



Millions of bird watchers worldwide report their observations to public databases, thereby contributing to the cumulative biodiversity knowledge. This is only one example of citizen science. Photo: Mats Hannerz.

Citizen science and public engagement

Contribute to climate research, report bird observations, count earth worms or even classify galaxies – there are many tasks in science that are expensive, labour-intensive and require data-collection in many places with many hands and eyes. The growing phenomenon of Citizen Science takes advantage of the public's enthusiasm, and here News & Views gives some examples.

Although an old approach, with early proponents such as Carl von Linné, it is a field that has recently expanded worldwide, and the Nordic countries are not lagging behind. Species observations are collected in ever-expanding databases in all countries, contributing to an extended knowledge of species distribution and population trends. Damage reporting is another example, where

observations can help to detect new diseases or potential outbreaks of insects.

Seasonal changes reflect global warming

The Swedish University of Agricultural Sciences (SLU) is one of the organisations that has taken advantage of nature-loving amateurs to collect large amounts of data.

Kjell Bolmgren, a plant ecologist specialising in phenology, is a citizen science enthusiast. He coordinates the monitoring of phenological observations of plants and animals. The data is collected and displayed via the web application naturenskalender.se (*Nature's Calendar*) under the

auspices of the Swedish National Phenology Network. The network is a collaboration between several universities, authorities and non-governmental organisations, with SLU as the host.

Nature's Calendar started off with observations of plant phenological events such as bud burst, blossoming, fruit ripening and autumn leaf colour changes. The data collected has become a useful monitoring resource,



Kjell Bolmgren.
Photo: Jenny Sverén-Gillner, SLU.



showing how spring and autumn timings change across the country and between years. Indeed, changes due to global warming have been detected:

– The changes in nature's calendar have proven to be the most obvious biological expressions of a warmer climate, Kjell Bolmgren says.

Comparison with old records

Phenological records have been collected over a long time. At the end of the 1800s and in the early 1900s hundreds of thousands of spring and autumn observations were made by farmers, priests and teachers in Sweden. The handwritten forms have now been scanned and digitised to allow comparisons between current observations and those recorded a hundred years ago.

– Data from our organized citizen scientists during the last five years shows that bud burst and spring flowering occurred 12 days earlier than a hundred years ago, Kjell Bolmgren says.

The phenological records are dependent on a network of volunteers who have signed up to be “phenology guards”, whose duty is to report spring and autumn signs.

Engaging schools and the public

Another group of volunteers are school children. In Sweden, autumn colours have been recorded annually since 2013 by over 10 000 students each year. And autumn phenology is worth further studies, according to Kjell Bolmgren.



Over 100 schools in Sweden are registered for the oak leaf project
Image from Nature's Calendar.

– The autumn processes are, in fact, more important to study than the spring phenology, simply because we know less about fall and how it is affected by climate change, he says.

In 2016, a particular project concerning the biodiversity associated with oak leaves is running in a collaboration between Stockholm University, University of Helsinki and SLU. Students will collect oak leaves in September and October. The leaves will then be sent to Helsinki University for the insects living on and in them to be identified.

Finding *Phytophthora* infections

The *Phytophthora* group at SLU in Alnarp will also take advantage of the public's enthusiasm. During 2016-2018, volunteer citizens will send reports on possible *Phytophthora* damage on trees, based on instructions from the researchers. The reported stands will be visited and samples will be taken for DNA analysis of the oomycetes – the organism group to which *Phytophthora* belong.

Biodiversity monitoring via apps

Our knowledge about species distribution is, indeed, dependent on many dedicated citizens, and nature-loving amateurs have collected specimens and made lists for centuries. However, new technology has allowed reporting to explode. The internet was the first stage, and easy to handle forms and applications for smartphones were next. *eBird*, a global reporting service, collates observations from millions of bird watchers throughout the world. Several services in the Nordic countries have also made it easy to submit observations directly in the field.

Sweden – 54 million records

The Swedish *Artportalen* (Species portal) currently contains over 54 million records (September 2016) of all species from birds to fungi and lichens. The data can be used by

land owners, nature conservation authorities and also by interested amateurs. The transparency of the data means it can be used by anyone to conduct their own research. The inflow of data is well illustrated by the fact that every four seconds, a new observation is submitted.

Denmark – "We need to interact with the citizens"

Biodiversitet.nu (Biodiversity Now) is a Danish effort to collect data from nature enthusiasts. It has about 12 000 active users (summer 2016), and over 200 000 observations of animals and plants in Denmark. A corresponding project *Svampeatlas.dk* (Danish Fungi Atlas) has collected around 290 000 observations since it was launched in 2009, and several new fungi species for Denmark have been found.

Carsten Rahbek, Director at the Natural History Museum of Denmark, told one local newspaper:

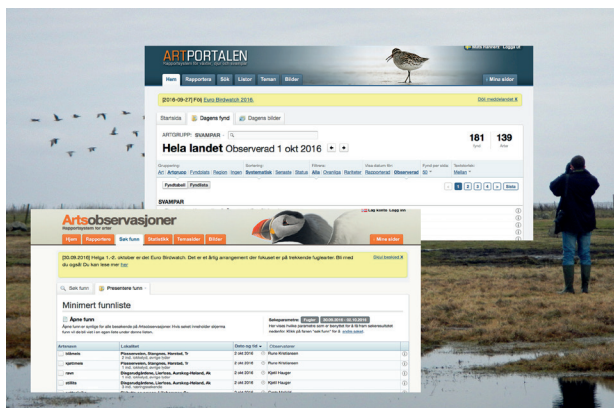
– If we really want to monitor biodiversity, we need to design a project that is for everybody, and makes people want to participate. When we consider biodiversity in Europe, we will never be able to monitor the progress and decline of species if we rely on professionals – we can do some, but it is simply too expensive. We need to interact with the citizens.

Norway - adds public surveys

The Norwegian *Artsdatabanken* (Norway's Species Map Service) was launched in 2008. In 2014, the 10 millionth bird observation was received, and 1.4 million records have been submitted for all other species groups. Besides species reports, the system also makes surveys conducted by land managers and consulting companies publicly available.

And the success of the species service has been tremendous.

– The efforts of individuals have exceeded all expectations we had when we launched the Species Observation System. We applaud all of the keen naturalists who



The Swedish Artportal and Norwegian Artsobservasjoner has assembled millions of species recordings. Photo Mai Miyahara.

Students collect earthworms

University of Helsinki in Finland has started a citizen science project which

have collectively contributed all this important fieldwork, says Ivar Myklebust, Director of the Norwegian Biodiversity Information Centre, on the webpage of Artsdatabanken.

Detecting diseases

Damage is a field where volunteer reports make a great contribution. The Norwegian Institute of Bioeconomy Research (NIBIO) has launched *Skogskader.no*. The database was populated with digitalised damage reports dating back to the 1960s. It is constantly added to with reports from volunteers and practitioners.

A similar system is run by SLU in Sweden – *Skogsskada*. A new version was launched in 2015 with more descriptions of various sorts of tree damage, and an easy to handle reporting form. The inflow of new insects and pathogens to Europe is increasing due to global trade and climate change. The reporting system can help to detect new phenomena and invasions at an early stage.

aims at mapping the biodiversity and genetics of earthworms. The project has currently engaged over 90 schools across the country who will collect earthworms in forest soils. Spreading mustard powder on the soil surface encourages earthworms to emerge, allowing easy collection. The specimens thus collected will be genetically analysed.

Classifying galaxies

And back to galaxies. The project *Galaxy Zoo* needed to classify 900 000 images of galaxies, a job requiring a great deal of manual interpretation. The researchers estimated it would take 3-5 years for one person to classify all the images, working 24 hours a day 7 days a week.

When the public was invited to participate, 150 000 volunteers helped to classify the galaxies online. The result was over 40 million classifications in less than 5 months, on average 38 analyses of each image.

And there are many similar projects that make use of the assistance of citizens. The British project *Oldweather.org* let 16 000 people mark up and transcribe handwritten weather reports from over a million scanned pages. *Cyclonecenter.org* asked the public to look through 300 000 satellite images of tropical storms to judge their strength. The reason for letting people interpret such records is because humans can sometimes be better than computers at detecting patterns in images.

Can the amateur reports be trusted and used?

The mass of data collected by amateurs opens of course discussions on the reports validity and usefulness for scientific or management purposes.

A study made by scientists from Great Britain and Denmark examined trends in bird populations from casual observations (citizen scientists) with those from more systematic monitoring. They found that declines in bird populations were not as often detected in the casual observations.

One probable explanation is that amateur birdwatchers tend to report what they find personally exciting or special, and ignore reporting common birds. When a species is tending to become rare, it will more often be reported. The authors of the article still encourage people to keep reporting their observations, but urge them to report all species, not only a selection.

Read more: Kamp, J. et al. 2016.

Unstructured citizen science data fail to detect long-term population declines of common birds in Denmark. Diversity and Distributions 22, 1024-1035.



ECSA

The *European Citizen Science Association* has the mission to encourage the growth of Citizen Science. The first international conference of the organisation was held in Berlin in May 2016, with 320 participants from 29 countries.

The vision declared by ECSA is that "...in 2020, citizens in Europe are valued and empowered as key actors in advancing knowledge and innovation and thus supporting sustainable development in our world. Citizen Science is a recognized, promoted and funded approach to foster scientific literacy and the democratization of scientific expertise, to increase the social relevance and sustainable impact of research and to improve the evidence base for environment, biodiversity and climate change policy in Europe and globally."

Read more: <http://ecsa.citizen-science.net>

What is Citizen Science?

Citizen Science is defined in Oxford English Dictionary as "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions." Wikipedia adds that Citizen Science is "scientific research conducted, in whole or in part, by amateur or nonprofessional scientists".