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A grid mapping scheme for the flora of Tyumen city: a case study for an invasive and a synanthropic plant species

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Abstract. Biodiversity inventory is one of the widespread fields in biological studies around the world. The understanding the correct distribution of each taxon needs obtaining the complete number of species' records in the study area. In this research, we compared the completeness of reliable expert data and citizen science data obtained through iNaturalist platform for the urban area of the city Tyumen. The comparison was conducted using the grid mapping scheme developed by us for the study area with grid cell size of 1 × 1 km. As target plants, an invasive species *Heracleum sosnowskyi* and a synanthropic species *Urtica cannabina* were selected. We found that neither only expert data nor only citizen science (iNaturalist) data can reflect a reliable distribution of these species in the city Tyumen. We believe that only joint coordinated use of both citizen science data and expert data could provide the relevant and reliable data on species' distribution.

Key words: alien species, citizen science, expert data, *Heracleum sosnowskyi*, iNaturalist, urban flora, *Urtica cannabina*.

Схема сеточного картографирования флоры г. Тюмени на примере инвазионного и синантропного видов растений

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Аннотация. Инвентаризация биоразнообразия является одной из широко распространенных областей биологических исследований во всем мире. Для понимания корректных данных о распространении каждого таксона необходимо получить данные обо всех находках вида на территории исследования. В настоящем исследовании мы сравнили полноту достоверных экспертных данных и данных гражданской науки, полученных с помощью платформы iNaturalist, для территории г. Тюмень. Сравнение было проведено с использованием разработанной нами схемы сеточного картографирования исследуемой территории с размером ячейки сетки 1 × 1 км. В качестве целевых растений были выбраны инвазионный вид *Heracleum sosnowskyi* и синантропный вид *Urtica cannabina*. Мы обнаружили, что ни лишь экспертные данные, ни лишь данные гражданской науки (iNaturalist) не могут отразить достоверное распространение этих видов на территории Тюмени. Мы считаем, что только совместное скоординированное использование данных гражданской науки и данных экспертов может предоставить актуальные и надежные данные о распространении видов.

Ключевые слова: *Heracleum sosnowskyi*, iNaturalist, *Urtica cannabina*, городская флора, гражданская наука, чужеземный вид, экспертные данные.

Biodiversity research and its inventory is one of the most widespread fields in natural sciences (e.g. Khapugin, 2020; Selwood & Zimmer, 2020). Around the world, the main way to obtain knowledge on plant diversity is documentation of records of separate taxa. Without doubts, the most reliable data are being revealed by experts-botanists during special botanical field trips in the certain study areas. Herbarium specimens are recognised as the best or even only evidence of plant presence in a certain location (e.g. James et al., 2018).

Despite this, the higher number of non-professionals-naturalists currently became one more force obtaining a large amount of field data around the world. The work of such non-professional observers is called as a «Citizen Science» (e.g. Bonney et al., 2009; Hand, 2010). One of the most widespread and popular practical methods of applying the biodiversity-based citizen science is the platform iNaturalist (iNaturalist, 2020). This source is considered as one of leading providers of open data on the global biodiversity, which used in research publications around the world (e.g. Fourcade, 2016; Spear et al., 2017; Heberling & Isaac, 2018; Ocampo-Peñuela et al., 2018), including Russia (Seregin et al., 2020). Exactly citizen science methods are most applicable in (sub)urban areas characterised by a high amount of private properties making it difficult or even impossible to survey the biodiversity using standard sampling techniques.

Earlier, we proposed a scheme of grid mapping for the whole Tyumen region (Khapugin & Kuzmin, 2020). On its basis, we developed a scheme of grid mapping of the Tyumen urban area using 1 × 1 km grid cell size (Figure 1). For this purpose, we digitised the Tyumen city boundaries using the urban area boundaries on the map stored on the official web-site of the Tyumen city administration (see <http://www.tyumen-city.ru/win/download/25848/>).

Since the study area contains anthropogenically disturbed urban area, we selected a highly harmful invasive alien plant, *Heracleum sosnowskyi* Manden., and a synanthropic archeophyte plant, *Urtica*

cannabina L. An additional task of the study was to compare the both completeness and overlapping expert data (herbarium collections, first author's observations) and citizen science data (observations of a Research Grade level). Both plant species are relatively well identifiable, on the basis of which we hoped to have the higher proportion of reliable data in the study area.

Figure 1. Distribution of *Urtica cannabina* (A) and *Heracleum sosnowskyi* (B) in the Tyumen city urban area on the basis of expert data (red dots) and iNaturalist data (blue squares) demonstrated using grid mapping method

For *Urtica cannabina*, we had expert data on 17 local populations in the city Tyumen. They were arranged into seven grid cells (Figure 1A). At the same time, by 12 August 2020, iNaturalist contained data on 17 Research Grade observations within the study area, which were then arranged into ten grid cells of the Tyumen city map. Figure 1A shows that in Tyumen, *U. cannabina* is known from 13 grid cells. We may see 4-cell overlapping of data from iNaturalist and experts.

Originally we had expert data on 15 *Heracleum sosnowskyi* populations in the city Tyumen. They were arranged into seven grid cells (Figure 1B). By 12 August 2020, iNaturalist contained data on 11 Research Grade observations in the city Tyumen, which were arranged into seven grid cells of the used mapping scheme. Therefore, there is a 2-cell overlapping of data from iNaturalist and experts. Thus, in total, *H. sosnowskyi* is distributed in 12 grid cells. We may notice that both expert and citizen science data are incomplete to reflect reliable distribution of both plant species in the city Tyumen. So, of 13 grid cells, where *Urtica cannabina* is currently known, expert data confirm species' presence in seven grid cells (53.9 %), while iNaturalist indicates its presence in ten grid cells (76.9 %). At the same time, of 12 grid cells, where *Heracleum sosnowskyi* is currently noted, expert data show its presence in seven grid cells (58.3 %), while citizen science data confirm the species' existence in seven grid cells (58.3 %).

Thus, it is well seen that both expert and citizen science data cannot separately reflect the reliable distribution of one of the most recognisable plant species in an urban area (Tyumen city). This is in partial accordance with conclusions of Spear et al. (2017) mentioned that joint coordinated partnering citizen scientists and researchers could help to solve an issue with data incompleteness in studies on biodiversity inventory. In addition, the use of iNaturalist allows to find any observation and re-check it in nature at the most relevant time.

Concerning the developed grid mapping scheme of the Tyumen city and studied plant species, we assume that the obtained distribution of both species is still far of the completeness. In future, the new records of these species are expected in both centre and periphery of the Tyumen urban area. We suggest applying the collaboration of citizen scientists, naturalists-observers and researchers in further studies of biodiversity anywhere as wider as possible.

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