Finnish Environment Institute SYKE, Finland

Feasibility study for using citizen science in biodiversity monitoring

Twinning Project MK 13 IPA EN 02 17

Strengthening the capacities for effective implementation of the acquis in the field of nature protection

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What is Citizen Science?

In general, citizen science means engaging ordinary citizens by organizing means to collecting manage and share ecological data following the FAIR principles (Finable, Accessible, Interoperable and Re-usable) to guarantee and promote open access, open data and open science. Especially in Northern and Western Europe, citizen data is commonly used by NGOs, managing authorities, scientists and government agencies. Clearly, very large datasets used for management, monitoring and reporting are based on observation data produced by other than governmental bodies and personnel. In Finland, for example, more than 96 % of all species observations are based on observations by citizens. Citizen science has an important role in assessing the status of the biodiversity in most European countries. For example, reporting of species under Habitats Directive (Article 17) and Birds Directive (Article 12) are mainly based on observations by citizens. In contrast, reports on the conservation status of different habitat types are usually based on data from different national (often governmental) organizations. Citizen data can also be used as a source for reporting to CBD and IPBES.

Bird watchers were pioneers

Bird watchers were one of the first active group of nature enthusiasts who started to create methods to collect and share data based on their field observations. Nowadays the list of ornithological databases covers almost the whole Europe – or actually the whole Europe, since many of the database portals allow saving observations from any country, such as FinBIF, https://plutof.ut.ee/#/, iNaturalist.

European commission has collected all relevant databases in a publication which is focusing on sustainability of bird hunting. This report provides a good overview on bird observation databases in different countries:

https://cdn.fbsbx.com/v/t59.2708-21/50266760_606661399776763_8503290155153489920_n.pdf/20181029-Guidelines-on-the-use-of-bird-portals-data-update-of-Key-Concepts-Document.pdf?_nc_cat=111&_nc_ht=cdn.fbsbx.com&oh=80c13e10f5e27eb4c02f4a59ab70be4b&oe=5C5FBC0D&dl=1&fbclid=IwAR34h8JbJ3Asq4p3a-jdbDj5t0xbawg-HOkqf3yXJHu0fMPGA-zXXVsSvSA

Fig. 1. A young citizen observing birds.

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Table 1) List of bird observation databases in Europe (A-I) (from the publication: "Guidelines on how to use the existing information in EuroBirdPortal and the regional/national online bird portals to help determine the start of the spring migration period for huntable bird species in the European Union.")

EU Member State	Online portal	Online system	EBP Partner
Austria	https://www.ornitho.at	Ornitho	BirdLife Austria
Belgium	http://observations.be	Observation.org	Natagora
	http://waarnemingen.be		Natuurpunt
Bulgaria	https://www.smartbirds.org	Smartbirds	Bulgarian Society for the Protection of Birds
	https://app.bto.org/birdtrack2/main/data-home.jsp	BirdTrack	
Croatia[1]	http://www.fauna.hr	Ornitho	Association BIOM
Cyprus[2]	https://app.bto.org/birdtrack2/main/data-home.jsp	BirdTrack	BirdLife Cyprus
			The North Cyprus Society for the Protection of Birds and Nature
Czech Republic	http://birds.cz	Birds.cz	Czech Society for Ornithology (CSO)
Denmark	http://dofbasen.dk	DOFbasen	Dansk Ornitologisk Forening (DOF)
Estonia	https://plutof.ut.ee/#/citizen-science-projects	PlutoF	Estonian Ornithological Society
Finland	https://www.tiira.fi/	Tiira	BirdLife Suomi
France	https://www.faune-france.org	Ornitho	Ligue pour la Protection des Oiseaux (LPO)
Germany	http://ornitho.de	Ornitho	Dachverband Deutscher Avifaunisten (DDA)
Greece	https://app.bto.org/birdtrack2/main/data-home.jsp	BirdTrack	Hellenic Ornithological Society
Hungary	http://map.mme.hu	MAP	Magyar Madártani és Természetvédelmi Egyesület
Ireland	http://blx1.bto.org/birdtrack	BirdTrack	BirdWatch Ireland
Italy	https://www.ornitho.it	Ornitho	Lega italiana protezione uccelli (LIPU)
			Centro Italiano Studi Ornitologici (CISO)
			EuroBirdNet Italia

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Latvia	http://dabasdati.lv/	Dabas Dati	Latvian Fund for Nature Latvian Ornithological Society (LOB)
Lithuania[3]	http://ornitologija.lt/orni/web	Lietuvos Paukščiai	Lithuanian Ornithological Society(LOD)
Luxembourg	https://www.ornitho.lu	Ornitho	natur&ëmwelt
Malta[3]	https://app.bto.org/birdtrack2/main/data-home.jsp	BirdTrack	
Netherlands	http://trektellen.nl	Tektellen	Dutch Centre for Field Ornithology (Sovon)
	http://avmap.nl	Avimap	
	https://waarneming.nl	Observation.org	
Norway	https://mobil.artsobservasjoner.no	Mobile application	Artsdatabanken
	https://www.artsobservasjoner.no/		
Poland	https://ornitho.pl	Ornitho	Polish Society for the Protection of Birds (OTOP)
Portugal	http://ebird.org/portugal	eBird	Portuguese Society for the Study of Birds (SPEA)
			Laboratorio de Ormnitologia (LABOR)
Romania	http://www.openbirdmaps.ro	Openbirdmaps	Milvus Group
	http://pasaridinromania.sor.ro/ornitodata	Ornitodata	Societatea Ornitologica Romana
Slovakia	http://aves.vtaky.sk	Aves-Symfony	Slovenska ornitologicka spoloénost/BirdLife Slovensko
Slovenia[1]	http://atlas.ptice.si	Atlas.ptice	BirdLife Slovenia (DOPPS)
Spain	https://ebird.org/spain	eBird	Sociedad Española de Ornitologia (SEO/BirdLife)
	https://app.bto.org/birdtrack2/main/data-home.jsp	BirdTrack	
	https://www.ornitho.cat	Ornitho	Catalan Ornithological Institute (ICO)
	https://www.ornitho.eus		Aranzadi Zientzia Elkartea
Sweden	https://artportalen.se	Artportalen	Swedish Species Information Centre SLU
Switzerland	https://www.ornitho.ch	Ornitho	Swiss Ornithological Institute
United Kingdom	http://blx1.bto.org/birdtrack	BirdTrack	British Trust for Ornithology

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Most of the species data in Finland are bird observations. Annually, approximately 1,4 million observations are saved in the **TIIRA-database** (see the list above). The Finnish Biodiversity Information Facility FinBIF, is a national biodiversity data infrastructure, which compiles all available biodiversity data of Finland. All open FinBIF data is available at the species.fi-portal (https://laji.fi/en). The service is managed by the Finnish Museum of Natural History Luomus at the University of Helsinki. Its services include numerous projects and observation recording services to promote citizen science. Annual data statistics are not relevant since there data flow is based on the pace of new partners joining the national effort to provide their data to be shared via FinBIF. Currently number of observations in more than 32 million and the bird data covers 54% of the total number. FinBIF data warehouse consists of data from government agencies, scientific research (including monitoring), NGOs and citizen observations. Increasing proportion of observations are recorded by individual enthusiastic. Large amounts of data collected clearly indicates the huge potential of citizen science.

In Lithuania, for comparison, the **Protected Species Informational System** (PSIS) has been in use for about 10 years. Even though the system has been operative for a long time and it is widely used, some further development of the system is necessary. All citizens can report their species observations in the system including pictures, coordinates, etc.. User registration was previously not obligatory, but from 19.12.2018 it was introduced. Last (27.2.2019) improvements in the database are defined at http://ornitologija.lt/orni/web/news. PSIS service is open for all citizens. According to the Lithuanian experience, it is not easy for people to easily and accurately identify species, so the data needs to be verified by experts on later stage especially in the case of threatened or protected species records. In these cases the experts may contact the observer for acquiring more information. The same applies in North Macedonia, where many citizens have difficulties to correctly identify species, if they do not have expertise background. There is also a little n of interest for this kind of activity to make species observations, thus there is a need to raise awareness and promote more educational events, outdoor activities, materials and applications that are easy to use and understand for amateur nature enthusiastic. The data provided by the volunteers should be automatically labelled as uncertain identifications before they are verified by experts.

As all the data in Lithuania are open for specialists, scientists and planners, the PSIS data are commonly used for Environment Impact Assessment EIA, Strategic Environmental Assessment (SEA), preparation of protected areas management plans, in forestry management projects, for issuing permits for logging, for preparation of monitoring programs and improvements of the Natura 2000 network, for example.

Availability of species databases in some Balkan countries

In the neighbouring countries of the Republic of North Macedonia, some biodiversity applications to support citizen science data collation are already in use.

Slovenia has a public service of animal husbandry gene bank and Central database **GOVEDO**. Slovenian observations from the flora and fungi, for example, databases can be seen via the Global Biodiversity Information Facility (**GBIF)** portal.

In Serbia, species observations from the services developed in social media are collected into the national database and used in their national biodiversity portal "**Alciphron**" (http://alciphron.habiprot.org.rs/). Serbian portal is widely used and it has a user friendly interface.

In Greece "**SpeLog** *is the scratchpad that lists all species in Greece. It is developed in the framework of LifeWatch Greece (www.lifewatchgreece.eu) where it serves as the taxonomic backbone for Greek biodiversity data management and analyses, including the PESI national focal point, the GBIF Greece node, and the MedOBIS Regional Node*." This system does not offer a species data base, but serves in the use of GBIF.

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Global Biodiversity Information Facility GBIF provides a service, Integrated Publishing Toolkit (IPT), through which any observations from any country can be transferred directly to GBIF database for open access. However, national biodiversity databases have advantages of allowing the ICT-development (architectural, technical, content etc.) to serve the national (or regional) needs such as national or EU reporting.

Butterfly monitoring in Europe

Monitoring butterflies and moths also have a wide network in Europe. Butterflies in particular have been monitored over a long time in many countries. Observations on the collapse of insect populations in Europe have shown the value of participatory monitoring of species data.

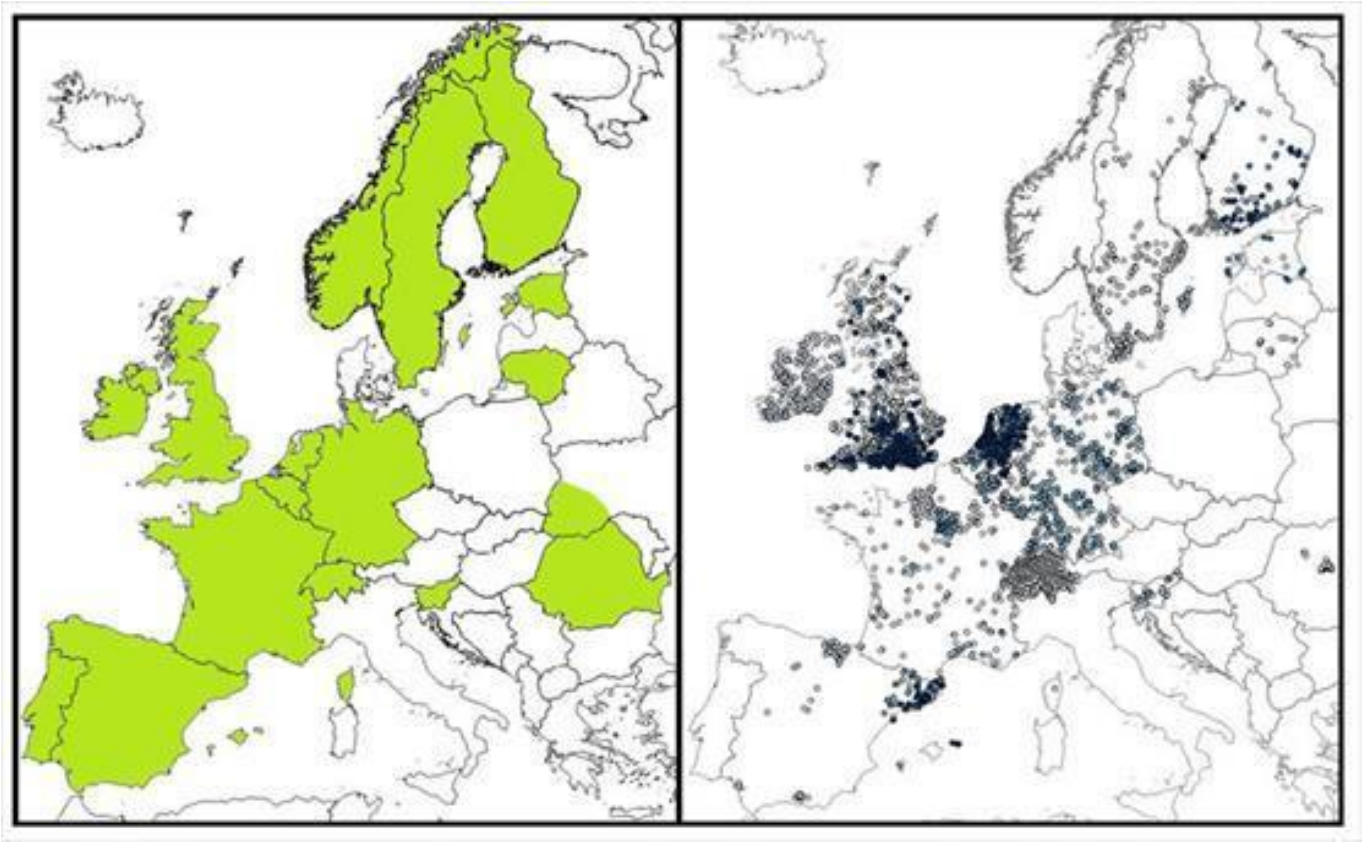

Fig. 2. Countries having butterfly monitoring systems and is participating in the butterfly monitoring network in Europe (left) and exact points of observations (right).
Map from: https://www.syke.fi/fi-FI/Ajankohtaista/Hyonteiskantojen_tilaa_seurataan_yha_laa(49479).
* In most countries monitoring is based on work of volunteers. The role on administration is to provide guidance and databases for the monitoring and access to data. Even if many European countries are not included in the network yet, good data on butterfly observations is available from almost every country in Europe.

* Original publication behind the maps:
1.) Van Swaay, C.A.M., S., Botham, M., Brereton, T. Carlisle, B., Dopagne, C., Escobés, R., Feldmann, R., Fernández-García, J.M., Fontaine, B., Gracianteparaluceta, A., Harpke, A., Heliölä, J., Kühn, E., Lang, A., Maes, D., Mestdagh, X., Monasterio, Y., Munguira, M.L., Murray, T., Musche, M., Õunap, E., Pettersson, L.B., Piqueray, J., Roth, T., Roy, D.B., Schmucki, R., Settele, J., Stefanescu, C., Švitra, G., Tiitsaar, A., Verovnik, R (2017). Technical report: making Bioscore distribution models based on Butterfly Monitoring Transects. Report VS2017.029, Dutch Butterfly Conservation, Wageningen, Netherlands.

2.) Van Swaay, C.A.M., Van Strien, A.J., Aghababyan, K., Åström, S., Botham, M., Brereton, T., Chambers, P., Collins, S., Domènech Ferrés, M., Escobés, R., Feldmann, R., Fernández-García, J.M., Fontaine, B., Goloshchapova, S., Gracianteparaluceta, A., Harpke, A., Heliölä, J., Khanamirian, G., Julliard, R., Kühn, E., Lang,

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A., Leopold, P., Loos, J., Maes, D., Mestdagh, X., Monasterio, Y., Munguira, M.L., Murray, T., Musche, M., Õunap, E., Pettersson, L.B., Popoff, S., Prokofev, I., Roth, T., Roy, D., Settele, J., Stefanescu, C., Švitra, G., Teixeira, S.M., Tiitsaar, A., Verovnik, R., Warren, M.S. (2015). The European Butterfly Indicator for Grassland species 1990-2013. Report VS2015.009, De Vlinderstichting, Wageningen.

Benefits from using citizen data

It is always cheaper to use a very large number of volunteers than to hire a large number of experts. In most countries the number of professional experts for each taxonomic group is at the maximum tens of people, whereas in many countries the number of volunteers (enthusiastic amateurs) interested in some popular taxonomic group (birds, butterflies, fungi) may exceed thousands of people.

The possibility to record personal observations and to compare them to observations made by other people may increase the interest of the general public to observe and analyze changes in the environment. Strengthening the motivation to make observations is crucial for capacity building of citizen science. Moreover, people may start to see new values in the nature they have not recognized before. User friendly services may even increase the interest of the quality of the environment in general.

Another benefit comes from improved quality of the data. The average quality of data is rather high due to control performed by large number of other observers. However, some taxonomic groups might be too demanding for the large public, and therefore end users of the data should be able to evaluate the data quality before using it for scientific and administrative purposes. The quality of data is usually better if observations first have been checked in forums of experts in social media in case of exceptional findings.

Training and capacity building courses and workshops are obviously needed. These courses can be as part of some educational programs in universities or e.g. basic courses for amateurs, which are well planned to attract wide audiences – they could be fun and at the same time educational.

The role of GBIF – global collection and sharing of species data

The Global Biodiversity Information Facility (GBIF) is an international network and research infrastructure funded by the world's governments. The goal of GBIF is to provide anyone open access to data about all types of life on Earth. GBIF has gathered more than 1,3 billion (as of 2019) records from more than 1400 institutions worldwide with data for more than 4 000species. Nearly half of the occurrence data comes from sources with significant citizen science participation. GBIF facilitates a common standard, the Darwin Core, for collecting and organizing biological data for taxa, occurrences (of a species) and events (documenting field studies).

GBIF operates through a network of national nodes, coordinating the biodiversity information facilities of participating countries and organizations. Macedonian Ecological Society is registered as a data provider and within the frame of GIZ regional project, it has developed a List of endemic taxa of the region. Other scientific institutions, universities, Museum of Natural History and Ohrid Hydrobiological Institute should be informed about this facility and they should register as users. In general, it is enough to have one managing authority of Integrated Publishing Toolkit (IPT), which then can be used by any other institutes invited and registered as a GBIF data provider (see more ar https://www.gbif.org/ipt). There are a lot of benefits of using GBIF services e.g. for automatic reporting of invasive alien species occurrence provisions within EU region.

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Qualifications of citizen science

The following four elements are pre-requisites for a functioning citizen science activity and its effective data flow.

1. Motivation of public to make observations.
   - Motivation of people can appear for several reasons
     - A feeling that it has a purpose, is important and meaningful
     - Recognition from people sharing the same interest / passion
     - A feeling of being an explorer
     - It becomes a competition, challenging yourself and others
     - It grew out from other interests, like collecting other items, enjoying outdoor activities, nature protection, gardening, photography
     - People may know it's worth observing and asking as there is a way to find an answer
     - Break the conviction that only experts can participate in monitoring of biological diversity. Everyone can learn if there is a will and opportunity.

2. Collective help in assessing observation.
     - Annotation system, where anyone can comment and suggest the quality of the observation
     - Communication system to share views between the users of a service

3. Ease of making documentation of observations.
     - Downloading and printing services
     - Managing your own observations

Availability of collected data: It is important for every observer to see how the distribution map is updated after he/she has uploaded his/her own species observation in the database. The result seen in the map gives a feeling of a reward for doing good work. For young people, especially, motivation to continue is often powered by a feeling of success. And user friendly interface, e.g. an open portal, should provide positive feedback to the users, which could be reinforced by experienced administrators, actively encouraging beginners.

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Fig. 3. Experienced experts provide support for the beginners in species identification. Specialist group for true bugs (Heteroptera) has annual meeting in Helsinki.

Sensitive species data

Sometimes open access to data might conflict with species protection or e.g. violate owner's rights including scientific research data. Precise localization might be misused for illegal hunting purposes, commercial or other destructive sampling of specimen, even if the collection was made by an amateur and not intentionally meant to cause harm. Increased visiting of vulnerable habitats caused by increased interest in some species, might even be a threat to those species with very limited local distribution. Therefore some data portals incorporate a system where some species locations are automatically generalized, coarsened, in different categories (e.g. 5x5 km, 10x10 km, 20x20 km, up to 50x50 km). This automatic process may be defined by species, by area, by time or for example by when certain specific activity is registered (e.g. breeding, mating/mating ceremonies). In e.g. the Swedish system (Artportalen) and in FinBIF the user may also choose an option for generalising the exact location of own observations.. For further use of data, the original precision is not lost, and may be made available for users with special need for precise localization, like management authorities, planners, researches or nature conservation groups. Risk-assessment of sensitive species (and habitats) should be a part of the establishment and management of an open access databases for biological data.
Even though the generalising of thelocality data could be perceived as a restriction for some, it could also be seen as a possibility to increase public awareness on the need for protection of vulnerable or threatened species, if the reason behind is well communicated.

In Lithuania, some species are regarded very sensitive, and for this reason not all data are opened (freely available) for public use. Photographing of nature, species, particularly of birds, is very popular activity. However, it may cause, if not planned properly with experts, a high risk for instance to sensitive rare species. A photographer needs to have a good knowledge and experience to avoid such unwanted

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result of the activity. In general awareness is raising and sensitivity of certain species can be better taken into account in many activities.

Most countries have created national lists of sensitive species (see; http://cms.laji.fi/wp-content/uploads/2018/11/Suomen_Lajitietokeskus_sensitiivinen-lajitieto_lajilista_2017.xlsx). Such lists are needed in the preparation of reports under Article 17 of the Habitats directive. In the reporting format is an option to indicate any species as “sensitive species” in the reporting country. Typical cases in the lists of sensitive species are:

1) Rare orchids
2) Nesting places of some raptors bird species
3) Rare amphibians and reptilies
4) Rare mollusks
5) Rare butterflies
6) Some rare, endemic taxon.

In preparation of species experiences from CITES should be taken into account. In CITES work, species potential for illegal taking and poaching are identified.

The list of sensitive species should be kept at the minimum because including species in the list has some tradeoffs in relation to observing activity. This may have some influences in the data gathering and make collection of data more difficult. There is a need to understand that not all threatened species are sensitive to open access data; i.e. the list of sensitive species does not equal the threatened species assessment results. To include the species to the list of sensitive species needs to be carefully considered to reflect a real risk or a threat if the occurrence data is opened.

Current status of citizen science in the Republic of North Macedonia

At the moment, there is rather little citizen science related activity in North Macedonia. Still activities in many fields are already well-established in social media. This means, the potential for collection of species data is already there, but some following steps are needed.

Table 2. Current status of qualifications for citizen science in the Republic of North Macedoia.

Activity	**Status in the Republic of North Macedonia**
Motivation of people to make observations	Works well for some taxa, but not for all taxonomic groups Common awareness should be improved Citizens are unable to recognize the taxa at field. Basic educational programmes and courses for amateurs are needed to make them try and participate. Also development of smart applications for identification of species at field like digital identification keys will be helpful. Applications like NatureGate and PlantNet can be used and facilitate the process of identification of species at field.
Licencing / Permitting systems required from the observers / researcher	Time consuming system

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	There is a legal obligation to submit a report from the scientific research as part of the licence. The reports are mainly in textual formats, stored on local computers, which can-not be interchanged between various data providers, public entities and scientific institutions. Paper-based reporting should be replaced by a system where data is available in an open and transparent manner.
Collective help in assessing observations	Works well for some taxa, but lack of expertise in many other Few discussion groups in social media in the country Experts are not yet willing to participate on voluntary basis!
Easy reporting and documentation of observations	Public system non-existing / under development
Availability of collected data for the management, science and public	Open database lacking Data is available only in publications and personal files Lack of IT infrastructure for biodiversity database to combine data from different sources and ensure data flow.

Social media – Facebook groups serving citizen science in the Republic of North Macedonia

Probably the best example of a functional Citizen Science process is the social media based collection of species data among fungi experts (see: "**Fungi Macedonici**" and "**Mediterranean fungi**"). This activity is maintained both at national level and at a broader level in the Mediterranean region. Additionally, the activity among people interested in invertebrates has increased slowly. The group "**Insecti Serbije** ☺ " also accepts observations from neighbouring countries. The group has very clear rules for when to indicate that the observation is made outside Serbia. The experts in the group have shown to be very helpful and having excellent knowledge in a large number of taxonomic groups. Another group, the "**Balcan Entomofauna**" has a smaller number of members, and only few of them are from Makedonia.

At the moment there are rather good possibilities for production of species data based on interest from public. However, the starting point to develop the next step is not equally promising.

Databases in the Republic of North Macedonia

At the moment there is no national database for citizens to register their observations. A new database on biodiversity information has been under development, but it is not in use yet. According to the current plans, the new database also will not serve citizen science purposes. At the moment, long history and strong tradition of heavy bureaucracy may be preventing the use of citizen science data in administration and environmental management.

There is lack of agreements, standards and protocols at national level to facilitate the data flow and lack of adequate legal basis to facilitate sharing of data. Secondary legislation should be developed for defining the structure, content, form and manner of operation, keeping and maintaining the system, obligations and deadlines for the submission of data, environmental information and appropriate reports to the designated institution, and the way of managing the data and information about the environment.

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Table 3. Comparison of feasibility (potential) in EU (in general), Finland (FI), Lithuania (LI) and North Macedonia (MK) for different taxonomic groups. This table is based on best expert guess". It is not referring any single publication. Estimated numbers of experts are given in the brackets. The estimation of potential is dependent on the size of each taxonomic group (species richness) compared to the size (population) of country.

	EU (all)	FI	exp.	LI	exp.	MK	exp.
ıscular plants	good	good	200	good	30	good	30
osses	moderate	good	20	moderate	5	moderate	5
ıngi	moderate	good	15 000	moderate	5	good	5-10
ıtterflies	good	good	12 000	moderate	30	good	5
oths	moderate	good	12 000	moderate	3	moderate	2
eetles	moderate	good	200	good	30	moderate	5
ragonflies	good	good	40	good	15	good	1-2
ther insects	moderate	moderate	100	moderate	5	low	0
achnids	low	moderate	50	moderate	5	low	1
ustaceans	moderate	moderate	10	moderate	5	moderate	2
olluscs	moderate	moderate	10	moderate	5	moderate	1-2
ther invert.	low	low	4	moderate	5	low	0
ammals	good	good	2000	good	100	good	20
sh	moderate	good	100	good	25	good	10
rds	good	good	20 000	good	200	low	5-10
ept. and amph.	good	moderate	20	good	10	good	4

Checklists and taxonomy

One requirement for the good management of databases is the provision and maintenance of national checklists from all taxonomic groups. One logical address for such responsibility would be national museums of natural history, since scientific work in the museums is mostly based on expert knowledge in taxonomy and phylogeny. This means, the data like species list with valid names are close to scientific work done in the Natural history museums. Moreover, if this responsibility is given to the museum sector, there has to be sufficient financing allocated. No museum can do this essential work properly without reasonable resources. It is also highly recommended to harmonise the species checklists with GBIF taxonomic backbone and related Catalogue of Life (CoL) checklists. In near future the CoL checklists will be improved to include the taxon concepts to the list. Current list are based on names only and may be misguiding. In practice, it means that when we are using a certain name, it has a reference to what is meant by this name in relation to current understanding of taxonomy. See more in: http://www.catalogueoflife.org/annual-checklist/2019/ and GBIF backbone: https://www.gbif.org/dataset/d7dddbf4-2cf0-4f39-9b2a-bb099caae36c.

The role of scientific collections

Natural history museums are the memory on accumulated natural history knowledge. The collections of natural history museums, together with published papers and ecological studies, provide a historical basis for species data and habitat requirements for species. To gain optimal benefit from these observations, all observations must be digitized and saved in databases open to research as well as to public. The requirements of FAIR principles (see above) and "open access" and "open science" must be taken into account when planning the final outcomes of the databases.

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Potential next steps

An open platform for reporting and sharing collected data

What is urgently needed is a user friendly, open database, where any registered people can register their observations and also have access to their own data for later. Good examples of this can be seen in many countries around Europe. Some countries have even offered IT-platforms for free for countries that have a need for such. Sweden, for example, has been one forerunner in this sector. They have had their species database, "**Artdatabanken**", already for more than 25 years". To establish and develop a good citizen science system for North Macedonia it would probably be easier to do it in co-operation on the Mediterranean or Balkan level. This would enable a large enough "critical mass" of experts behind the activity. Once the process becomes more attractive for a larger audience it would be easier to share or establish national groups. In every case, an open place for the collected data is needed.

One possibility is to start immediately is using already well established open platforms like iNaturalist, which has also an intuitive and cutting edge application for mobile users including automatic identification assistance. See more: https://www.inaturalist.org/places/macedonia. In the INaturalist database, there are already more than 1700 (as of 07/2019) species observations from North Macedonia and more than 400 of those have been verified by other users. These numbers are increasing constantly. There is also an API service where ICT skilled experts can extract the data using different filters.

Activities that may strengthen awareness of citizens

Birdwatching Rally is one activity in Lithuania which is rising of public awareness and wishes to involve broader audience (including international) into observation of bird species. It is organised by **Lithuanian Ornithological Society** in autumn (October). Last ones were organised in Nemunas (the largest river of Lithuania) delta, in and around Curonian Lagoon. The last was held on 12-14 October, 2018 and it was organised the nineteenth time. This popular traditional event is an international competition**.**

During the international competition, teams are looking for the bird species in selected territory in coastal Lithuania. Every year event is attracting more and more birdwatchers from different countries as it's the largest birdwatching event in the Baltics. Birdwatchers from more than 11 countries have attended competition in the previous years. The teams compete with each other in order to record as many bird species as possible not only from their appearance, but also from their voices within a fixed time. Rally route crosses the Nemunas Delta area as well as Curonian Lagoon and the Baltic Sea coasts as the Baltic Flyway is crossing Lithuania.

The covered territory is large, therefore all teams drive around by cars and consequently the event is called a rally, but not an ordinary one, as there is no precise route or speed strips. The only official criterion here is to finish on time and to reach the finish line. The success in the Birdwatching Rally is guaranteed to those, who have enough species identification knowledge, birdwatching in the field conditions experience and allocate time for precise planning. The prize for the 1st place goes to the team that records the highest number of bird species. However, sometimes the success is one of the factors, which decides the winning team. The longer list of the registered species also proves the higher birdwatching professionalism and skills of the teams. More information and requirements of the competition you can find in the **Birdwatching Rally rules.**
Every team are supplied with relevant info material. Schoolchildren and students participate in this event

Idea of Birdwatching Rally was born in Punia forest where the first competition was organised. The aim was not only to register more flora, fauna and fungi species but to make input into a better investigation of biodiversity of Lithuania.

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It is a good possibility to visit different areas of Lithuania, to get knowledge from the best experts of nature sciences as different specialists participate in the event. Special lectures and practical trainings are organized during the event. During the event was identified even new insect for Lithuania, found a lot of rare species. Just during one weekend without any financial resources quite a big area are investigated. The event is organised for scientists, nature observes, students, for anyone interesting in nature protection. GIS experts can participate the competition as well. Even families participate. People can meet colleagues, make their personal input into biodiversity protection, new ideas can be discussed. Participants like this event very much and wait for it all the year.

In Finland, annually more than 10 bird watching rally events take place. In addition, there are similar competitions concerning butterflies and even fish species.

***BioBlitz**:* is " *An intense period of biological surveying in an attempt to record all the living species within a designated area. Groups of scientists, naturalists and volunteers conduct an intensive field study over a continuous time period (e.g., usually 24 hours). There is a public component to many BioBlitzes, with the goal of getting the public interested in biodiversity. To encourage more public participation, these BioBlitzes are often held in urban parks or nature reserves close to cities*."
https://en.wikipedia.org/wiki/BioBlitz

BioBlitz is nowadays internationally a widely known concept and popular in many countries. Annually around 2-3 BioBlitz events take place in Finland. In addition, some FI experts have been invited to participate similar events in other European countries.

"**The Battle of towers**" is a competition of bird watching teams taking place annually in different bird watching towers around country. Annually around 300 teams participate the competition in Finland (https://www.birdlife.fi/tapahtumat/tornien-taisto/). The number of people in the team is not limited, but at least two members of a team must have been identified the species, before the observation can be accepted. The competition is taking place also in other Northern European countries but the numbers of team are smaller than in Finland. In this competition teams compete how many species of birds they can see and identify from the birdwatching tower during one morning-day (8 hours, between 05.00 – 13.00). The competition takes place every year durng the first Saturday of May.

Conclusion of recommendations concerning strengthening of citizen science in the Rpublic of North Macedonia

Development of secondary legislation and protocols for reporting.

- One organization should be named as a responsible body for the maintenance of national checklists of all taxa. In many countries, natural history museums have such a role. Updated checklists should be open for public in the internet (see FinBIF checklist: http://cdn.laji.fi/files/checklists/Lajiluettelo2018.xlsx) The checklist should be harmonised with GBIF/CoL backbone checklist (note that these checklist may be used as a starting point in creating the national lists)
- A service portal, which is linked to the database for the species observation by citizens, should be opened. The recorded species data (including map visualisation) should be open for the public (excluding sensitive species). All national data should be linked with GBIF.
- Development of IT systems for data flow and sharing of data. Potential of using already existing services e.g. iNaturalist, should be evaluated.
- Social media or other open platforms provide many possibilities to build up volunteer based observation systems, which also allow the quality assesments of the data. Moderator should be assigned to maintain discussions between the expert groups in social media and the administrators of species database.
- Administration and stakeholders of biodiversity data should co-operate to increase the awareness of public to learn to respect the values of the nature of North Macedonia. BioBlitz

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events and competitions related to species observations could be used for mobilizing and motivating people.

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