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Citizen Science for biological data in the Tyrol – South Tyrol – Trentino Euroregion: comparing options and a call for participation

Abstract

EN
Citizen Science is increasingly used to collect biological data globally due to easy-to-use smartphone applications and internet platforms that allow to collect and identify species records directly in the field. Here, we summarize and compare the applicability and data quality of two common portals (namely Ornitho and iNaturalist), by means of numbers of observations, users, and species. We focus geographically on the Alpine Central European region that comprises the provinces of Tyrol, South Tyrol and Trentino. The advantages and disadvantages of the portals and the potential benefit for science, stakeholders and common citizen are further discussed.

DE
Citizen Science ist eine Herangehensweise, um wissenschaftliche Daten über die Beteiligung der Bürger zu generieren. Besonders das Sammeln von biologischen Daten, stark unterstützt durch Internet- und Smartphone-Anwendungen, welche direkt im Feld verwendet werden können, ist eine global wachsende Disziplin, welche enorme Datenmengen liefert. Dieser Beitrag präsentiert und vergleicht die Daten und den Gebrauch von zwei der meist verwendeten Portale (nämlich Ornitho und iNaturalist) bezüglich der gesammelten Beobachtungen, den Beobachtern und der Anzahl an beobachteten Arten. Dabei legen wir den geographischen Fokus auf die alpine Europaregion Tirol, Südtirol und Trentino. Die Vorteile und Nachteile beider Portale und möglicher Nutzen für Forscher, Stakeholder und Bürger werden diskutiert.

IT
La Citizen Science è un approccio di raccolta di dati che prevede il coinvolgimento dei cittadini. Anche per dati biologici questo approccio è in costante crescita a livello globale, supportato dall'uso di internet e smartphones che ne permettono l'impiego anche direttamente sul campo. Questo contributo presenta e confronta i dati e l'utilizzo dei due principali portali per collezionare dati biologici (Ornitho e iNaturalist), usando le osservazioni raccolte, il numero di utenti ed il numero di specie per la regione europea che comprende le provincie del Tirolo, l'Alto Adige ed il Trentino. Vengono poi discusse le possibili applicazioni ed i vantaggi per la scienza, per gli stakeholder e per i cittadini.

Keywords: Citizen Science, Ornitho, iNaturalist, EGTC Euroregion Tyrol – South Tyrol – Trentino

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1. Introduction

Citizen Science is the research approach that involves common citizen volunteers in the acquisition and/or analysis of data, usually under the supervision of professional scientists (Dickinson & Bonney 2012). Citizen Science is growing worldwide, both as a mean to gather great amounts of data and to engage the public to take part in the research process (Bonney et al. 2014). Non-experts can considerably contribute to improve our knowledge of species distribution patterns and ecological processes providing a high quantity of data on a broad scale, with a sampling effort difficult to match by experts (Dickinson & Bonney 2012; Dickinson et al. 2010, 2012). For example, citizen science observations can aid early detection of invasive species and accelerate response projects (Courchamp et al. 2017). Collecting roadkill data helps to study the impact of transport infrastructures on wildlife (Crall et al. 2011; Vercayie & Herremans 2015). However, citizen science data suffer from some limitations, such as uneven sampling efforts towards human accessible areas or anthropized environments, as well as charismatic and easily to recognize species (Isaac et al. 2014).

Two online citizen science portals, *Ornitho.it* and *iNaturalist.org,* are currently used in Europe. Ornitho is a portal that originated in 2003 in Switzerland, mainly for recording birds, but was recently extended to integrate also other taxa, such as bats, reptiles, amphibians, dragonflies and other insects and plants (at least for the Italian version of this portal). It is powered by Biolovision Sàrl and is subdivided so far into five portals on European national level: Switzerland, France, Italy, Austria and Germany. Ornitho became the portal of usage by most of the single countries' bird institutions (such as the Austrian "Vogelwarte" and the Italian "Centro Italiano Studi Ornitologici").

iNaturalist was developed in 2008 in California and in just 10 years it has become one of the biggest citizen science portals for biological observations with worldwide application. This initiative is nowadays supported by several institutions, among them the California Academy of Sciences (since 2014), the National Geographic Society (since 2017), the International Union for the Conservation of Nature (IUCN) and the Global Biodiversity Informatics Facility (GBIF).

Both portals have a related application for smartphones to make direct records in the field possible (called similarly "NaturaList" for Ornitho and "iNaturalist" for iNaturalist). Further, iNaturalist recently released a new application called "Seek" which is based on the extensive image database of iNaturalist, allowing an automated and instant taxon identification directly in the field. However, these mobile applications are not the focus of this article and will therefore not be further discussed.

iNaturalist can be described as a social media portal that deals with naturally occurring organisms. Further, it can also be used as a medium to identify and record species for personal interest. The basic principle is that a user uploads a picture (or an audio record) as prove for the presence and identification of an organism, with information on location and observation date; further a variety of information such as the project affiliation, tags, sex and development stages can be added. The user can also add a taxonomic identification, as accurately as possible as he is capable of (e.g. on order, family or species level). After uploading, the observation is getting attention by the community of users who themselves can add their identification and comments, making the validation itself citizen science based. If there are diverging opinions on the taxonomical identification, the algorithms choose the consensus of the majority of users to give the observation a taxon name. If two or more users agree upon a species ID, the status "research grade" for this observation is reached, which basically means that the ID was reviewed, confirmed and is therefore much likelier to be correct. The advantage in such an open validation process is that most records are validated by someone (i.e. large amounts of data are processed; Wiggins & He 2016). However, the downside is that all users (and not just experts) can deliver their suggested IDs that are not necessarily correct.

For Ornitho, registered users must follow similar steps to upload observations. Records must include date, location as well as taxon name to be successfully uploaded; further information such as sex, age and status (e.g. breeding, foraging, casualty) can be added

but photographs are not mandatory. However, Ornitho has a different validation process where merely non plausible species identifications and identifications of critical species are checked exclusively by experts assigned to a specific area or taxon (group). This restricted validation increases the accuracy of the reviewed observation but is limiting the amount of validated data.
The structure of the database followed by iNaturalist is partly compliant with the international Darwin Core Standards (Wieczorek et al. 2012; Heberling & Isaac 2018), that provide the possibility of easy and fast share of uniform biological data. Ornitho is apparently not following this standard, making it difficult to share and combine its data with other databases. Recently, all the observations of iNaturalist that reach the "research grade" status were included in the Global Biodiversity Information Facility (GBIF.org) database. These data are updated on a weekly base and are conform with the Darwin Core standard, making them directly and fast accessible to researchers worldwide. Also, the International Union for Conservation of Nature (IUCN) uses GBIF data to update the state and range maps of threatened organisms (IUCN, 2019). On the other hand, no clear information on sharing and usage of Ornitho data could be found, apart from its own publications (such as the breeding birds atlas on regional, national or European level).
The idea behind this short contribution is to compare both citizen science portals in terms of advantages and disadvantages, usability and data collected. We then report in detail the presence and distribution data of organisms in the Alpine Euroregion Tyrol – South Tyrol – Trentino (Euregio, Europaregion), stretching from the Northern Alps in Austria (Tyrol) over the Central Alps in South Tyrol and Tyrol to the southern Alps in Italy (Trentino). This contribution is further meant to stimulate both the use by citizens to report species records engaging directly with nature and its inhabitants on one hand and institutions such as local nature history museums and research facilities as well as single experts to use (and share their knowledge) and improve the data delivered with these existing and free portals.

2. Methods

We used data that were freely accessible online from iNaturalist.org as well as from Ornitho.it and Ornitho.at. For the latter, as only limited data were freely accessible and usable, we were not able to further analyse the data quality and taxonomical subdivisions in more detail (as performed with iNaturalist observations with date of record, yearly increase and taxonomical subdivisions). As indication of usage we refer to the number of users and for the collected data to the total number of observations and taxa. Statistics were accessible on each national portal of Ornitho, just for Tyrol the data was thankfully provided by the Austrian coordinator of Ornitho.at. For iNaturalist, the integrated filter function with several query combinations was used to generate the here presented numbers (in detail, the query combinations used were: observations contained within the administrative boundaries of the EGTC Tyrol – South Tyrol – Trentino Euregion or the single regions, combined with either month or year of observation or taxonomical grouping). All data were taken on and until August 30, 2019, except where stated otherwise.
The observation data were compared between iNaturalist and Ornitho and between the regions of Tyrol (Austria, including North and East Tyrol), and South Tyrol and Trentino (both Italy) in the south, which all are part of the EGTC Tyrol – South Tyrol – Trentino Euregion. Further, qualitative comments on the usability and impression were collected by the authors themselves and colleagues. Geographic and demographic data for these regions were found on the official EUREGIO – EGTC Web-page (last accessed on 30.08.19 and online under URL: www.europaregion.info).

3. Results

3.1. Comparison of Ornitho and iNaturalist

Ornitho is by far the biggest portal in terms of observation (29 times more observations in Italy and 105 times more for Austria in comparison to iNaturalist, but more similar to iNaturalist in regard to the user number) on a national level (i.e. in Italy 1.9 times more iNaturalist users, in Austria 2.3 times more Ornitho users; Table 1). The absolute numbers are higher for Italy since Austria is a smaller country. The higher number of species reported by the Italian Ornitho version is also because different taxa (from mammals to plants) are partly integrated in counterpart to the Austrian version that just targets birds.

The missing restriction to specific taxonomic groups of iNaturalist makes it possible to record a much higher number of species, for all countries and regions worldwide. As a comparison, the Italian Ornitho, although it allows the recording of several taxonomic groups, consists of more than 97.5 % bird observations (in iNaturalist for Italy, bird observations make up for 27 % of all observations). The yearly trend in reported observations on a national level is constantly and steeply increasing for iNaturalist (121,744 observations in Italy and 14,730 in Austria for 2018) but has reached a steady position for Ornitho in both countries (1,628,672 observation in Italy and 931,156 in Austria for 2018). Interestingly, for both countries the Ornitho observations are peaking in the spring months (March, April and May).

Table 1. Summary of the number of observations, species and users of the two most common citizen science portals *Ornitho* and *iNaturalist* partitioned among Italy and Austria. The values present cumulative data until the date of 30.08.2019.

	Portal	**Italy**	**Austria**
Observations	Ornitho	15,939,030	5,471,876
	iNaturalist	550,615	52,288
Species	Ornitho	1,936	541
	iNaturalist	15,107	6,411
User number	Ornitho	11,046	5,545
	iNaturalist	20,882	2,417

The three regions of Tyrol, South Tyrol and Trentino are displaying a clear north-south gradient. Tyrol has higher numbers regarding population, tourism and total area (Table 2). Ornitho is mostly used in Tyrol and less in Trentino (observations and user; Table 3), while iNaturalist shows an opposite pattern (with lots of observations, species and users in Trentino; Table 2).

Table 2. Summary of demographic numbers such as population, size and usage (observation, species and users) of iNaturalist and Ornitho in the three political regions of the Euroregion Tyrol – South Tyrol – Trentino. Geographic data from www.europaregion.info were all set on 30.08.2019, except for * which are set on 17.09.2019.

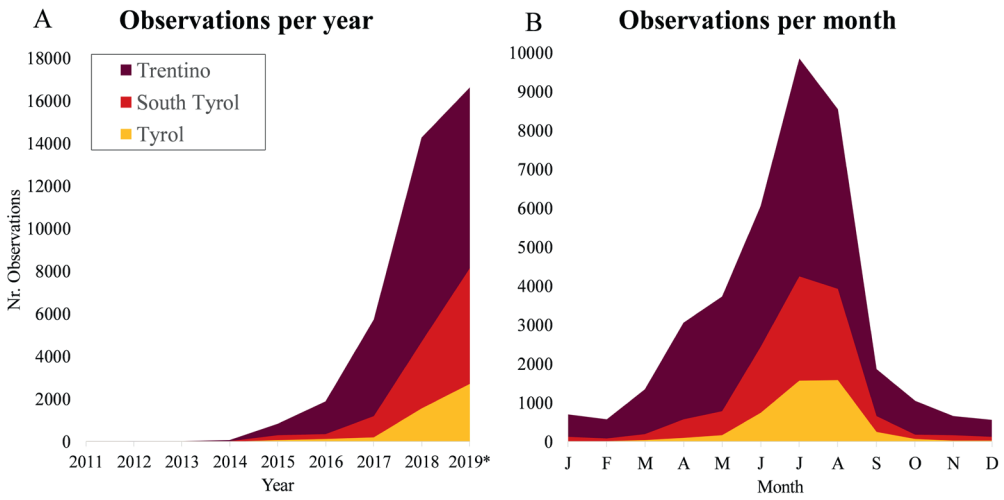
		Tyrol	South Tyrol	Trentino	Geographic trends (north to south)
Area (km²)		12,648	7,398	6,207	→
Population		721,574	515,714	536,237	→
Tourism (hotel overnight stays)		35,102	29,017	11,483	→
Observations	Ornitho	408,287	332,414	308,476	→
	iNaturalist	4,606	10,067	24,662	→
Species	Ornitho	318	687	693*	→
	iNaturalist	1,316	2,132	3,124	→
User	Ornitho	900	206	184	→
	iNaturalist	607	997	1,699	→

Table 3. Main advantages and disadvantages of the two most used citizen science portals Ornitho and iNaturalist in the EGTC Tyrol – South Tyrol – Trentino Euregion. Missing or negative (–) and given or positive (+) aspect are presented; (±) for neutral statements. NOTE: The list is by no mean exhaustive and relies on the authors own impressions and on the common settings of each portal.

Characteristics	**Ornitho**	**iNaturalist**
Open access policy of data	(–) restrictions present	(+) generally open, single user setting might restrict data access
Worldwide application	(–) only in Ornitho user countries	(+) no restrictions
Validation step done by experts	(+) all validations by experts	(±) all user can validate identifications, among them many experts
Proportion of validated records	(–) only in cases of difficult identification/implausible record	(+) most observations are validated
Presence & absence data records possible	(±) lists of a location comprising a time effort that can be used	(–) No absence data or effort quantification possible
Data integration in other online databases	(–) not to our knowledge	(+) GBIF and others Darwin Core Standards
Taxonomic restrictions	(–) limited taxa possible	(+) linked to trusted taxon provider, user can add missing taxon, too
Basic observation requires a prove of presence/ID	(–) only in cases of difficult identification/improbable record	(+) a picture or audio record are required (otherwise incomplete)
Data management and usage by users	(±) restricted to personal observations and frequent user, downloads in spreadsheets possible	(+) filter tool allows multiple query combinations by everyone, downloads in spreadsheets possible
Possibility to collect data in automated manner	(–) only by date, regional, taxonomical and user based	(+) possibility to create long-lasting collections with multiple queries (called “projects”)
Target campaigns	(±) for special cases (e.g. invasive or endangered species) set up by portals manager	(+) projects can be started by every user that holds more than two observations
Learning potential for user	(±) Limited species information and communication possibilities between users and curators	(+) High potential for learning about species, identification and interact with multiple taxon experts and curators

3.2 iNaturalist Data for the Euroregion

Since the data of iNaturalist are freely available, we collected all the observation for the Euroregion Trentino – South Tyrol – Tyrol in the collection project called "BioDiv EUREGIO Tyrol – South Tyrol – Trentino" (online under URL: www.inaturalist.org/projects/biodiv-euregio-tyrol-south-tyrol-trentino). With these data we generated the following graphics that clearly depict (1) the fast-growing usage of this portal over the last few years (Fig. 1A), (2) the great changes in usage over the seasons with a very high number of records in July and August and low numbers in winter consistent over all three regions (Fig. 1B), (3) the great difference in usages between the three political regions (Fig. 1A), and (4) the differing taxonomical proportion of records regarding observations and species (Fig. 2).



* data until 30.08.2019 were used.

Fig. 1. Plots of the observation years (A) and months (B) partitioned among the three political regions in the Euroregion Tyrol – South Tyrol – Trentino Euroregion. Values represent accumulated observations for each region and time period.

Most iNaturalist observations in the Euroregion already reached the status of research grade (58.6 %) and most of the remaining (33.1 %) meet all necessary requirements (i.e. date of observation, geographic position and a first taxonomic ID) but lack the validation step (or are on a higher taxonomical level). All other observations (8.3 %) are mainly observations that either lack one of the mentioned information or depict non-wild organisms, such as cats, dogs, cows or humans.

The taxonomic diversity of the reported organisms for the Euroregion is quite large (i.e. 4,089 verified and determined species) spanning from fungi to vertebrates, plants, insects and lichens (Fig. 2). Interestingly, the difference between the number of observations and species varies between the taxonomic groups. Insects (and to a smaller extent fungi/lichens, arachnids and other invertebrates) have few observations per species whilst vertebrates (and higher plants) show more observations for a relatively small species number (i.e. indicating a higher interest in the groups and/or a higher chance for observations).

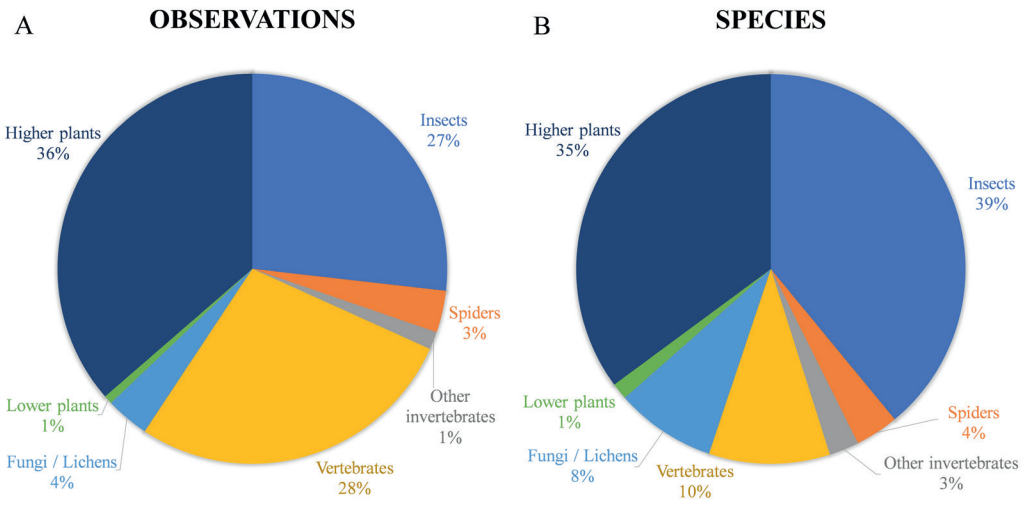


Fig. 2: iNaturalist observations (A) and species (B) numbers from the Euroregion Tyrol – South Tyrol – Trentino partitioned among taxonomic groups. A dominance of animals (59% observations and 56% species in sum) over plants (37% observations and 36% species) can be seen, with a predominance of insects and vertebrates for the animals and higher plants for autotrophs.

The main differences of Ornitho and iNaturalist in terms of advantages, disadvantages and characteristics are listed in a qualitative manner in Table 3. Generally speaking, the main differences in favour of iNaturalist are the worldwide applicability and the taxonomically more flexible system (i.e. new taxa can be added by the user itself via trusted external provider) with its completely open access data policies (except for sensible records and if terms were changed manually by the user), against a (semi)national usage of Ornitho with its restricting data policy and limited taxonomic flexibility.

4. Discussion

Citizen Science is predicted to be growing and it seems that the public is increasingly included into the research process (Silvertown 2009; Sullivan et al. 2017). This trend can be seen also in the Tyrol – South Tyrol – Trentino Euroregion. Portals such as iNaturalist and Ornitho can increase the biological and distributional knowledge of taxa while providing an interaction of the public with experts and raising awareness for biodiversity. Such interactions and the growing interest of the public towards the natural world is directly expected to increase the sensibility and care for nature and the environment in general. The contrasting north to south gradients in the usage of the two portals depict differing preferences, but also a potential for a future growth in those areas where they are less used.

Both portals are evolving to adapt to user requests to be more flexible in terms of reporting observations (e.g. using mobile devices) and including automated species identification (at least on iNaturalist). The development of Ornitho to include other taxa and to be used on a greater geographical scale (and maybe also a more open data policy) are potential future steps that can upgrade this portal to an international level which is now partially lacking. As an example, the Italian portal of Ornitho is now open to a quite wide taxonomic array of species, especially invasive species (but also endangered ones) that are targeted additionally to the classical bird observations (which still make up for over 97 % of the observations).

The peaking usage in the summer months of iNaturalist corresponds with the phenology of most taxa that peaks in summer but might also depict the contribution of tourists and guests that are often visiting the Euroregion for recreation, especially for outdoor activities (Schirpke et al. 2018). On a national level, Ornitho observation data instead peak in the spring months (for both Italy and Austria) coinciding with the bird migration and first breeding period, most probably since target campaigns by Ornitho

to record breeding species on local or national level are in place for several years.
As expected, the taxa that are most characteristic and more easily observable are the ones that are mostly reported, which is confirmed by the analysed iNaturalist data (i.e. vertebrates in general, but also plants). This aspect leads to more observations for one single species, allowing to better understand its distribution, behaviour and potential conservation. This characteristic for vertebrates is especially represented by Ornitho, where lots of single records for limited species numbers are present, allowing to publish national or regional inventories for taxa (such as: Arbeitsgemeinschaft für Vogelkunde 2017; Defloriani et al. 2018; an Austrian breeding-birds atlas is also in progress). On the other hand, taxa that are depicted by less observations per species and that report a higher species number (e.g. invertebrates), are the ones that might harbour interesting data of less known species (such as new records of both alien and autochthonous species). iNaturalist is, in our opinion, now – and in future – more suited for this second aspect (and with more observations also for the first aspect, see the dominance of vertebrate observations in Fig. 2).
In the near future, the more "open" policy of iNaturalist (i.e. in terms of data sharing, taxonomical and geographical potentials) along with the strong tendency to provide a prove of occurrence and identification in comparison to Ornitho (where evidence photos are more rare among observations), is expected to further boost this portal. Ornitho works with a more limited format and in our opinion it should be updated to increase its general flexibility (as for example is happening with the Italian version that includes more taxa), also by adopting a more open data policy. According to our experience with both portals, it appears that the personal satisfaction and reward for the single user is higher with iNaturalist compared to Ornitho (at least for the average citizen) and will on the long run increase its usage. A further point in favour of iNaturalist is that also tourists and guests visiting the regions for a limited period are able to directly contribute without the necessity to get used to new portal policies (or adapt their devices to report in other national operating Ornitho portals). However, the greatest advantage of Ornitho is in our opinion the ability to include "Lists" that comprise a time effort and a certain area, generating both presence as well as absence data (although for modelling purposes also this information is not unambiguous; see Lobo et al. 2010).
The data provided by citizen science portals can be of interest for local institutions, especially for nature museums that are keeping record of the locally occurring taxa (Bisanti 2015; Heberling & Isaac 2018). Some have already started to use these portals as a tool to gather data (e.g. the MUSE Science Museum of Trento for collecting dragonflies occurrences; Assandri 2019), others are working on how to integrate such data (e.g. the Museum of Nature in South Tyrol as part of the project "Biodiversity Monitoring South Tyrol").
The participation of such institutions can increase the quality of the reported data by letting its experts thoroughly validate the observations that are then implemented in the local databases (such as the one of the Museum of Nature in South Tyrol called "FloraFauna" and partially online under URL: www.florafauna.it). These institutions should also use these free tools (especially the "projects" function provided by iNaturalist) for targeted campaigns on specific taxa (as the MUSE did already, see above) to reduce the working load and allow a facilitated way for users to report sightings. Further, with the growing data provided via citizen science, also additional studies exceeding faunistic records can be developed; such as biotic interaction studies (Gazdic & Groom 2019), detection and solution of conflicts between nature and human activities such as road kills (Vercayie & Herremans 2015) and bird-window collisions (Kummer et al. 2016; Winton et al. 2018).

5. Conclusion and outlook

In our opinion the growing citizen science approaches will continue to provide biological data, thereby improving the knowledge of the occurring taxa, of new incoming species and of general changes in nature. Also, citizens find a facilitated and interesting way to learn more about nature by allowing them to easily access expert knowledge. After all that has been said, we encourage everyone, from single experts to institutions to citizens to participate in recording and reporting the surrounding nature.

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