians' do not know any species except the orchid they care for in the meadow nearby. On the other hand, there are very skilful people who are only interested in 'collecting' new species which they had never seen before. Nevertheless, the involvement of those 20% in a structured way has an enormous potential for increasing knowledge and following the trends of biodiversity (Mora Aronsson, pers. communication, 2012).
- There is a large potential to increase the number of participants in citizen science observations. Some preconditions for engaging especially young people in the monitoring project are; there needs to be information available on the Internet, a good online-system should be in place showing that people can participate in a larger context, and there should be a guarantee that the information collected will be used (Mora Aronsson, pers. communication, 2012).
- The increasing development of Internet and online reporting such as the Swedish Species gateway over the last decade has provided a harmonization of all efforts, and it has increased the number of people who report observations (Chapter 3). The community of people who share the use of a reporting site continually improves the knowledge level and pushes each other to know more and to involve more friends. However, often skilled elderly people fear participating in the project because they cannot manage a computer and the Internet. For these people, an online system is not enough (Dickinson et al., 2012).
- These Internet platforms do not only facilitate reporting, but they have also completely changed access to data and transparency for public and scientific validation. If data is reported in a public system, everyone can see and compare them with those reported by others. There is no need for permission to test the data and to use them for analysis, and the public validation of data is very efficient (Snäll et al., 2011). This new way of sharing information, instead of keeping it secret, is gaining more and more interest from young people who are thus willing to also participate in observation schemes (Mora Aronsson, pers. communication, 2012).

5.2 Constraints and shortcomings of citizen science reporting schemes for biodiversity

- Analysis made using the databases of the EuMon project show a number of shortcomings of citizen science observation schemes in terms of their main focus on species counting (Figure 4.10). Additionally they are limited to mostly birds (Figure 4.3). Habitats are underrepresented (BioMAT, 2011). There is limited information on the success of 'management/restoration' measures (Figure 4.6), and on pressures such as fragmentation, climate change, and pollution (Figure 4.5). In addition, the geographical scope of these citizen science species and habitat observation schemes lack sufficient trans-national projects (BioMAT, 2011),

- For birds, vascular plants, butterflies, mammals, and some other groups of organisms, the amount of volunteers is substantial, but for many other groups, there are only few people with sufficient species knowledge. This is the reason why there is a huge amount of data on birds and vascular plants, but nearly no data available on, for example, centipedes and fresh water algae (Mora Aronsson, pers. communication, 2012; Snäll et al., 2011).
- Actually, it is crucial to understand what citizen science can perform. Data collection is never science, but it can be done in a more or less scientific way to be used in a scientific context. Data collections with good design are a prerequisite for scientifically sound analysis. The more variation there is in data quality, the more work is needed for handling the data for analysis). Sound citizen science also depends on a good knowledge of limits and shortcomings of the data used. Interaction between scientists and citizens contributing to biodiversity observations is needed at various stages of the programme (Snäll et al., 2011).
- Volunteers are just volunteers; they collect data because of fun and of usefulness. They perform the work on their free time and free time is a limited resource. With a small amount of resources, it is possible to improve the quality and substantial harmonisation. However, without full payment, it is not possible to encourage volunteers to do anything, which is not perceived as being useful in longer terms (Snäll et al., 2011).
- The effort in collecting data is variable in time and space, e.g. citizens generally collect more data on weekends than on working days and more densely populated regions are normally more represented in the databases (Mora Aronsson, pers. communication, 2012).

5.3 Consequences for a possible

An important lesson learned from existing experiences such as in Sweden, is the need for a broad involvement and understanding of people who participate in citizen science biodiversity observation schemes. It takes time to engage these people. Many meetings, fine adjustment efforts, and instructive courses are needed to ensure success. It is better to start at a small scale and gradually expand to consolidate the programme.

Keeping citizens 'faithful' in their regular and in the long run contributions to biodiversity observation remains a challenge to the managers of citizen science programmes.

Based on their long experience in working with both skilled volunteers, as well as enthusiastic citizens, SLU partners of the European Topic Centre on Biological Diversity thus recommend:

- To stay local – A long term citizen science organisation has to work bottom-up even if guidance to ensure consistency in the reporting comes from a 'higher' level. It is of crucial importance that the organisation is local so that the people involved care for the sites, data, and results. As a direct consequence, it is also crucial that people can report in their own language
- To provide feedbacks – It is the key factor for success. Feedback can be of all kinds: getting results back, acknowledgments in media, conferences, and scientific reports
- To ensure public transparency –There is a great advantage in having a data depository, which is public and free to use for any purpose. The importance of sharing data should never be underestimated. Public validation to raise the data quality should also be considered.

To a large extent, all the considerations above support the five key factors of success identified by Cooper et al. (2007), and Devictor et al. (2010) (Figure 1.1) i.e.: simplicity, existence of a structured scheme linking participants, feedback, communication, and sustainability.

In this context, it is important for the European Environment Agency, before being engaged in a project on a citizen science for biodiversity, to carefully assess what specific values it can bring for which objective, which networks can be used, and how long should it run?

The above overview shows that many networks/programmes are already in place and they will continue to be set up. The pilot application for Invasive Alien Species, currently under development by the EEA (EEA, 2011b), provides the opportunity to test a European approach to citizen science on a small scale, i.e. based on a limited group of species. If properly coordinated with existing national or regional networks already in place, such a project can potentially enhance collaboration at European level; stimulate new initiatives in countries, which have not started working on this topic. It can even help to detect new 'alien' species to Europe or within European ecological regions through exchange of information at European level.

However, the work load behind gathered citizen science data through an Eye on Earth project should not be underestimated. Despite a possible supporting automatized and standardized Internet tool, the data and accompanying material, such as photos must be verified by specialists, analysed, and incorporated into the system.

The EEA, however, could rely on a network of already established governmental, especially scientific organizations with specific expertise for certain biodiversity parts (Chapters 2 and 3), while non-governmental organizations strengths can be seen in public mobilization and response without necessarily employing specialized scientists. Both, governmental and non-governmental organizations should be involved in EEA citizen science biodiversity knowledge projects for different purposes.

As an alternative to the EEA setting up a new citizen engagement process across Europe, another approach could be to work with some of the existing networks of national effort, e.g. bats, birds, butterflies. It could try to sort out, if there is information from these databases, which is meaningful and adds value above the national scale (more towards indicators, but in this case as spatial product). For example, there is European value in spatially mapping changes of species population surveys, which could be based on existing regional and national citizen science networks as joint activities, e.g. regarding migration and fluctuation. As the main costs for successful citizen science lie in training, feedback, recruitment, and problem solving, the established citizen science structures on different scales in Europe, described in this report need to provide the main input. Similarly, many of these European outputs would rely on local, national, and regional website interfaces to collect and present information, provide feedback, etc.

In any case, each European level project towards a common activity on citizen science should be based on national and regional developments. Development of competing systems should be avoided, while the EEA should try to improve and to bring together existing national and regional networks. The focus should be set on the question of quality control. The public control in the meaning of web 2.0-technologies of creating and sharing data, such as Wikipedia functions, is not sufficient on its own. Both extremes, ignoring false values, as well as denunciation of single persons due to false values have to be avoided. Another aspect to keep in mind are differences in the accessibility of the citizen science data in different countries, as these might not always be easy accessible.

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7 Annex

7.1 Questionnaire

Dear all,

As part of task 1.2.1.B.4 of the Implementation Plan, ETC/BD is to assist the EEA in scoping the Biodiversity component of the Eye on Earth project (NatureWatch), by addressing the potential and benefits as well as constraints and shortcomings of citizen participation to biodiversity knowledge. This includes the potential contribution to enhancing knowledge in Natura 2000 sites as well as the monitoring of Invasive Alien Species.

Specifically SLU has a responsibility to produce a scoping paper on the feasibility and relevance of a European NatureWatch project. Based on concrete examples on citizen science projects the paper should provide the EEA with a background information on how, for what and with whom this type of projects have been put in place and address their potential in terms of helping improving biodiversity knowledge.

Examples will first be assessed from Sweden but examples from other countries will be sought for, through partners of the ETC/BD Consortium. We would be very pleased if you could contribute to this paper with examples from you country.

We are aware that a review work has already been done as part of the EUMON project and you may already have answered to similar types of questions (<http://eumon.ckff.si/biomat/0.1.10.php>). Please answer these questions anyway since the information may have been updated and in this document it will also be presented in a summarized text compared to EUMon database.

The questions below would hopefully be of help to you when producing your examples. Please, if possible give one example for each headline (2.1, 2.2 and 2.3) in the Draft Content. Last date for contribution is 15th of June. Don't hesitate to come back with questions if you have any difficulties.

Questions as help for the examples:

- For what purpose is the project running?
- Who or what is the coordinator?
- How big is the effort for the coordinating part?
- What geographical range is covered?
- What species/ species groups are covered?
- Is there any relation to N2000-object within the project?
- Pros and cons with the project
- Where is the data stored?
- The applicability of the dataset
- In what matter and how is the feedback to the volunteers run?
- Contact-person or webpage

7.2 Structured overview by theme/taxon of mentioned examples in Chapters 2 and 3

Table 2 Overview of examples mentioned in Chapters ‘2 Overview of examples of biodiversity observation schemes involving volunteers in European countries’, and Chapter ‘3 Detailed example of species monitoring schemes involving volunteers in Sweden’

Taxonomic group or biodiversity theme	Country	Biodiversity observation scheme involving volunteers	Weblink
	Finland	The survey of Finnish herpetofauna	http://laji.fi/sammakot-ja-matelijat?locale=en
	Ireland	Lizard and smooth newt surveys	http://iwt.ie/
	Ireland	Frog spawn survey	http://www.ipcc.ie/help-ipcc/hop-to-it-national-frog-survey-irelandcard/
	United Kingdom	National Amphibian and Reptile Recording Scheme (NARRS)	http://www.narrs.org.uk/whatisnarrs.htm
Birds	Austria	Stunde der Gartenvögel	http://www.stunde-der-wintervoegel.at/
	Czech Republic	Czech ornithological society	http://www.birds.cz/avif/obs.php
	Denmark	DOFbasen	http://www.dofbasen.dk/observationer/index.php?english=yes
	Finland	Winter bird census	http://www.luomus.fi/seurannat/talvilintulaskennat/index.htm
	Finland	Nest record scheme	http://www.luomus.fi/fi/pesakorttitutkimuksen-ohjeet
	Finland	Winter feeding site count (includes mammals)	http://www.luomus.fi/fi/ruokintapaikkaseuranta
	Finland	Breeding land bird point counts	https://www.luomus.fi/fi/linnustonseuranta
	Finland	Census of breeding waterfowl	http://www.luomus.fi/fi/vesilintujen-laskentaohjeet
	Finland	Archipelago bird census	http://www.luomus.fi/fi/saaristolintulaskenta
	France	Visionature (mostly observations of birds)	http://www.ornitho.fr/

	Germany	German Association of Ornithologists	http://www.bfn.de/0304_vogelmonitoring-pdm.html
	Germany	Survey of the Common Cuckoo (<i>Cuculus canorus</i>)	https://www.nabu.de/tiere-und-pflanzen/aktionen-und-projekte/vogel-des-jahres/2008-kuckuck/07228.html
	Germany	Stunde der Gartenvögel	http://www.nabu.de/aktionenundprojekte/stundedergartenvogel/index.html
	Ireland	BirdWatch Ireland bird sightings schemes	http://www.birdwatchireland.ie/Ourwork/Volunteersurveys/tabid/1217/Default.aspx
	Ireland	SpringAlive survey	http://www.springalive.net/en-ie
	Ireland	Bird Atlas	http://www.bto.org/volunteer-surveys/birdatlas
	Ireland	Sightings of raptor species online	http://www.goldeneagletrust.org/
	Latvia, Lithuania	Aquatic Warbler monitoring programme	http://www.meldine.lt/en/?subscribe=1
	Poland	Ornitho.pl	http://www.ornitho.pl/
	Poland	Bird Monitoring within the State Environmental Monitoring System	http://monitoringptakow.gios.gov.pl
	Sweden	Swedish Bird Survey	http://www.fageltaxering.lu.se/
	Sweden	Ottenby Bird Observatory – bird ringing scheme	http://birdlife.se/ottenbyfagelstation/start/
	Sweden	Swedish Ornithological Society	http://www.sofnet.org/
	Turkey	KuşBank	http://www.kusbank.org
Butterflies	Czech Republic	Czech Butterfly Conservation Society	http://www.lepidoptera.cz
	Finland	Monitoring of butterflies in Finnish agricultural landscapes	http://www.environment.fi/en-US/Nature/Species/Species_monitoring/Monitoring_butterflies_in_Finnish_agricultural_landscapes
	Finland	The National Butterfly Recording Scheme in Finland (NAFI)	http://www.luomus.fi/nafi/
	Germany	Nationwide butterfly sightings	http://www.tagfalter-monitoring.de/

	Ireland	Irish Butterfly Monitoring Scheme	http://butterflies.biodiversityireland.ie/
	The Netherlands	National Network Butterflies	http://www.vlinderstichting.nl/vlinders.php?id=91
	Sweden	Swedish Butterfly Monitoring Scheme	http://www.dagfjarilar.lu.se/
	Sweden	Entomological Society of Sweden	http://www.sef.nu
	United Kingdom	Butterflies for the New Millennium (BNM)	http://butterfly-conservation.org/111/Butterflies-fortheNewMillennium.html
	United Kingdom	Big butterfly count	http://www.bigbutterflycount.org/
Fauna (general)	Finland	Wildlife triangle scheme	http://www.rktl.fi/english/news/wildlife_monitoring_in.html
	Finland	Field triangle scheme	http://www.rktl.fi/riista/ohjeet_lomakkeet/peltokolmiolaskenta.html
	Finland	Fish tagging	http://www.rktl.fi/kala/kalavarat/kalamerkinta/palauta_kalamerkit/
	Germany	German Hunting Association	http://www.jagdnetz.de/wild
	Sweden	Swedish Museum of Natural History	http://www.nrm.se/en/frontpage.16_en.html
Flora (general)	Czech Republic	BOTANY.cz Web Society	http://www.botany.cz
	France	TelaBotanica – The French botany network	http://www.tela-botanica.org/site:accueil?langue=en
	France	‘Sauvages de ma rue’ (wildness of my road)	http://sauvagesdemarue.mnhn.fr/sauvages-de-ma-rue/presentation
	Germany	Census projects on the Flora of Germany	http://www.floraweb.de
	The Netherlands	FLORON – national flora inventory	http://www.floron.nl
	Sweden	Swedish National Phenological Network	http://www.blommar.nu
	Sweden	Swedish Botanical Society	http://www.sbf.c.se/

	Switzerland	National Inventory of Swiss Bryophytes (NISM)	http://www.nism.uzh.ch/index.php
	United Kingdom	BSBI plant Distribution Maps Scheme	http://www.bsbi.org.uk/maps_and_data.html
	United Kingdom	British Bryological Society	http://rbg-web2.rbge.org.uk/bbs/bbs.htm
Flora and fauna (general)	Austria	Naturbeobachtung	http://www.naturbeobachtung.at
	Czech Republic	BioLib	http://www.biolib.cz/en/main/
	Denmark	Danish Birds and Nature	http://www.fugleognatur.dk/
	Estonia	Estonian Nature Observations Database	http://loodus.keskkonnainfo.ee/lva/LVA.aspx?lang=eng
	Estonia	eBiodiversity	http://elurikkus.ut.ee/index.php?lang=eng
	Finland	Spring Follow-Up	http://www.luontoliitto.fi/toiminta/kevatseuranta
	Finland	Phenology research scheme	http://www.luomus.fi/en/node/114
	France	Vigie-Nature	www.vigienature.mnhn.fr
	France	Seasonal Observatory	http://www.obs-saisons.fr/about
	France	Citizen Science biodiversity knowledge projects in France	http://www.jagispourlanature.org
	Germany	GBOL project collecting the DNA barcodes	https://www.bolgermany.de/gbol/was-ist-gbol
	Hungary	Hungarian National Biodiversity Monitoring System (HBMS)	http://www.termesztvedelem.hu/nbmr
	Ireland	Bioblitz	http://bioblitz.biodiversityireland.ie/
	Ireland	Sightings of Irish wildlife	http://www.biology.ie/
	Ireland	iSPYnature	http://ispynature.com/
	Luxembourg	Maacht Mat!	http://data.mnhn.lu/en/maach_mat
	Luxembourg	Luxembourg Naturalist Society	http://www.snl.lu/the-luxembourg-naturalist-society/#botanical-research-group-of-the-snl
The Netherlands	Online reporting system 'Observation.Com'	http://www.waarneming.nl	
The Netherlands	Telmee	http://www.telmee.nl/index.php?c=portal&m=home	

	Poland	BioDiversity4all	http://www.biodiversity4all.org/index.cfm?p=48F2A1D1-1DE0-5C8B-DF96BC3E0D8D1520
	Romania	Rodna Mountains National Park	http://www.eci.ox.ac.uk/research/humaneco/downloads/rodna/romania-policybrief.pdf
	Sweden	The Species Gateway in Sweden	http://www.artportalen.se
	Switzerland	Swiss Biodiversity Monitoring Programme	http://www.biodiversitymonitoring.ch/en/home.html
	United Kingdom	National Biodiversity Network (NBN)	http://www.nbn.org.uk/
	United Kingdom	Open Air Laboratories (OPAL)	http://www.opalexplornature.org/surveys
	United Kingdom	Nature's Calendar	http://www.naturescalendar.org.uk/
	United Kingdom	UK Citizen Science supported wildlife sightings	http://www.bbc.co.uk/breathingplaces/wildlife_survey/
Fungi	United Kingdom	British Mycological Society	http://www.britmycolsoc.org.uk/mycology/recording-network/
Invasive Alien Species (IAS)	Belgium	Early Warning and Rapid Response System for IAS	http://waarnemingen.be/invasive_alert_view.php
	Finland	Baltic Sea Alien species observations	http://www.riistakala.info/vieraslajit/index.php
	France	The yellow-legged hornet observations (<i>Vespa velutina nigrithorax</i>)	http://inpn.mnhn.fr
	Germany	Sightings of Common Ragweed (<i>Ambrosia artemisiifolia</i>)	http://www.ambrosiainfo.de/kontakt.html
	Germany	Ambrosia Scout	http://alphablind.com/portfoliomenu/ambrosia-scout/
	Germany	North Rhine-Westphalia IAS portal	http://neobiota.naturschutzinformationen-nrw.de/site/
	Ireland	Sightings of IAS	http://invasives.biodiversityireland.ie/spot-the-alien/
	Poland	Reporting of the appearance of the red-eared slider (<i>Trachemys scripta elegans</i>)	http://www.salamandra.org.pl/obcekampania.html

	United Kingdom	GB Non-Native Species Information Portal (GB-NNSIP)	https://secure.fera.defra.gov.uk/nonnativespecies/factsheet/index.cfm
	United Kingdom	Invasive Harlequin Ladybird survey	http://www.harlequin-survey.org/
Invertebrates	Finland	Field experiments of dung beetles and other decomposers	http://www.helsinki.fi/foodwebs/research/dungbeetles_developments.htm
	Finland	Insect survey	http://it.hatikka.fi/public_query2.php?queryid=0.1740
	Finland	Crayfish observations	https://www.webropolsurveys.com/Answer/SurveyParticipation.aspx?SDID=Fin208862&SID=3d1864ea-ed6f-4b91-9b1c-fd2a5db73777
	Ireland	Bumblebee monitoring scheme	http://pollinators.biodiversityireland.ie/
	Sweden	Faunawatchers – Fauna guardians	http://www.artdatabanken.se/en/
	Sweden	Regional Entomological societies	http://www.trollslandor.se/
	United Kingdom	UK Ladybird Survey	http://www.ladybird-survey.org/
	United Kingdom	Rothamsted Insect Survey	http://www.rothamsted.ac.uk/insect-survey/
Mammals (excluding marine)	France	Large carnivores (wolf, lynx, and brown bear) in France	http://www.oncfs.gouv.fr/Grands-carnivores-loup-lynx-ours-ru245/Grands-carnivores-Docs-telechargeables-ar469
	Ireland	Ireland's National Bat Monitoring Programme	http://www.batconservationireland.org/what-we-do/monitoring-distribution-projects
	Poland	Wolf and Lynx census	http://www.polishwolf.org.pl/large-predators
	Poland	Atlas of Mammals of Poland	http://www.iop.krakow.pl/ssaki/
	Sweden	Swedish Association for Hunting and Wildlife Management	http://jagareforbundet.se/
	United Kingdom	National Bat Monitoring Programme	http://www.bats.org.uk/pages/nbmp.html
Marine species	Finland	Seal observations	http://www.rktl.fi/riista/hylkeet/hyljehavainnot/

Greece	COMBER Fish observation	http://www.comber.hcmr.gr http://www.pensoft.net/journals/zookeys/article/2149/abstract/
Ireland	Casual sightings of cetaceans	http://www.iwdg.ie/content.asp?id=18
Italy	Divers for the Environment: Mediterranean Underwater Biodiversity Project	http://www.marinesciencegroup.org/SPA/indexITA.htm
Malta	Spot the jellyfish campaign	https://www.um.edu.mt/news_on_campus/researchinitiatives/archive/spotthejellyfish2011
Malta	Biological Conservation Research Foundation (BICREF)	http://www.bicref.org/sighting-reports/
Malta	Marine biodiversity sightings	http://news.transport.gov.mt/tag/dolphins/
Spain	Life Cubomed - jellyfish sightings	http://www.lifecubomed.eu/en/