



# Биоэртүрлілікті зерттеудегі цифрлық технологиялар

## Digital technologies in biodiversity research

### Цифровые технологии в исследовании биоразнообразия



#### ЛЕКЦИЯ 1

## Полевая биология в цифровом мире



Слайды CC BY:

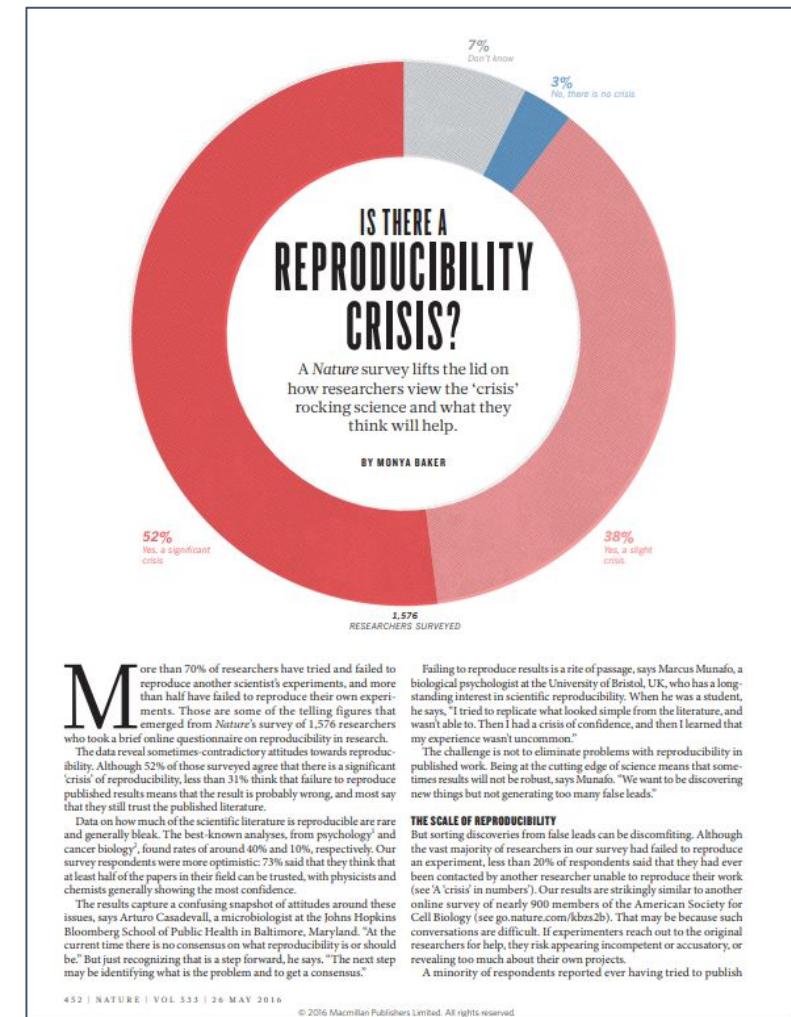
Dag Endresen, GBIF Norway  
Артём Созонтов, ИЭРИЖ УрО РАН  
Наталья Иванова,  
Максим Шашков



Natalya Ivanova

# Есть ли кризис воспроизводимости научных исследований?

Результаты опроса 1576 исследователей показали, что более 70% исследователей пытались и не смогли воспроизвести эксперименты другого ученого, и более половины не смогли воспроизвести свои собственные эксперименты.



**M**ore than 70% of researchers have tried and failed to reproduce another scientist's experiments, and more than half have failed to reproduce their own experiments. Those are some of the telling figures that emerged from *Nature*'s survey of 1,576 researchers who took a brief online questionnaire on reproducibility in research.

The data reveal sometimes-contradictory attitudes towards reproducibility. Although 52% of those surveyed agree that there is a significant 'crisis' of reproducibility, less than 31% think that failure to reproduce published results means that the result is probably wrong, and most say that they still trust the published literature.

Data on how much of the scientific literature is reproducible are rare and generally bleak. The best-known analyses, from psychology<sup>1</sup> and biology<sup>2</sup>, found rates of around 40% and 10%, respectively. Our survey respondents were more optimistic: 73% said that they think that at least half of the papers in their field can be trusted, with physicists and chemists generally showing the most confidence.

The results capture a confusing snapshot of attitudes around these issues, says Arturo Casadevall, a microbiologist at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland. "At the current time there is no consensus on what reproducibility is or should be." But just recognizing that is a step forward, he says. "The next step may be identifying what is the problem and to get a consensus."

A minority of respondents reported ever having tried to publish

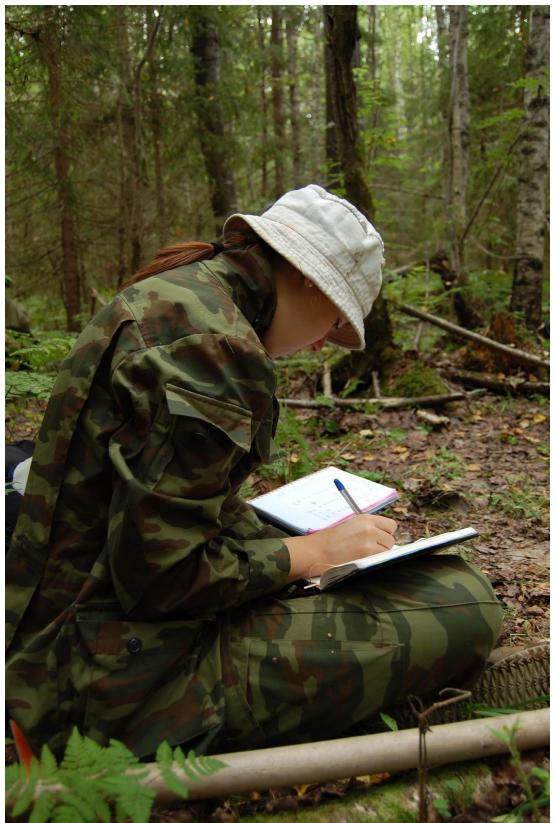
Failing to reproduce results is a rite of passage, says Marcus Munafò, a biological psychologist at the University of Bristol, UK, who has a long-standing interest in scientific reproducibility. When he was a student, he says, "I tried to replicate what looked simple from the literature, and wasn't able to. Then I had a crisis of confidence, and then I learned that my experience wasn't uncommon."

The challenge is not to eliminate problems with reproducibility in published work. Being at the cutting edge of science means that sometimes results will not be robust, says Munafò. "We need to be discovering new things but not generating too many false leads."

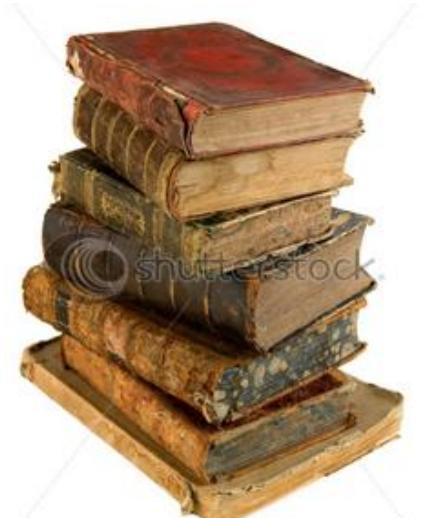
**THE SCALE OF REPRODUCIBILITY**  
But sorting discoveries from false leads can be disconcerting. Although the vast majority of researchers in our survey had failed to reproduce an experiment, less than 20% of respondents said that they had ever been contacted by another researcher unable to reproduce their work (see 'A crisis in numbers'). Our results are strikingly similar to another online survey of nearly 900 members of the American Society for Cell Biology (see go.nature.com/khsz2b). That may be because such conversations are difficult. If experimenters reach out to the original researchers for help, they risk appearing incompetent or accusatory, or revealing too much about their own projects.

A minority of respondents reported ever having tried to publish

Baker, M. 1,500 scientists lift the lid on reproducibility. *Nature* 533, 452–454 (2016). <https://doi.org/10.1038/533452a>



Полевые данные ценные сами по себе и должны быть  
доступны для повторного анализа



# Оцифровка научных биологических коллекций

Making data and images of millions of biological specimens available on the web



# Biodiversity Heritage Library

<https://www.biodiversitylibrary.org/>



- Открытый доступ к литературе о биоразнообразии
- >147000 источников, опубликованных с 1450 по 2022 гг.

Biodiversity  
Heritage  
Library



*Inspiring discovery through free access to biodiversity knowledge.*

The Biodiversity Heritage Library improves research methodology by collaboratively making biodiversity literature openly available to the world as part of a global biodiversity community.

BHL also serves as the foundational literature component of the Encyclopedia of Life (EOL).

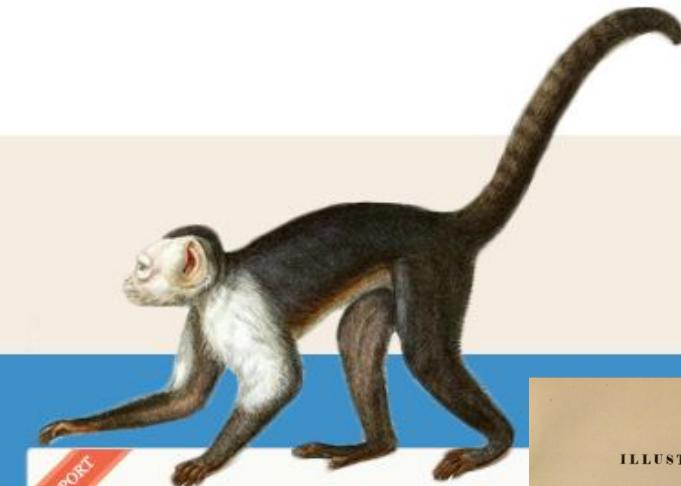
Search across books and journals, scientific names, authors and subjects

Search the catalog and full-text 

Full-text  Catalog 

[ADVANCED SEARCH](#)

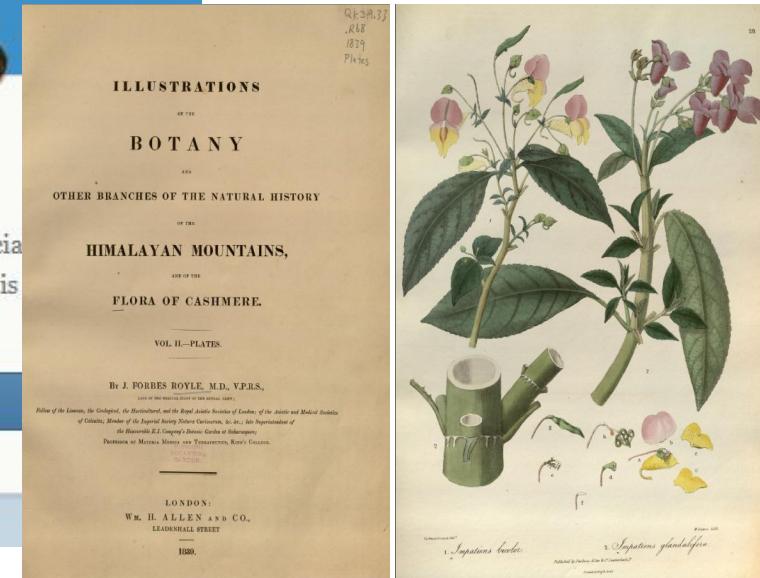
Browse by:  Title  Author  Date  Collection  Contributor



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<https://www.biodiversitylibrary.org/page/2913426#page/35/mode/1up>



# Citizen science

Привлечение волонтеров к сбору научных  
данных под руководством  
профессиональных исследователей

Подробнее: [https://en.wikipedia.org/wiki/Citizen\\_science](https://en.wikipedia.org/wiki/Citizen_science)



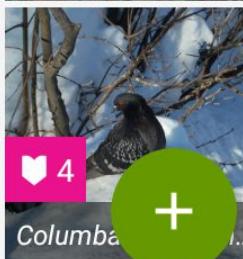
Объем данных, собираемых через системы  
любительских наблюдений,  
в мире возрастает существенно быстрее по  
сравнению с «научными» источниками

Для данных, доступных через GBIF

- EOD – eBird Observation Dataset  
>1 млрд наблюдений
- Observation.org >58 млн наблюдений
- iNaturalist Research-grade Observations  
>40 млн наблюдений

My Observati... ≡ 🔍 ⋮

4,761 OBSERVATIONS 1,027 SPECIES 1,431 IDENTIFICATIONS

|   |  |  |
|---|--|--|
| <br><i>Catocala fraxini</i> | <br><i>Plantago media</i>       | <br><i>Gagea minima</i>       |
| <br><i>Ficaria verna</i>    | <br><i>Corydalis solida</i>     | <br><i>Petasites spurius</i>  |
| <br><i>Catocala nupta</i>  | <br><i>Bromus inermis</i>      | <br><i>Chelidonium majus</i> |
| <br><i>Vicia sepium</i>   | <br><i>Trifolium pratense</i> | <br><i>Columba...</i>       |

# Мобильное приложение iNaturalist

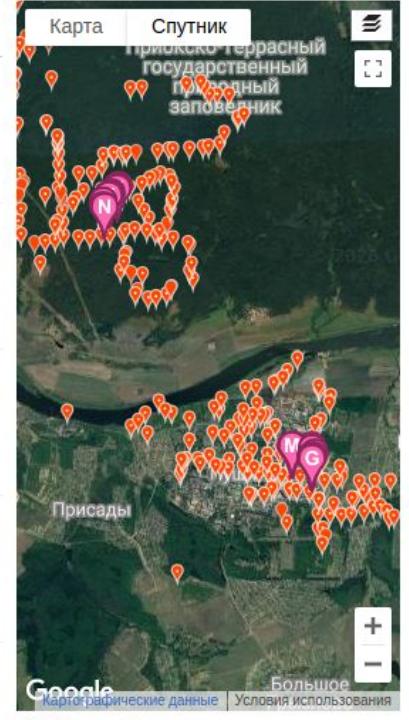
Explore Your Observations Community Identify More

Your Observations

Add Observations Batch edit Search

| Photos / Sounds  | Species / Taxon Name                            | Date observed                   | Place  | Date Added  |
|--|---|---------------------------------|--|---|
| <br>A   | <i>Taraxacum officinale</i><br>Common Dandelion | May 16, 2020<br>10:04 AM<br>MSK | 8, Pushchino,<br>Moskovskaya<br>oblast', Russia,<br>142290 (Google,<br>OSM)  | May 16, 2020<br>10:53 AM MSK<br>1 ID<br>Research Grade<br>Edit   View »     |
| <br>B   | <i>Taraxacum officinale</i><br>Common Dandelion | May 16, 2020<br>09:54 AM<br>MSK | Mkrn. D.,<br>Pushchino,<br>Moscow Oblast,<br>Russia, 142290<br>(Google, OSM) | May 16, 2020<br>10:52 AM<br>MSK<br>1 ID<br>Research Grade<br>Edit   View »  |
| <br>C   | <i>Artemisia vulgaris</i><br>Common Mugwort     | May 16, 2020<br>09:52 AM<br>MSK | Mkrn. D.,<br>Pushchino,<br>Moscow Oblast,<br>Russia, 142290<br>(Google, OSM) | May 16, 2020<br>10:47 AM<br>MSK<br>1 ID<br>Research Grade<br>Edit   View »  |
| <br>D | <i>Chelidonium majus</i><br>Greater Celandine   | May 16, 2020<br>09:51 AM<br>MSK | Mkrn. D.,<br>Pushchino,<br>Moscow Oblast,<br>Russia, 142290<br>(Google, OSM) | May 16, 2020<br>10:47 AM<br>MSK<br>1 ID<br>Research Grade<br>Edit   View »  |
| <br>E | <i>Lamium album</i><br>White Deadnettle         | May 16, 2020<br>09:51 AM<br>MSK | Mkrn. D.,<br>Pushchino,<br>Moscow Oblast,<br>Russia, 142290<br>(Google, OSM) | May 16, 2020<br>10:46 AM<br>MSK<br>2 IDs<br>Research Grade<br>Edit   View » |

Карта Спутник



Google Картографические данные Условия использования

Redo search in map area

Версия, доступная через браузер [www.inaturalist.org/home](http://www.inaturalist.org/home)

# FAIR принципы данных

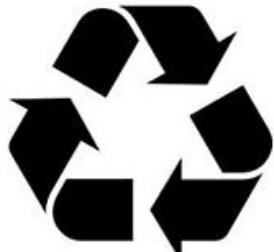
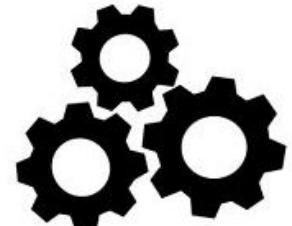
Данные можно найти в сети Интернет  
! идентификаторы !  
! метаданные !

Findable  
A  
ccessible



Данные должны быть совместимыми с другими подобными массивами данных  
! стандарты !

Interoperable  
R  
Reusable



Данные должны быть доступны  
! бесплатно и в открытом доступе !

Данные могут быть многократно использованы для решения разных научных и практических задач  
! лицензии (правила использования) !

# Политика научных журналов в отношении исходных данных: обзор издательства

**SPRINGER NATURE**

## Тип 1

Журнал призывает авторов, когда это возможно и целесообразно, размещать данные, подтверждающие результаты их исследований, в общедоступном хранилище.

## Тип 2

Журнал настоятельно рекомендует, чтобы все наборы данных, на которые опираются выводы статьи, были доступны для читателей. Авторам рекомендуется предоставить информацию о доступности данных в своей статье.

## Тип 3

Журнал настоятельно рекомендует, чтобы все наборы данных, на которые опираются выводы статьи, были доступны для читателей. Авторам необходимо предоставить информацию о доступности данных в своей статье.

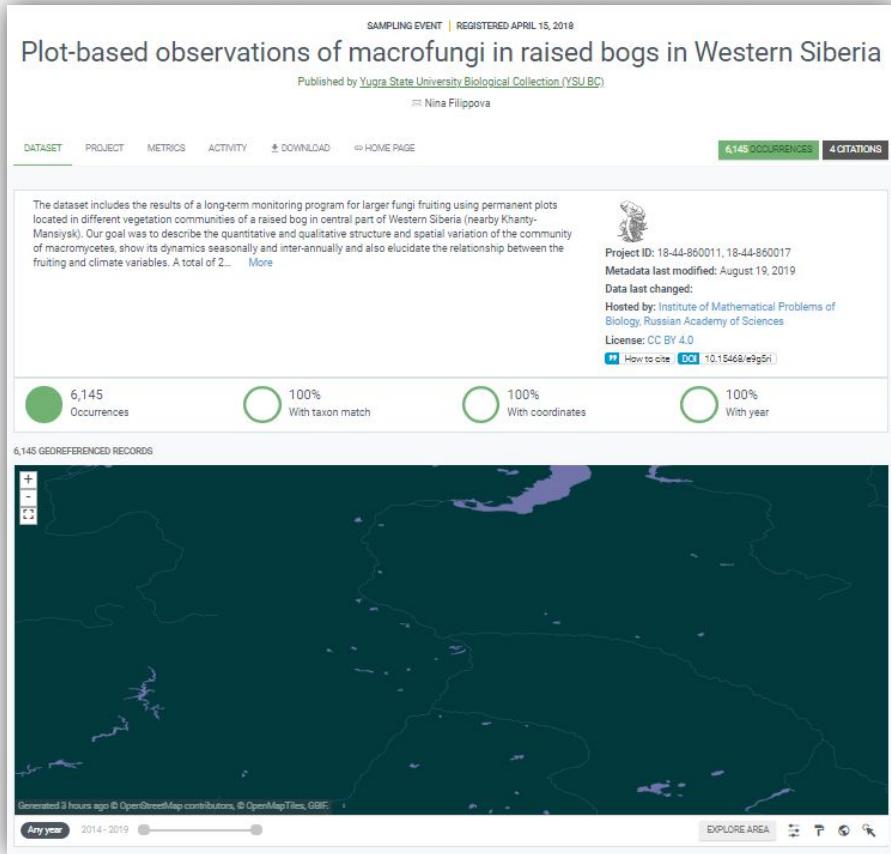
## Тип 4

Журнал требует, чтобы все наборы данных, на которые опираются выводы статьи, были доступны рецензентам и читателям. Авторам необходимо предоставить информацию о доступности данных в своей статье.

Файлы на вашем рабочем компьютере или USB-накопителе возможно содержат ценные знания, которые могут извлечь другие исследователи. <https://www.springernature.com/gp/authors/research-data>

# Data paper Статья о данных

Рецензируемая публикация в научном журнале, содержащая описание набора данных, доступного через Интернет



Biodiversity Data Journal 7: e35674  
doi: 10.3897/BDJ.7.e35674

open access

Data Paper

**Sampling event dataset on five-year observations of macrofungi fruit bodies in raised bogs, Western Siberia, Russia**

Nina Filippova<sup>1</sup>, Elena Lapshina<sup>2</sup>  
<sup>1</sup>Yugra State University, Khanty-Mansiysk, Russia

Corresponding author: Nina Filippova ([nfilippova@yusu.edu.ru](mailto:nfilippova@yusu.edu.ru))  
Academic editor: Dmitry Schigel  
Received: 23 Apr 2019 | Accepted: 23 Jul 2019 | Published: 30 Jul 2019  
Citation: Filippova N, Lapshina E (2019) Sampling event dataset on five-year observations of macrofungi fruit bodies in raised bogs, Western Siberia, Russia. Biodiversity Data Journal 7: e35674. <https://doi.org/10.3897/BDJ.7.e35674>

**Abstract**

**Background**

The data paper includes the results of a long-term monitoring programme for macrofungi fruiting using permanent plots located in different vegetation communities of a raised bog in central part of Western Siberia (nearby Khanty-Mansiysk). The goal was to describe the quantitative and qualitative structure and spatial variation of the community of macromycetes, show its dynamics seasonally and inter-annually and also elucidate the relationship between the fruiting and climate variables. A total of 263 circular 5 m<sup>2</sup> subplots (for a total area of 1,315 m<sup>2</sup>) were inspected weekly during vegetation seasons 2014–2018 and carpophores of different fungal taxa were counted. The resulting sampling-event dataset includes 16,569 of plot-based observations (= sampling events) with corresponding 6,011 occurrence records of macromycetes identified to species or genus level. In total, 69 species were revealed during the study. About 80% of plot-based observations contain zero records and mark absence of visible fruiting bodies in a certain plot and time.

© Filippova N, Lapshina E. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Filippova N., Lapshina E. (2019)  
doi: 10.3897/BDJ.7.e35674

|                       | <b>Исследовательская статья<br/>Research paper</b>                       | <b>Статья о данных<br/>Data paper</b>                               |
|-----------------------|--|---|
| <b>ЦЕЛЬ</b>           | Проверка научной гипотезы  | Описание первичных полевых данных, приведенных к требуемому формату |
| <b>РАЗДЕЛЫ</b>        | Введение<br>Материалы и методы<br>Результаты<br>Обсуждение<br>Заключение | Введение<br>Материалы и методы<br>Описание данных                   |
| <b>РЕЦЕНЗИРОВАНИЕ</b> | Рецензирование текста рукописи   | Аудит данных<br>Рецензирование текста рукописи                      |



NEWS | 23 MAY 2022

## Call for data papers describing datasets from Northern Eurasia (extended)

*GBIF partners with FinBIF and Pensoft to support publication of new datasets about biodiversity from across Northern Eurasia*



Northern banded newt (*Ommatotriton ophryticus*), observed in Georgia. Photo 2021 Natalia Bulbulashvili via iNaturalist Research-grade Observations, licensed under CC BY-NC 4.0.

- **Подача рукописей до 1 декабря**
- Набор данных должен быть опубликован в 2022 году и содержать **> 7 000 записей** о встречах видов
- Территория: Россия, Украина, Беларусь, **Казахстан**, Кыргызстан, Узбекистан, Таджикистан, Туркменистан, Молдова, Грузия, Армения, Азербайджан

<https://www.gbif.org/news/B00TTCi85Yly3qNo5KXSM/call-for-data-papers-describing-datasets-from-northern-eurasia-extended>



GBIF | Global Biodiversity Information Facility

# Free and open access to biodiversity data

OCCURRENCES SPECIES DATASETS PUBLISHERS RESOURCES

Search



What is GBIF?

About GBIF Kazakhstan



*Aedes albopictus* (Skuse, 1894) observed in Hat Yai, Thailand by Punnapis Onrhammarat (CC BY-NC 4.0)



2,246,476,386

Occurrence records



79,025

Datasets



1,926

Publishing institutions



7,894

Peer-reviewed papers  
using data

## Глобальная Информационная Система о Биоразнообразии GBIF.org



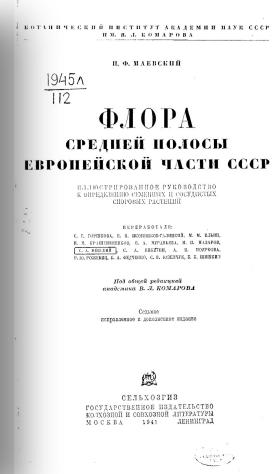
Данные о коллекционных образцах



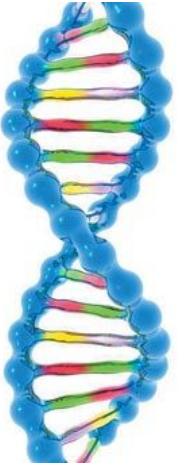
Данные об окаменелостях



Литературные данные



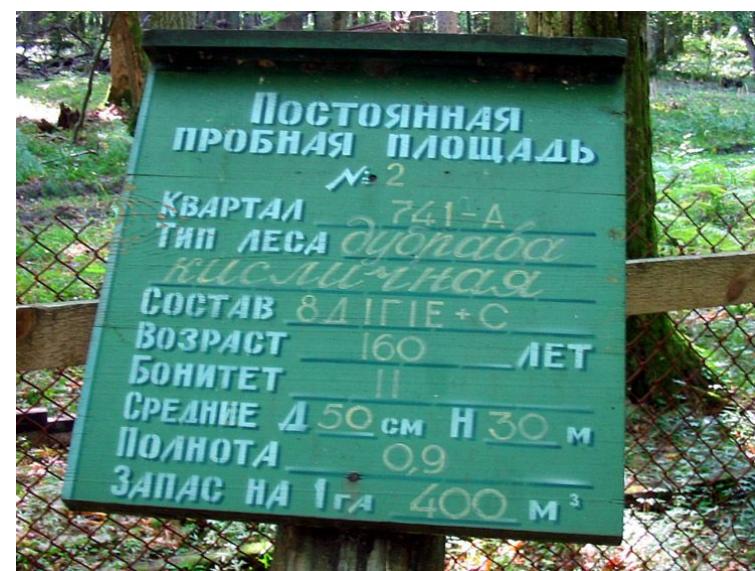
Биоматериалы



Наблюдения



Данные автоматических регистраторов



Данные площадных и маршрутных учетов

Какие данные доступны через GBIF

# Типы наборов данных, доступных через GBIF

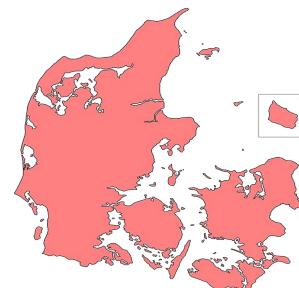
## Метаданные (METADATA only)



### Таксономический список CHECKLIST

для публикации  
таксономических данных:  
списки охраняемых  
видов, тематические  
видовые списки и др.

1 строка – 1 таксон



### Найдены OCCURRENCE DATA

Найдена - простое полевое  
наблюдение или  
коллекционный образец

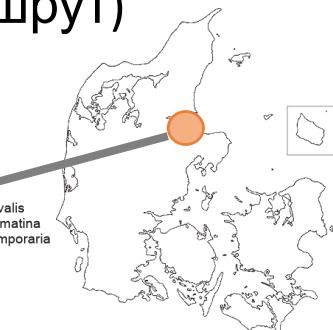
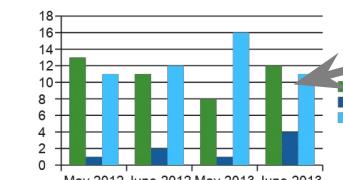
1 строка = 1 особь или 1 группа  
особей



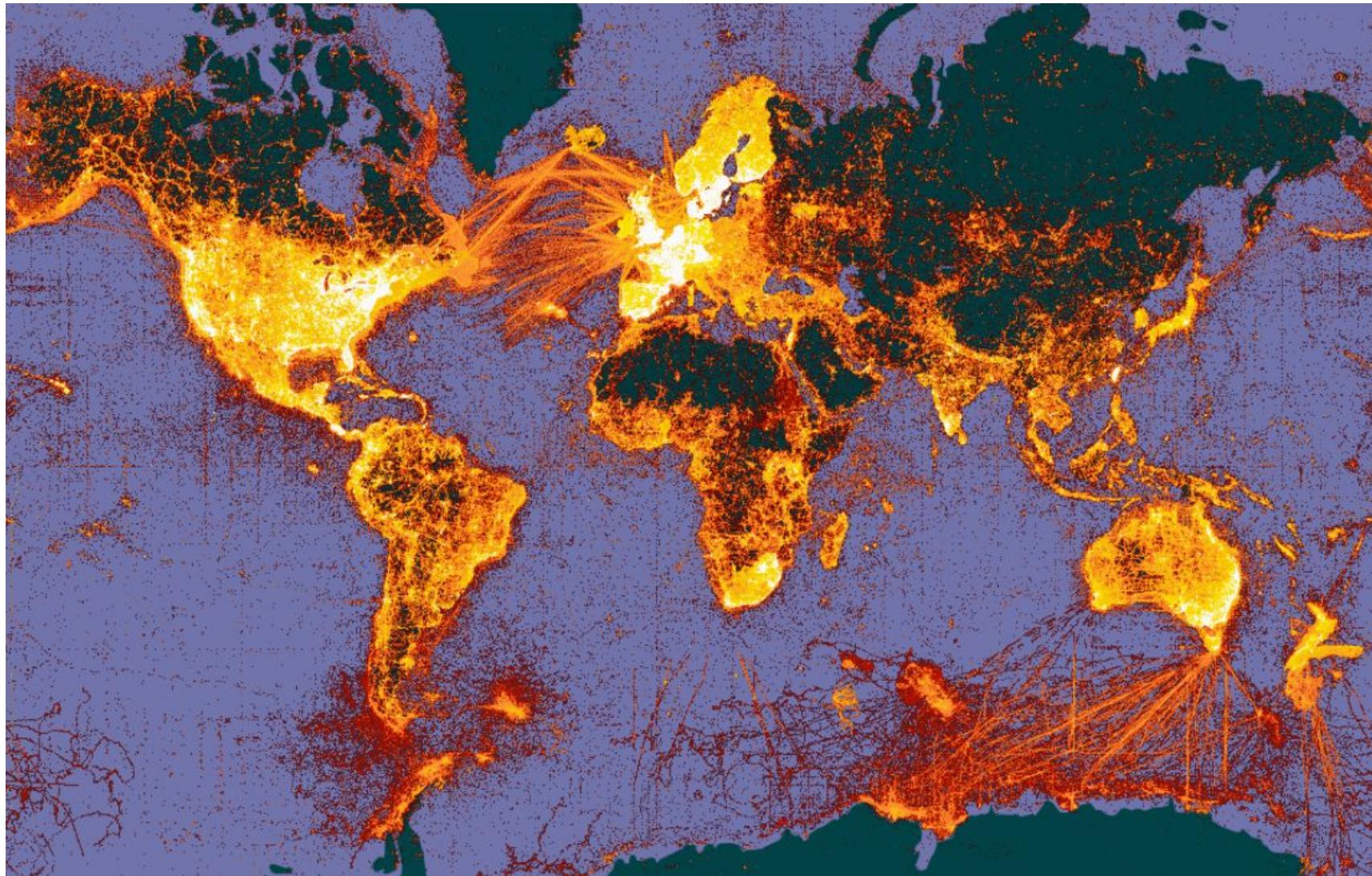
### Описания, учеты или сборы SAMPLE EVENT DATA

2 таблицы: данные о сборе  
+ данные о находках

1 запись на листе event =  
1 событие (площадка,  
 маршрут)



# Карта глобального биоразнообразия GBIF



# Публикация данных в GBIF

Google Sheets screenshot showing a data example for the BID CE Workshop 1 - SESSION 08. The spreadsheet contains 15 rows of data with columns for Cat. Numb., University, Collector, No. of spec., YE, MO, DA, and Co. The data is from the University of Guatemala, with collectors including Betancur J, Fonnegra R, and Vargas I, and years ranging from 1991 to 1997.

|    | A          | B                       | C          | D            | E    | F  | G  |
|----|------------|-------------------------|------------|--------------|------|----|----|
| 1  | Cat. Numb. | University              | Collector  | No. of spec. | YE   | MO | DA |
| 2  | UWP:100217 | University of Guatemala | Betancur J | 1            | 1991 | 5  | 11 |
| 3  | UWP:100218 | University of Guatemala | Betancur J | 1            | 1991 | 5  | 11 |
| 4  | UWP:101378 | University of Guatemala | Fonnegra R | 1            | 1994 | 5  | 31 |
| 5  | UWP:101717 | University of Guatemala | Betancur J | 1            | 1993 | 11 | 9  |
| 6  | UWP:101737 | University of Guatemala | Betancur J | 1            | 1993 | 11 | 7  |
| 7  | UWP:102143 | University of Guatemala | Betancur J | 1            | 1994 | 4  | 20 |
| 8  | UWP:102144 | University of Guatemala | Betancur J | 1            | 1994 | 4  | 20 |
| 9  | UWP:102233 | University of Guatemala | Vargas I   | 1            | 1995 | 12 | 6  |
| 10 | UWP:103108 | University of Guatemala | Cardona F  | 1            | 1996 | 4  | 3  |
| 11 | UWP:104139 | University of Guatemala | Fonnegra R | 1            | 1996 | 5  | 15 |
| 12 | UWP:104512 | University of Guatemala | Callejas R | 1            | 1995 | 7  | 21 |
| 13 | UWP:105292 | University of Guatemala | Acevedo P  | 1            | 1994 | 9  | 7  |
| 14 | UWP:106768 | University of Guatemala | Vargas I   | 1            | 1997 | 4  | 18 |
| 15 | UWP:107441 | University of Guatemala | Gonzales G | 1            | 1997 | 4  | 12 |

GBIF dataset page for "Belgian IFBL Flora Checklists (1939-1971)". The page shows basic dataset information, occurrence statistics, and a map of Europe with a cluster of red dots representing data points from Belgium.

**OCCURRENCE DATASET | REGISTERED 4 MAY 2010**

**Belgian IFBL Flora Checklists (1939-1971)**

Published by [Botanic Garden Meise](#)  
by [Wouter Van Landuyt](#) • [Nicolas Noe](#)

**DATASET** **METRICS** **ACTIVITY** **DOWNLOAD** [DATASET HOMEPAGE](#)

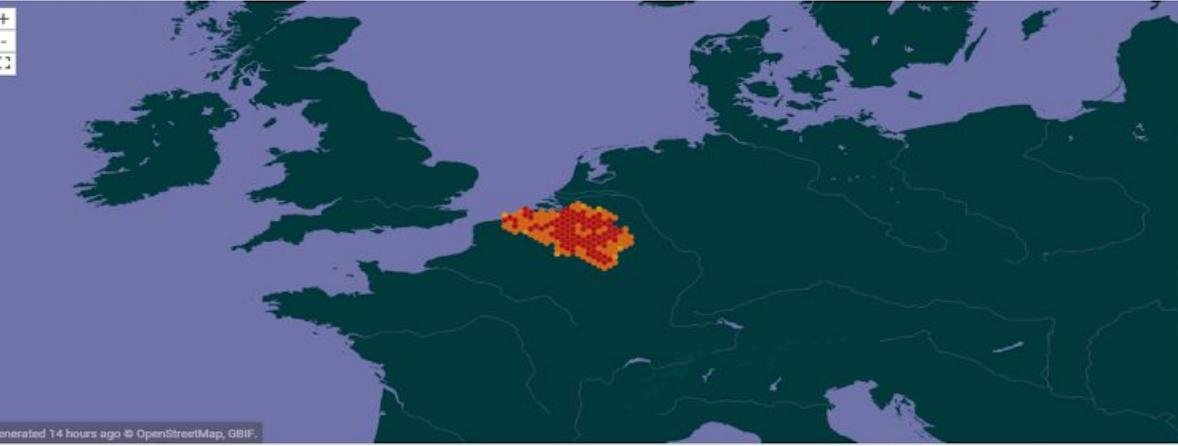
**1 045 806 OCCURRENCES** **9 CITATIONS**

The data in IFBL 1, 2 & 3 covers all of the IFBL 1 km<sup>2</sup> flora checklists sampled between 1939 and 1971. About 10000 original lists corresponding with some 1 200 000 data representative of the former distribution of vascular plant species in Belgium, were digitised. The IFBL data is Integrated in existing national and regional flora databases and will contribute to the realisation of regional Flora Atlases. The analysis of the digitised data will improve the possibilities to compare floral data over time. [more](#)

Metadata Last Modified: 5 March 2018  
Data Last Changed: 9 September 2015  
License: CC0 1.0  
[How to cite](#) [DOI](#) 10.15468/xmlbke

**1 045 806 Occurrences** **99.9% With taxon match** **100% With coordinates** **91% With year**

**1 045 806 GEOREFERENCED RECORDS**



Generated 14 hours ago © OpenStreetMap, GBIF.

Any year 1919 - 1990

**Description** **Description**

The data in IFBL 1, 2 & 3 covers all of the IFBL 1 km<sup>2</sup> flora checklists sampled between 1939 and 1971. About 10000 original lists corresponding with some 1 200 000 data representative of the former distribution of vascular plant species in Belgium, were digitised. The IFBL data is integrated in existing national and regional flora databases and will contribute to the realisation of regional Flora Atlases. The analysis of the digitised data will improve the possibilities to compare floral data over time.



PUBLISHER | SINCE AUGUST 8, 2022

# Institute of Zoology of the Republic of Kazakhstan

ABOUT

METRICS

HOME PAGE

110 OCCURRENCES

1 DATASET

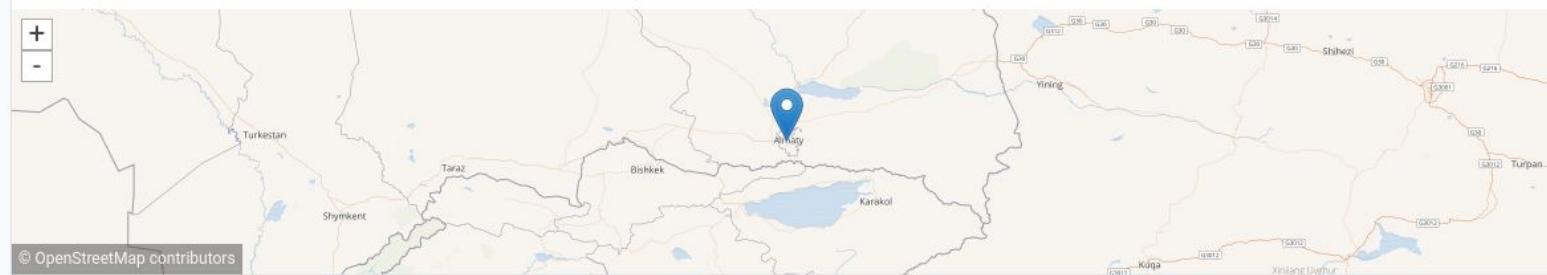
**Description:** Mission: To develop Kazakhstan zoology science from animal world investigations - from Republic of Kazakhstan to around of the globe. Vision: Institute of Zoology RK - leading world class science organization of fundamental and practical zoology. Institute of Zoology RK main directions: Kazakhstan wildlife investigation; animal population dynamics changes from environmental impact studying; studying of evolution, phylogeny, taxonomy diversity of present and past wildlife; ecologically valuable zoology problem solving.



**Endorsed by:** Participant Node Managers Committee

**Administrative contact:** Roman Jashenko

**Country or area:** Kazakhstan



## CONTACTS

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SAMPLING EVENT | REGISTERED JULY 25, 2017

The communities of terrestrial macrofungi in different forest types of boreal zone in West Siberia

Published by [Yugra State University Biological Collection \(YSU BC\)](#)

Nina Filippova

DATASET METRICS ACTIVITY DOWNLOAD HOME PAGE

5,693 OCCURRENCES 4 CITATIONS

The dataset includes the results of a long-term monitoring program for larger fungi fruiting using permanent plots located in different forest types in central part of Western Siberia (nearby Khanty-Mansiysk). Our goal was to describe the quantitative and qualitative structure and spatial variation of the community of macromycetes, show its dynamics seasonally and inter-annually and also elucidate the relationship between the fruiting and climate variables. A total of 320 circular 5 m<sup>2</sup> (for a ... [More](#)



Metadata last modified: August 8, 2019

Data last changed: August 8, 2019

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[How to cite](#) DOI [10.15468/ge1hkl](https://doi.org/10.15468/ge1hkl)

5,693 Occurrences

100% With taxon match

100% With coordinates

100% With year

5,693 GEOFERENCED RECORDS



## Citation

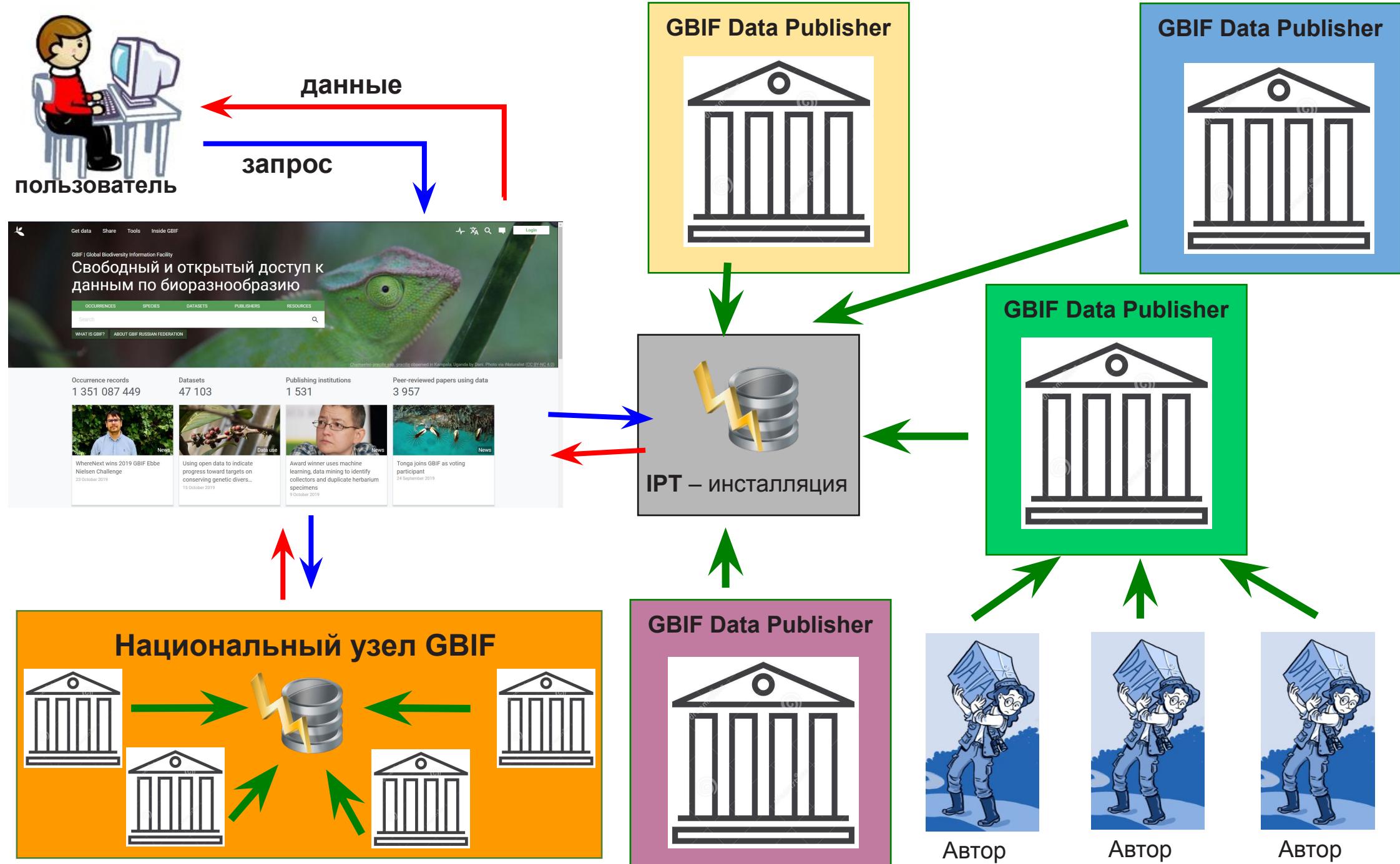
Filippova N (2018). The communities of terrestrial macrofungi in different forest types of boreal zone in West Siberia.

Version 1.2. Yugra State University Biological Collection (YSU BC). Sampling event dataset

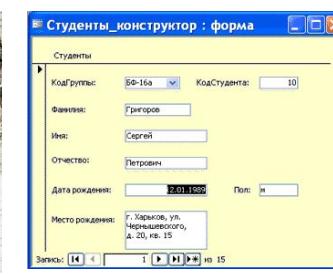
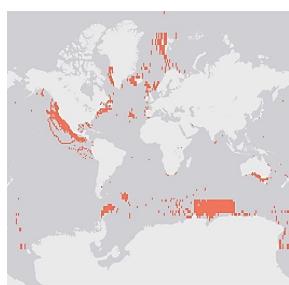
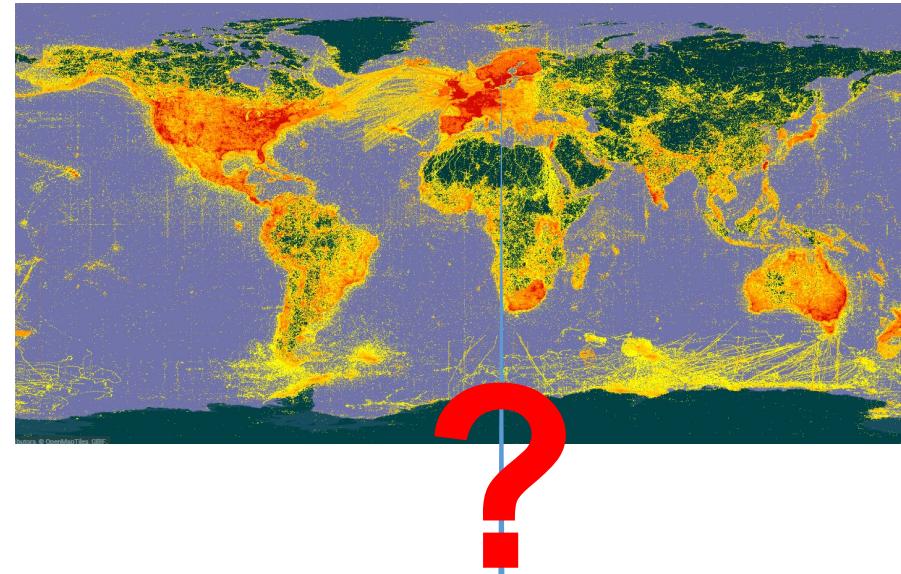
<https://doi.org/10.15468/ge1hkl> accessed via GBIF.org on 2019-03-22.

# Набор данных (dataset), доступный через GBIF

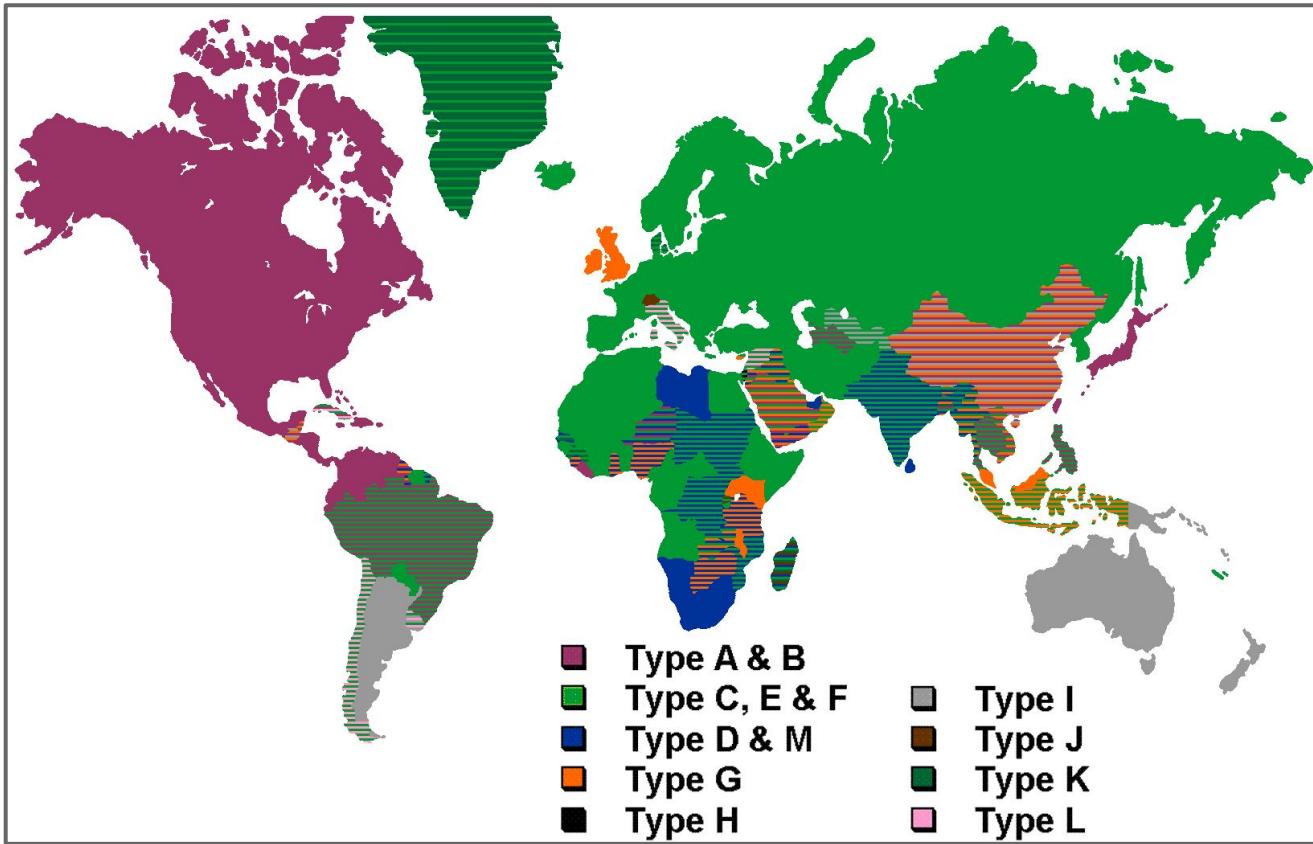
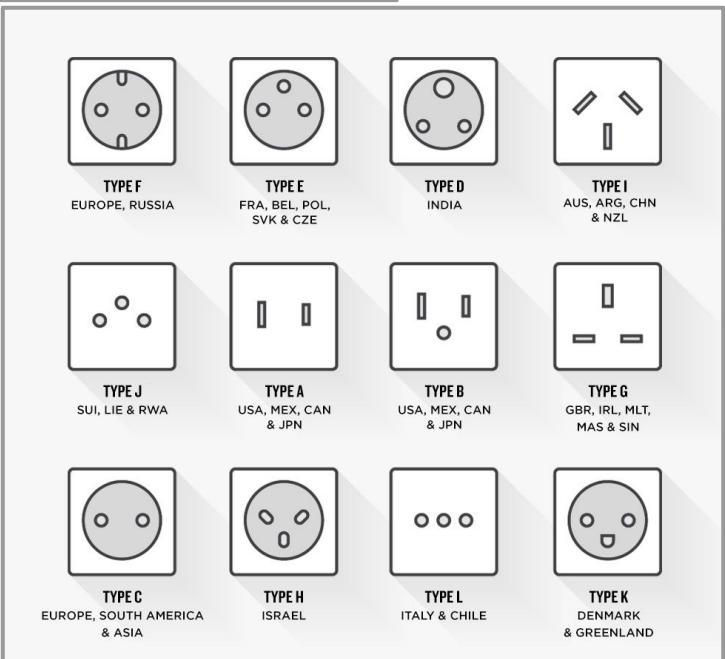
# Как устроена сеть GBIF

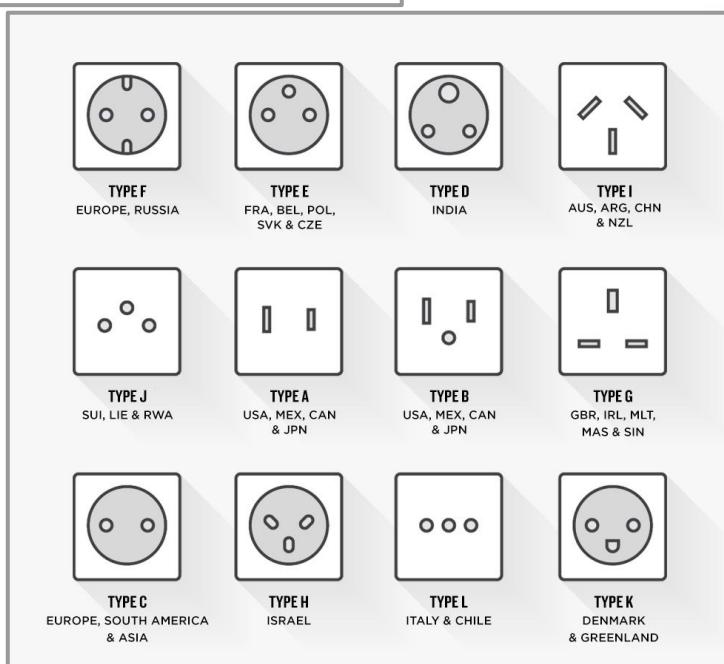


# Как объединить данные в глобальную систему?



ИСТОЧНИКИ ДАННЫХ





# Darwin Core – основной стандарт данных в GBIF

## Darwin Core

Darwin Core is a standard maintained by the [Darwin Core maintenance group](#). It includes a glossary of terms intended to **facilitate the sharing of information about biological diversity** by providing identifiers, labels, and definitions. Darwin Core is primarily based on taxa, their occurrence in nature as documented by observations, specimens, samples, and related information.

[technical specification](#)[current standard](#)[2009](#)[Darwin Core website !\[\]\(1c70f21f694d12b9fc928edb998ea27b\_img.jpg\)](#)[Find us on GitHub !\[\]\(179f6b45bf59a6537d86a5664856855b\_img.jpg\)](#)<http://rs.tdwg.org/dwc/terms/>

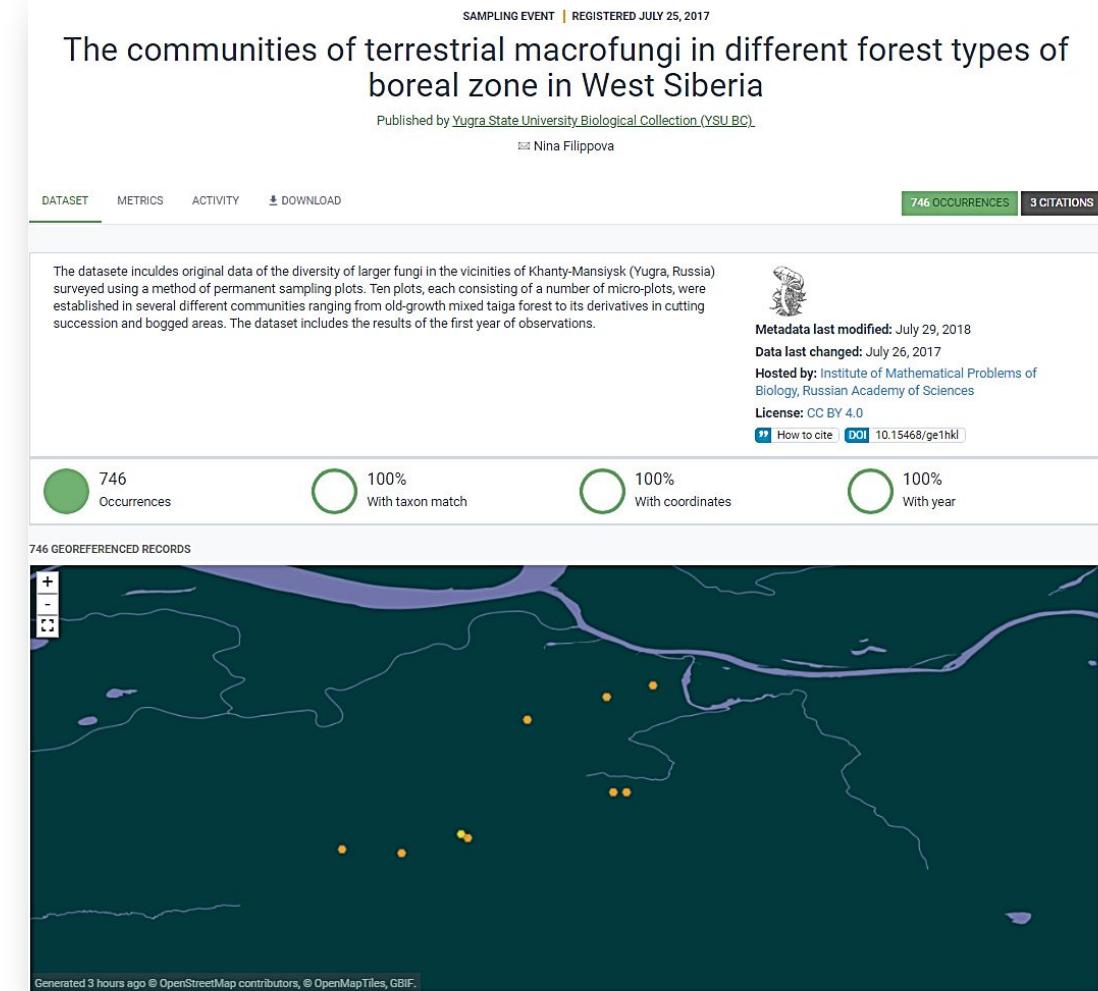
Система обмена информацией в GBIF построена на открытых стандартах, центральный из которых – **Darwin Core (DwC)**, стандарт, разработанный специально для хранения данных по биоразнообразию.

**Стандарт** – набор терминов (заголовки столбцов в таблице с данными) и правила использования этих терминов.

# ЗАЧЕМ публиковать свои данные через глобальные порталы?



или



# ЗАЧЕМ публиковать свои данные через глобальные порталы?



- Проверяемость результатов научных исследований
- Закрепление авторства собственных данных через DOI
- Повышение обнаружимости данных и исследований
- Возможности совместных исследований

- Повышение научного использования коллекций
- Лучшая сохранность фондовых образцов
- Систематизация и улучшение качества данных



- Выполнение обязательств в рамках международных Конвенций.
- Достижение Целей в области устойчивого развития, в том числе связанных с здоровьем человека, продовольственной безопасностью и глобальным изменением климата, а также сохранением биоразнообразия на суше и в океане.

Файл Главная Вставка Разметка страницы Формулы Данные Рецензирование Вид Надстройки Что вы хотите сделать? Вход Общий доступ

Сортировка и фильтр Выделить

Сортировка Найти и фильтр

Редактирование

B2 Achipteria coleoptrata (Linnaeus, 1758)

|    | A           | B   | C       | D    | E            | F                    | G       | H       | I       | J  | K  | L                            | M          | N          | O       | P | Q | R |
|----|-------------|---|---------|------|--------------|----------------------|---------|---------|---------|----|----|------------------------------|------------|------------|---------|---|---|---|
| 5  | iee-2010-04 | Achipteria coleoptrata (Linnaeus, 1758)       | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.0568 | 30.6463 | WGS1984 | 10 | 5  | Ind / soil caspен for A.S.   | Zaltsev A. | IEE RAS    |         |   |   |   |
| 6  | iee-2010-05 | Galluma obvia (Berlese, 1914)                 | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.0993 | 30.3815 | WGS1984 | 10 | 3  | Ind / soil c bog             | A.S.       | Zaltsev A. | IEE RAS |   |   |   |
| 7  | iee-2010-06 | Tectocephus velutus (Michael 1880)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.0993 | 30.3815 | WGS1984 | 10 | 1  | Ind / soil c Bottomal A.S.   | Zaltsev A. | IEE RAS    |         |   |   |   |
| 8  | iee-2010-07 | Achipteria coleoptrata (Linnaeus, 1758)       | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.1019 | 30.3891 | WGS1984 | 10 | 25 | Ind / soil c mixed for A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 9  | iee-2010-08 | Mediopelta hypographa (Mahunka 1987)          | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.1032 | 30.3907 | WGS1984 | 10 | 52 | Ind / soil c peatbog         | A.S.       | Zaltsev A. | IEE RAS |   |   |   |
| 10 | iee-2010-09 | Scheloribates laevigatus (Koch, 1835)         | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.4417 | 30.6801 | WGS1984 | 10 | 36 | Ind / soil c meadow          | A.S.       | Zaltsev A. | IEE RAS |   |   |   |
| 11 | iee-2010-10 | Microtritia minima (Berlese, 1904)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.4417 | 30.6801 | WGS1984 | 10 | 26 | Ind / soil c meadow          | A.S.       | Zaltsev A. | IEE RAS |   |   |   |
| 12 | iee-2010-11 | Rhysotritia duplicita (Grandjean 1953)        | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.4417 | 30.6801 | WGS1984 | 10 | 4  | Ind / soil c meadow          | A.S.       | Zaltsev A. | IEE RAS |   |   |   |
| 13 | iee-2010-12 | Scheloribates laevigatus (Koch, 1835)         | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.102  | 30.4306 | WGS1984 | 10 | 21 | Ind / soil c mixed for A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 14 | iee-2010-13 | Parakalumnidae                                | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.057  | 30.6418 | WGS1984 | 10 | 15 | Ind / soil c mixed for A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 15 | iee-2010-14 | Platynothrus peltifer (Koch, 1840)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.057  | 30.6418 | WGS1984 | 10 | 20 | Ind / soil c mixed for A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 16 | iee-2010-15 | Xenilus tegeocranus (Hermann 1804)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.057  | 30.6418 | WGS1984 | 10 | 2  | Ind / soil c mixed for A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 17 | iee-2010-16 | Hoplophirhacarus illinoiensis (Ewing, 1909)   | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.171  | 30.6404 | WGS1984 | 10 | 24 | Ind / soil c Transition A.S. | Zaltsev A. | IEE RAS    |         |   |   |   |
| 18 | iee-2010-17 | Tectocephus velutus (Michael 1880)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.171  | 30.6404 | WGS1984 | 10 | 3  | Ind / soil c Transition A.S. | Zaltsev A. | IEE RAS    |         |   |   |   |
| 19 | iee-2010-18 | Trichoribates trimaculatus (C.L.Koch, 1835)   | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.171  | 30.6404 | WGS1984 | 10 | 1  | Ind / soil c Transition A.S. | Zaltsev A. | IEE RAS    |         |   |   |   |
| 20 | iee-2010-19 | Opiella nova (Oudemans, 1902)                 | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.1042 | 30.39   | WGS1984 | 10 | 28 | Ind / soil c Raised pe A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 21 | iee-2010-20 | Nanhermannia dorsalis (Banks 1902)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.1042 | 30.39   | WGS1984 | 10 | 3  | Ind / soil c Raised pe A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 22 | iee-2010-21 | Phthiracarus globosus (Koch, 1835)            | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.1019 | 30.3891 | WGS1984 | 10 | 1  | Ind / soil c Raised pe A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 23 | iee-2010-22 | Opiella nova (Oudemans, 1902)                 | SPECIES | 2010 | 2010-06-0 RU | Bezhanits Polistovsk | 57.0984 | 30.3809 | WGS1984 | 10 | 2  | Ind / soil c Raised pe A.S.  | Zaltsev A. | IEE RAS    |         |   |   |   |
| 24 | iee-2010-23 | Tectocephus velutus (Michael 1880)            | SPECIES | 2010 | RU           | Bezh                 | 57.0984 | 30.3809 | WGS1984 | 10 | 11 | Ind / soil                   |            |            |         |   |   |   |
| 25 | iee-2010-24 | Zetomimus furcatus (Warburton & Pearce, 1959) | SPECIES | 2010 | 2010-06-0 RU | Bezh                 | 57.0984 | 30.3809 | WGS1984 | 10 | 1  | Ind / soil                   |            |            |         |   |   |   |
| 26 | iee-2010-25 | Hoplophirhacarus illinoiensis (Ewing, 1909)   | SPECIES | 2010 | 2010-06-0 RU | Bezh                 | 30.6452 | 57.1743 | WGS1984 | 10 | 12 | Ind / soil                   |            |            |         |   |   |   |
| 27 | iee-2010-26 | Scheloribates laevigatus (Koch, 1835)         | SPECIES | 2010 | 2010-06-0 RU | Bezh                 | 57.1743 | 30.6452 | WGS1984 | 10 | 1  | Ind / soil                   |            |            |         |   |   |   |
| 28 | iee-2010-27 | Chamobates cuspidatus (F.                     | SPECIES |      |              |                      |         |         |         |    | 1  | Ind / soil                   |            |            |         |   |   |   |
| 29 | iee-2010-28 | Scheloribates laevigatus (C.L.                | SPECIES |      |              |                      |         |         |         |    | 6  | Ind / soil                   |            |            |         |   |   |   |
| 30 | iee-2010-29 | Minuthozetes semirufus                        | SPECIES |      |              |                      |         |         |         |    | 4  | Ind / soil                   |            |            |         |   |   |   |

Region vs Patient

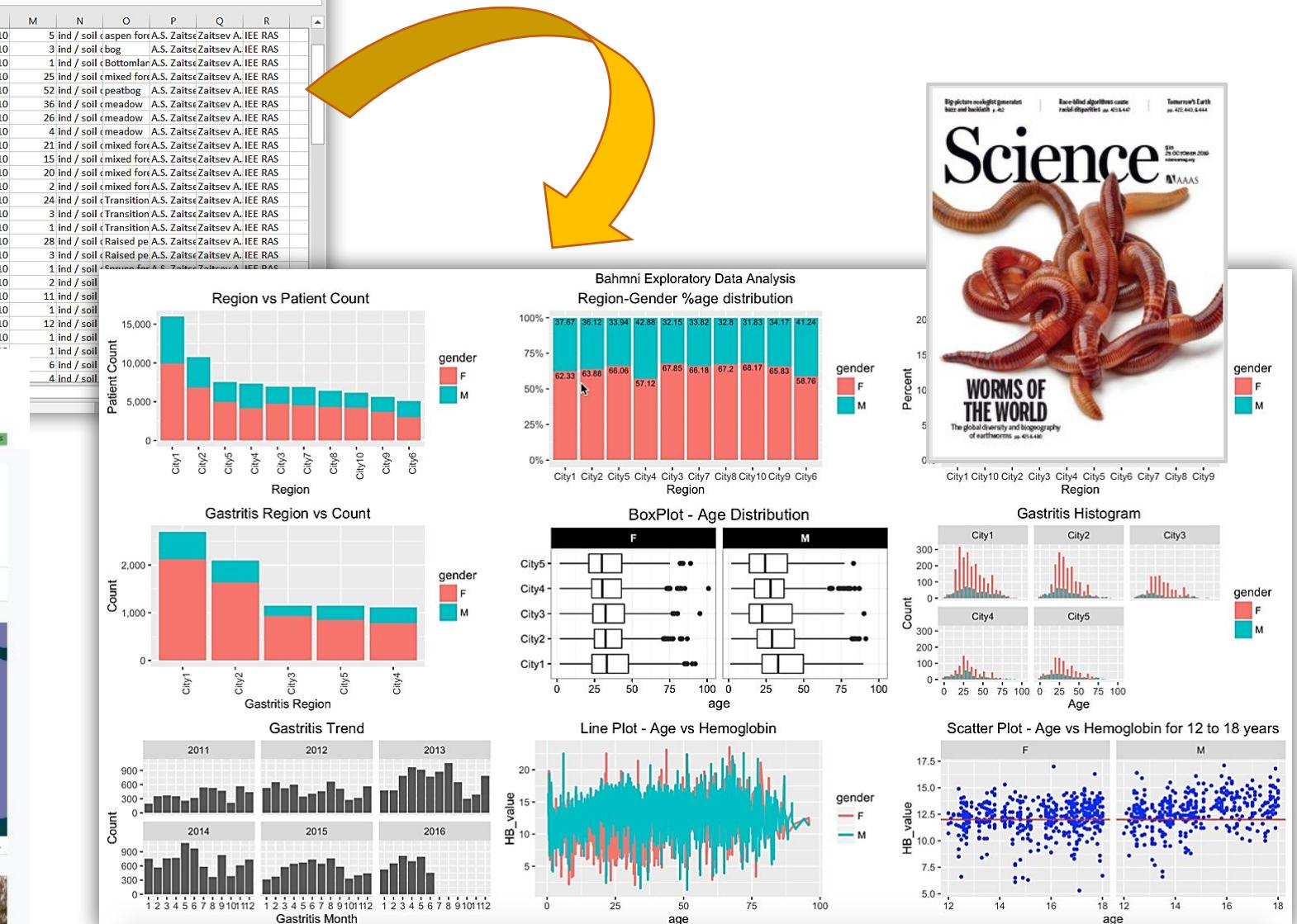
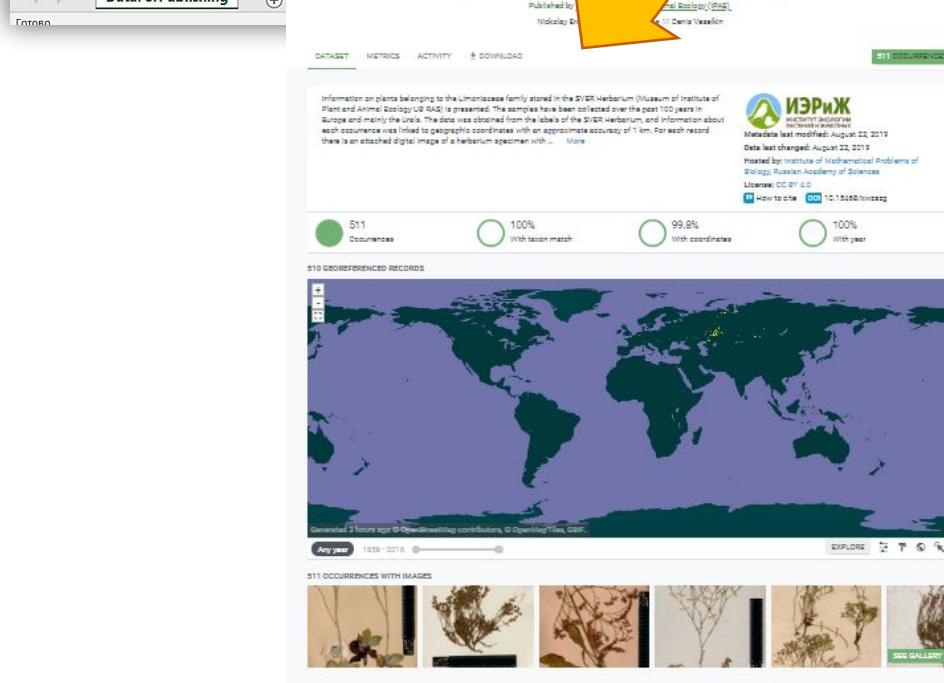
15,000

10,000

5,000

0

Patient Count



<https://i.pinimg.com/originals/5c/e1/ab/5ce1ab055f79a92c5c6a42586ca67de7.png>

# Зачем нужна проверка данных (data cleaning) ?

| A                   | B   | C          | D            | E     | F     | G               | H                 | I                  | J   | K               | L               | M            | N                    | O        | P         |
|---------------------|---|------------|--------------|-------|-------|-----------------|-------------------|--------------------|---|-----------------|-----------------|--------------|----------------------|----------|-----------|
| Registration number | Full name                                   | Status     | Conservation | Stage | males | Collector       | Collection number | Date of collection | Determiner                                    | Locality        | Family          | Class        | Country              | Latitude | Longitude |
| 1,00                | Eucidaris tribuloides africana Mortensen Ht | In alcohol |              | 1     |       | Dartevelle E.   | 132B              | XI.1965.III-1966   | Mortenser M'Vassa, Fausse Pointe No Cidaridae | Echinidae       | Congo, D. R.    |              |                      |          |           |
| 2,00                | Arbacia lixula africana Troschel            | In alcohol |              | 1     |       | Dartevelle E.   |                   | VII.1938           | Mortenser M'Vassa, Fausse Pointe No Arbacidae | Echinidae       | Congo, D. R.    |              |                      |          |           |
| 3,00                | Stomopneustes variolaris Lamarck            |            |              | 1     |       | Burgeon L.      |                   | 1934               | Mortenser Dar es Salaam                       | Stomopneustidae | Echinidae       | Tanzania     | S 06° 48' E 00° 00'  |          |           |
| 4,00                | Arbacia lixula africana Troschel            |            |              | 4     |       | Dartevelle E.   |                   | XI.1937            | Mortenser Cabinda, Ponta n'Gelo               | Arbacidae       | Echinidae       | Angola       |                      |          |           |
| 9,00                |   |            |              | 1     |       | Dartevelle E.   | B.4               | XI.1937            | Mortenser Cabinda                             | Cidaridae       | Echinidae       | Angola       |                      |          |           |
| 10,00               | Arbaciella elegans Mortensen                |            |              | 2     |       | Dartevelle E.   |                   | XI.1937            | Mortenser Cabinda                             | Arbacidae       | Echinidae       | Angola       |                      |          |           |
| 18,00               | Arbacia lixula africana Troschel            |            |              | 1     |       | Dartevelle E.   | G.I               | VII.1938           | Mortenser M'Vassa, Fausse Pointe No Arba      | Echinidae       | Echinidae       |              |                      |          |           |
| 19,00               | Paracentrotus lividus Lamarck               |            |              | 4     |       | Dartevelle E.   |                   | I.1937             | Mortenser Lobito bay                          | Echinidae       | Echinidae       |              |                      |          |           |
| 23,00               | Arbacia lixula africana Troschel            |            |              | 1     |       | Dartevelle E.   |                   | XI.1937            | Mortenser Cabinda                             | Arbacidae       | Echinidae       |              |                      |          |           |
| 26,00               | Echinometra lucunter L.                     | Microscop  |              | 1     |       | Dartevelle E.   | B.4               | VII.1938           | Mortenser M'Vassa, Fausse Pointe No Echinid   | Echinidae       | Echinidae       |              |                      |          |           |
| 27,00               | Eucidaris tribuloides africana Mortensen    |            |              | 1     |       | Dartevelle E.   |                   | VII.1938           | Mortenser Loango, Pointe                      | Echinidae       | Echinidae       |              |                      |          |           |
| 28,00               | Astropecten gruveli Kochler                 |            |              | 1     |       | Dartevelle E.   |                   | I.1937             | Mortenser Lobito bay                          | Echinidae       | Echinidae       |              |                      |          |           |
| 29,00               | Astropecten michaelensi Kochler             |            |              | 1     |       | Dartevelle E.   |                   | XI.1937            | Mortenser Cabinda                             | Echinidae       | Echinidae       |              |                      |          |           |
| 31,00               | Asterina sp.                                |            |              | 1     |       | Dartevelle E.   |                   | Lobito             | Mortenser Lobito Bay                          | Echinidae       | Echinidae       |              |                      |          |           |
| 32,00               | Astropecten dahomense                       |            |              | 1     |       | Dartevelle E.   |                   |                    | Banana  | Echinidae       | Echinidae       |              |                      |          |           |
| 35,00               | Radiorotula orbicularis radiata             |            |              | 1     |       | Dartevelle E.   |                   | I.1937             | Dartevelle Lobito Bay                         | Echinidae       | Echinidae       |              |                      |          |           |
| 53,00               | Radiorotula orbicularis L.                  |            |              | 17    |       | Vrydagh         |                   | 1937               | Dartevelle Lobito Plage                       | Echinidae       | Echinidae       |              |                      |          |           |
| 78,00               | Radiorotula orbicularis L.                  |            |              | 6     |       | Dartevelle E.   |                   | 1937               | Dartevelle Lobito Bay                         | Echinidae       | Echinidae       |              |                      |          |           |
| 170,00              | Radiorotula orbicularis L.                  |            |              | 35J   |       | Dartevelle E.   |                   | 1933               | Dartevelle Lobito Bay                         | Echinidae       | Echinidae       |              |                      |          |           |
| 206,00              | Radiorotula orbicularis L.                  |            |              | 40J   |       | Dartevelle E.   |                   | I.1937             | Dartevelle Lobito Bay                         | Echinidae       | Echinidae       |              |                      |          |           |
| 246,00              | Radiorotula orbicularis L.                  |            |              | 1     |       | Dartevelle E.   | 106               | 20-27.II.1959      | Dartevelle Lobito Bay                         | Echinidae       | Echinidae       |              |                      |          |           |
| 247,00              | Rotula angusti Klein                        |            |              | 1     |       | Dartevelle E.   |                   |                    | Dartevelle Banane                             | Scutellidae     | Echinidae       | Congo, D. R. | S 06° 00' E 012° 24' |          |           |
| 248,00              | Rotula angusti Klein                        |            |              | 1     |       | Bitremieuy R.G. |                   | 1930               | Dartevelle Moanda, Bas-Congo                  | Scutellidae     | Echinidae       | Congo, D. R. | S 05° 56' E 012° 21' |          |           |
| 347,00              | Radiorotula orbicularis L.                  |            |              | 14    |       | Dartevelle E.   |                   | 1933               | Dartevelle Lobito Bay                         | Scutellidae     | Echinidae       | Angola       |                      |          |           |
| 362,00              | Radiorotula orbicularis L.                  |            |              | 6J    |       | Dartevelle E.   |                   | 1933               | Dartevelle Lobito Bay                         | Scutellidae     | Echinidae       | Angola       |                      |          |           |
| 419,00              | Radiorotula orbicularis L.                  |            |              | 1     |       | Dartevelle E.   |                   | 1933               | Dartevelle Lobito Bay                         | Scutellidae     | Echinidae       | Angola       |                      |          |           |
| 420,00              | Paracentrotus lividus Lamarck               | Pt         | In alcohol   | 1     |       | Dartevelle E.   |                   | VI.1938            | Mortenser M'Vassa, fausse Pointe no Echinidae | Echinidae       | Echinidae       |              |                      |          |           |
| 424,00              | Arbacia lixula africana Troschel            |            | In alcohol   | 1     |       | Dartevelle E.   |                   | X.1937             | Mortenser Landana                             | Arbacidae       | Echinidae       |              |                      |          |           |
| 425,00              | Arbaciella elegans Mortensen                |            | In alcohol   | 1     |       | Dartevelle E.   | 13 P 10           | X.1937             | Mortenser Landana                             | Arbacidae       | Echinidae       |              |                      |          |           |
| 426,00              | Paracentrotus lividus Lamarck               |            | In alcohol   | 1     |       | Dartevelle E.   |                   | VI.1938            | Mortenser M'Vassa, Fausse Pointe no Echinidae | Echinidae       | Echinidae       |              |                      |          |           |
| 427,00              | Astropecten michaelensi Kochler             |            | In alcohol   | 1     |       | Etienne Dr.     |                   | 3.V.1910           | Mortenser Banane                              | Astropectinidae | Astropectinidae | Congo, D. R. | S 06° 00' E 012° 24' |          |           |
| 428,00              | Astropecten michaelensi Kochler             |            | In alcohol   | 1     |       | Schouteden Dr.  |                   | X.1930             | Mortenser Banane                              | Astropectinidae | Astropectinidae | Congo, D. R. | S 06° 00' E 012° 24' |          |           |
| 430,00              | Ophiactis africana Koehler                  |            | In alcohol   | 1     |       | Dartevelle E.   |                   | VI-IX.1956         | Mortenser Vista, Bas Congo                    | Ophiactidae     | Ophiactidae     | Congo, D. R. | S 05° 52' E 012° 17' |          |           |
| 431,00              | Ophiactis africana Koehler                  |            | In alcohol   | 1     |       | Dartevelle E.   |                   | II.1938            | Mortenser Vista, Bas Congo                    | Ophiactidae     | Ophiactidae     | Congo, D. R. | S 05° 52' E 012° 17' |          |           |
| 432,00              |   |            | In alcohol   | 1     |       | Dartevelle E.   |                   | X.1937             | Landana                                       | Ophiactidae     | Ophiactidae     |              |                      |          |           |
| 433,00              | Radiorotula orbicularis L.                  | Other      |              | 1     |       | Dartevelle E.   |                   |                    | Banane  | Scutellidae     | Echinidae       | Congo, D. R. | S 06° 00' E 012° 24' |          |           |
| 434,00              | Radiorotula orbicularis L.                  |            |              | 2     |       | Dartevelle E.   |                   | I.1937             | Lobito Bay                                    | Scutellidae     | Echinidae       | Angola       |                      |          |           |
| 438,00              | Radiorotula                                 |            |              | 1     |       | Dartevelle E.   |                   | 1933               | Lobito Bay                                    | Scutellidae     | Echinidae       | Angola       |                      |          |           |

Даты в разных форматах

Лишние ряды

Пустые ячейки

Данные всегда  
содержат  
ошибки!

Числа в разных  
форматах

# Качество данных

относительная концепция, которая зависит от способа использования этих данных



# Наиболее распространенные ошибки в данных

## Технические ошибки:

опечатки, пропущенные значения, лишние пробелы, корректность диапазонов для дат, соответствие типа данных полю, в котором они содержатся

## Ошибки формата данных

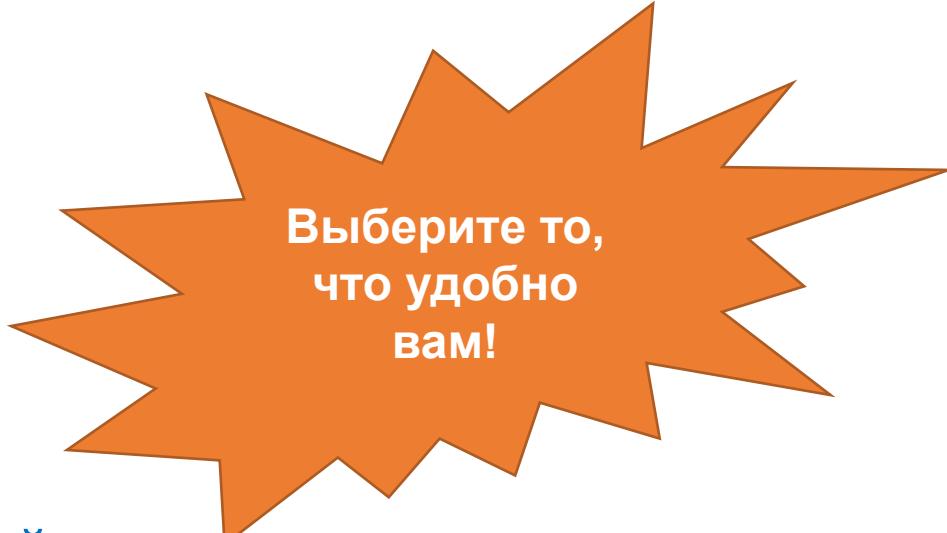
**Согласованность данных:** соответствие даты сбора, идентификации, обновления и оцифровки, координаты всех точек находятся в указанном регионе, точки находок сухопутных видов находятся на суше и т.д.

**Номенклатурные ошибки:** соответствие названия таксонов выбранному справочнику, соответствие других значений справочным

# Инструменты для поиска и исправления технических ошибок и ошибок в данных

## Текстовые редакторы:

- BBEdit (Mac)
- Notepad++ (Windows)
- Emacs, Vi (Unix, Linux)



Выберите то,  
что удобно  
вам!

## Инструменты, работающие с командной строкой:

- R
- RStudio (графический пользовательский интерфейс)
- Скрипты: Perl, Python,...



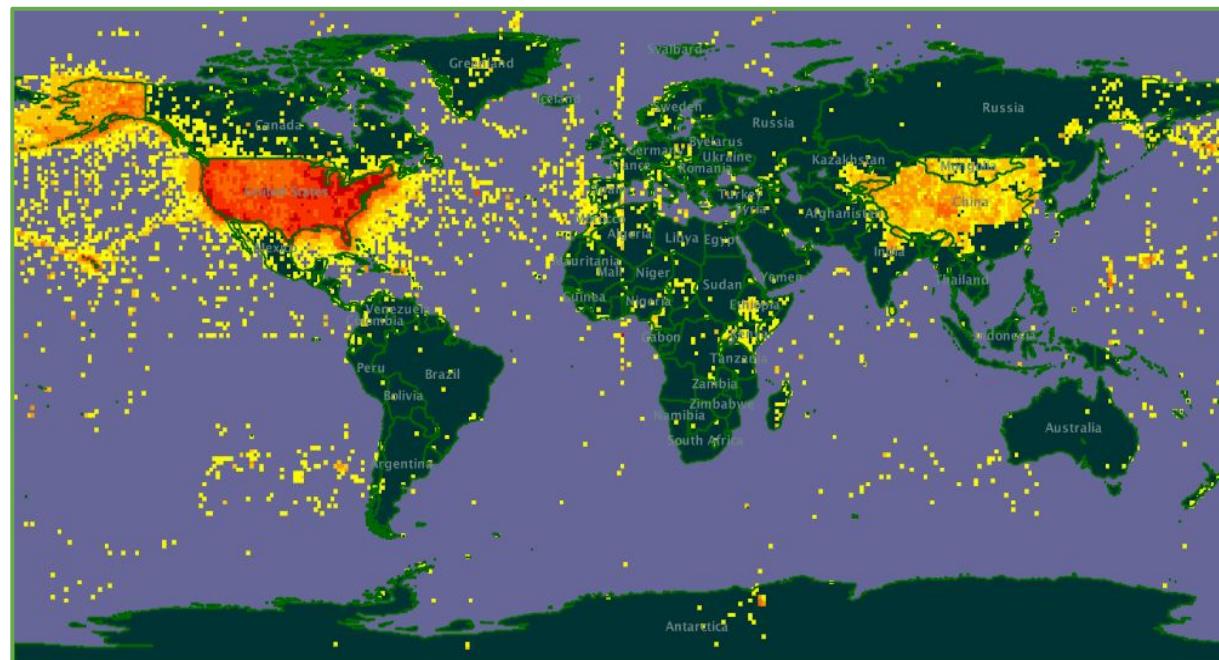
Excel

Refine OPEN 

QGIS

# Ошибки представления пространственных данных

- Широта и долгота перепутаны местами
  - Неправильно указано полушарие
  - Нулевые значения
  - Неизвестная система координат
  - Ошибки преобразования координат из одной системы в другую или из одной формы представления в другую



# Инструменты для верификации пространственных данных: QGIS

- Настольная (локальная) геоинформационная система (ГИС)
- Для трансформации, анализа, визуализации, проверки, верификации и т.д.
- <http://www.qgis.org>
- Open source!



RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

plots2022.R transsects2022deadwood.R Untitled1\*

Source on Save Run Source

```
1 setwd("~/Kologriv")
2 deadwood=read.csv('transects2022deadwood.csv')
3 dim(deadwood)
4 str(deadwood)
5 names(deadwood)
6
7 library('dplyr') #для подсчета частот
8 library('ggplot2')
9 library('tidyverse') #для создания перекрестной таблицы
10
11 ### число деревьев разных видов по трансектам
12 treescount=matrix(ncol=4)
13 colnames(treescount)=c('tree', 'count', 'numbertransect', 'site')
14 for (i in 1:15) {
15   a=count(deadwood[deadwood$transect==i], deadwood[deadwood$transect==i]$tree)
16   b=cbind(a, number=i, if (i<10) {site='core'} else {site='sekh'} )
17   names(b)=c('tree', 'count', 'numbertransect', 'site')
18   treescount=rbind(treescount, b)
19 }
20 treescount
21 treescount=treescount[2:45,]
22
```

49:61 (Top Level)

Console Terminal Jobs

```
~/Kologriv/ 
> dim(sekhacount)
[1] 10 4
> corecount$numbertransect=factor(corecount$numbertransect) # номер трансекты в фактор
> names(corecount)
[1] "tree"          "count"         "numbertransect" "site"
> ggplot(corecount, aes(fill=tree, y=count, x=numbertransect)) +
+   geom_bar(position='stack', stat="identity") +
+   scale_fill_manual(values = c('#1890F8', '#E07000', '#801088', '#D090A0', '#F8F800', '#402088', '#E810
8')) +
+   labs(x = 'Трансекты', y = 'Число стволов, шт.')+
+   guides(fill=guide_legend(title="деревья"))+
+   theme(axis.text=element_text(size=12),
+         axis.title=element_text(size=14,face="bold"))+
+   theme(legend.text = element_text(size=14), legend.title=element_text(size=16, face='bold'))
```

Environment History Connections

Global Environment

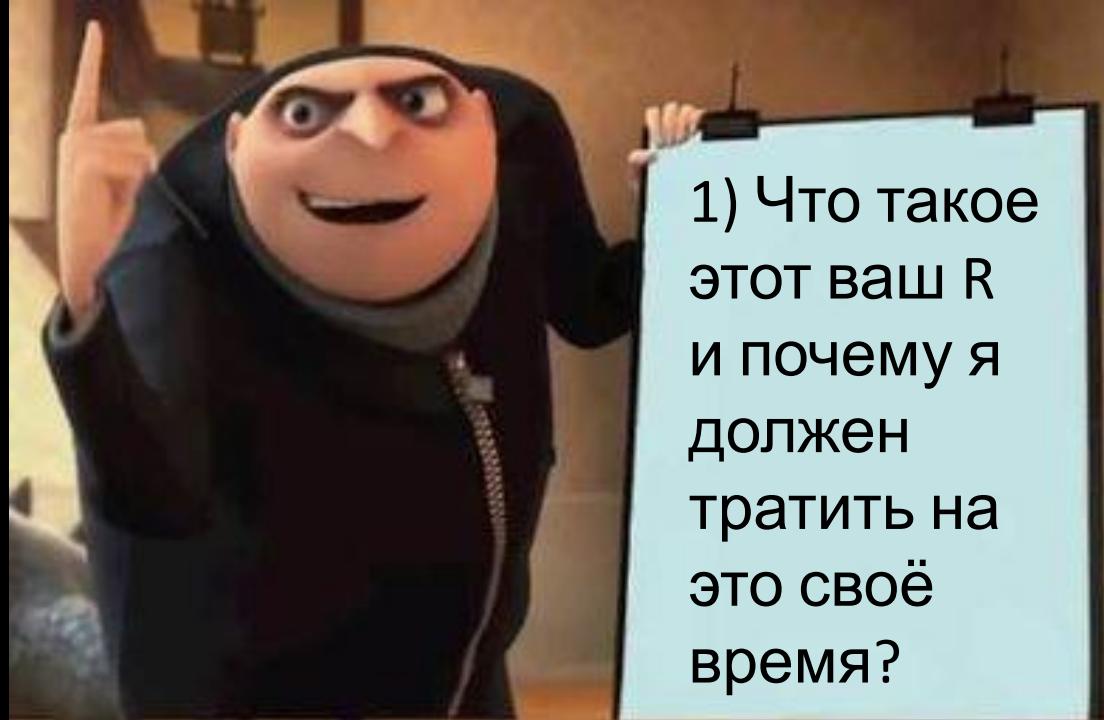
| corecount      | 34 obs. of 4 variables              |
|----------------|-------------------------------------|
| deadwood       | 353 obs. of 8 variables             |
| monthly        | 695 obs. of 5 variables             |
| monthly1       | 695 obs. of 3 variables             |
| monthly13      | 565 obs. of 4 variables             |
| monthly2       | 695 obs. of 3 variables             |
| monthly3       | 695 obs. of 3 variables             |
| monthly7       | 58 obs. of 5 variables              |
| nearest        | Formal class SpatialPointsDataFrame |
| occurs         | 3448 obs. of 6 variables            |
| occursDistinct | 1575 obs. of 6 variables            |

Files Plots Packages Help Viewer

Zoom Export

Деревья

- береза
- вяз
- ель
- клен
- липа
- пихта
- рябина



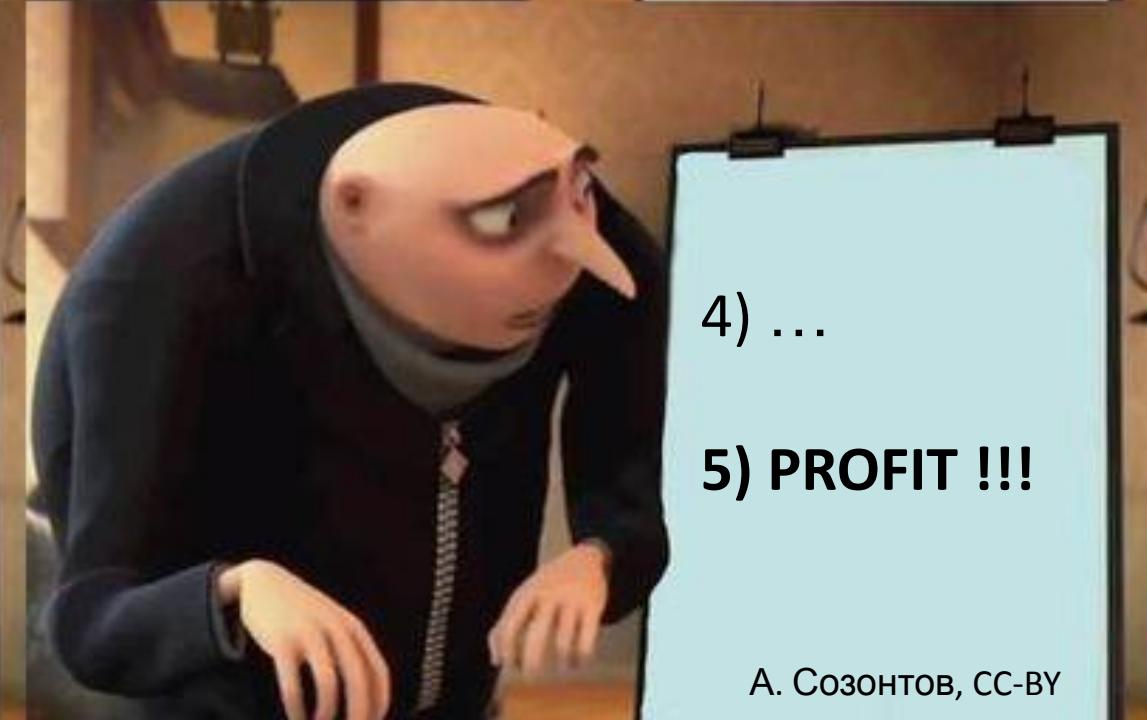
1) Что такое  
этот ваш R  
и почему я  
должен  
тратить на  
это своё  
время?



2) Чего R  
умеет такого,  
что я не могу  
сделать в  
Excel / Past /  
Statistica и  
другом ПО?



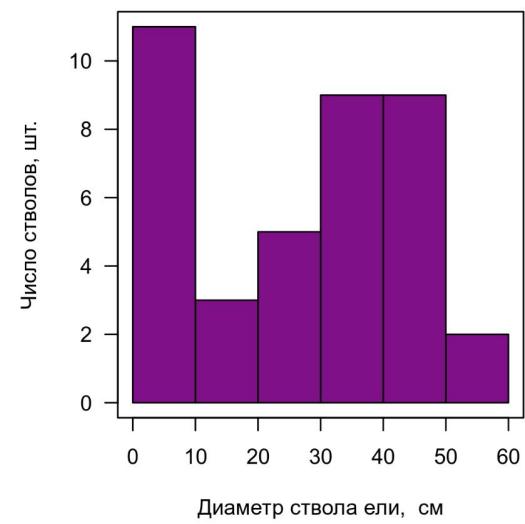
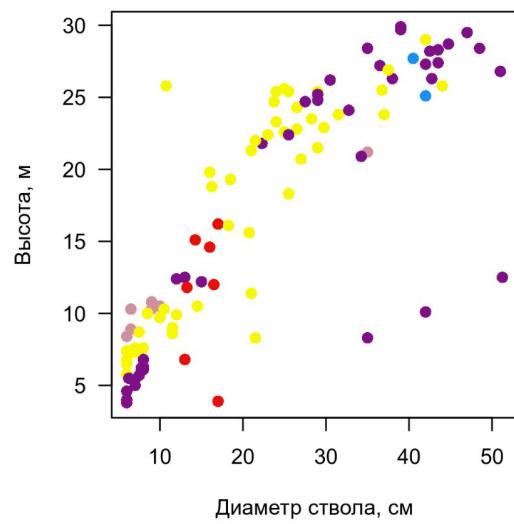
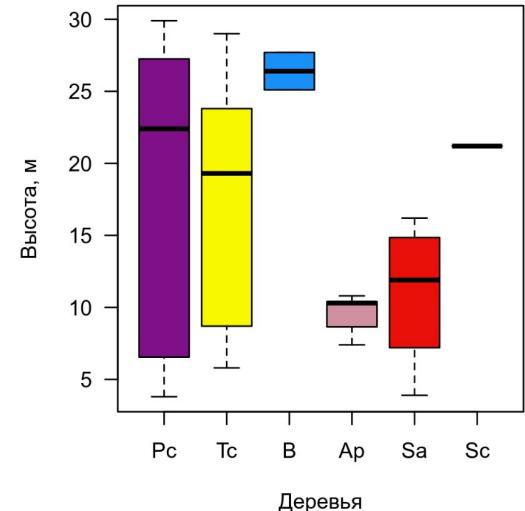
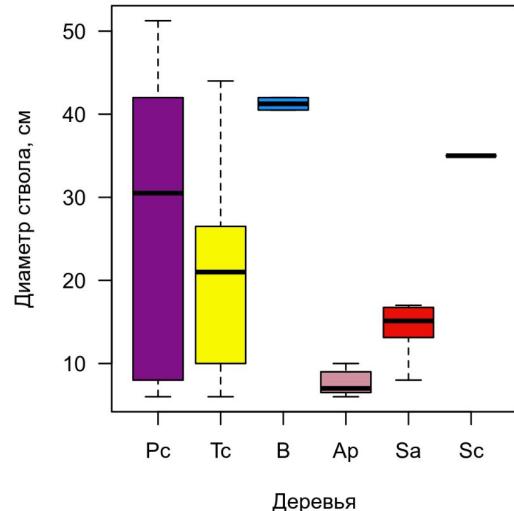
3) Считать это  
ладно, но  
сумеет ли R в  
два клика  
вывести мне  
на экран  
график, карту,  
диплом или  
диссертацию?

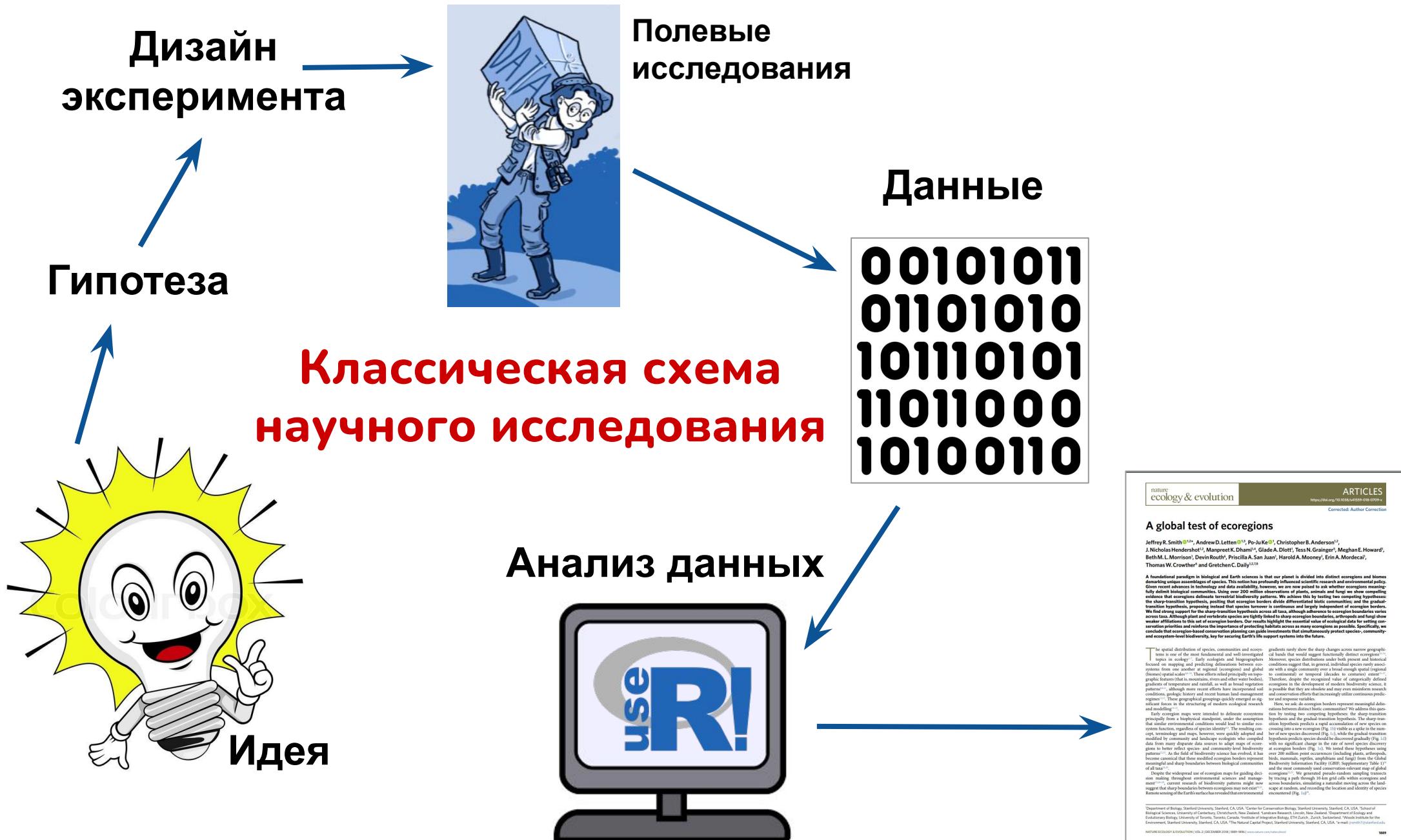


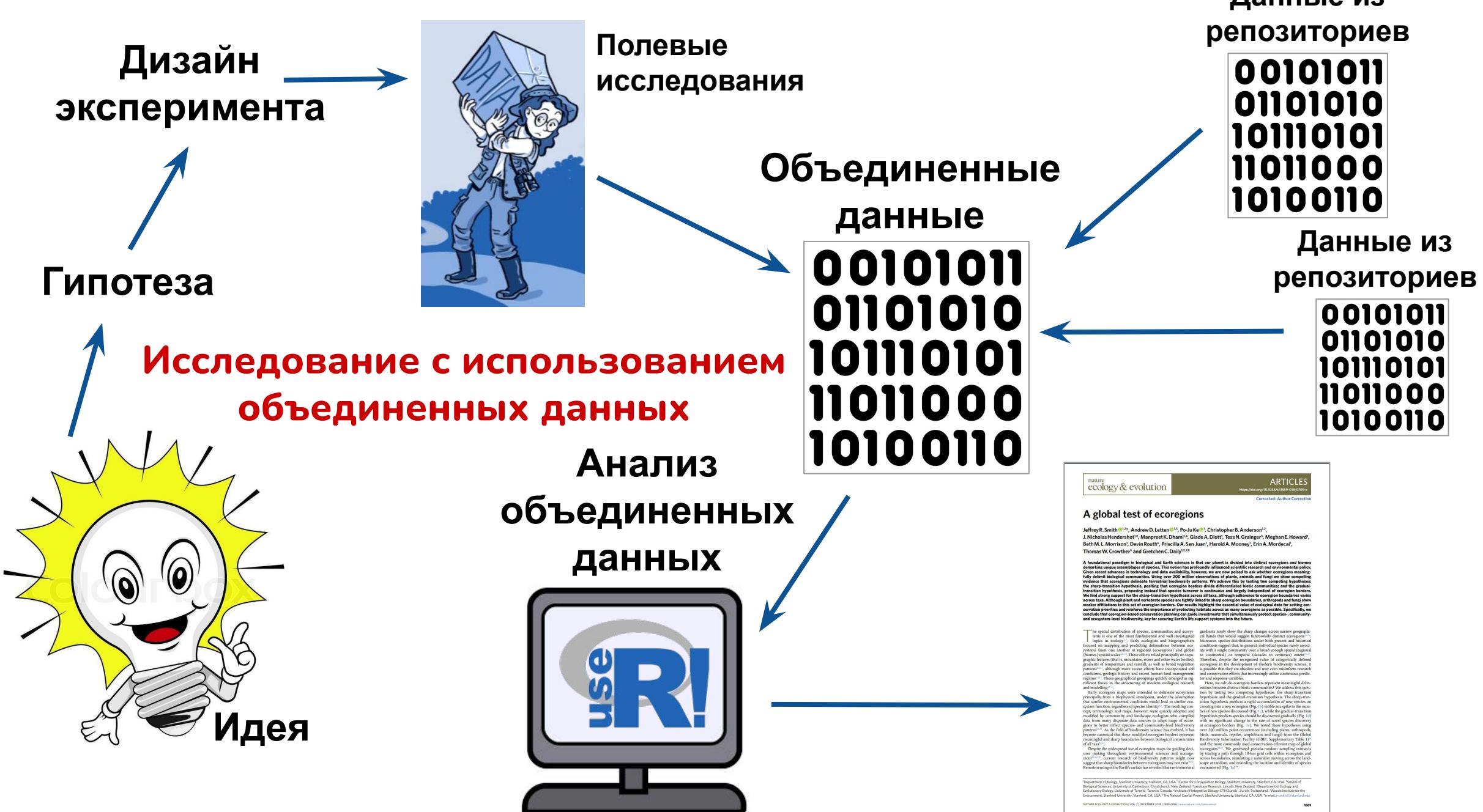
4) ...

**5) PROFIT !!!**

## Программный код - это не так страшно, как кажется







# Использование данных, доступных через GBIF

 NeoBiota

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Research Article NeoBiota 35: 61-85  
<https://doi.org/10.3897/neobiota.35.12460> (02 Jun 2017)

## Alien flora of Turkey: checklist, taxonomic composition and ecological attributes

▼ Ahmet Uludag, Necmi Aksoy, Ayşe Yazlık, Zubeyde Filiz Arslan, Efecan Yazmiş, İlhan Antonella Cossu, Quentin Groom, Jan Pergl, Petr Pyšek, Giuseppe Brundu

### Abstract

The paper provides an updated checklist of the alien flora of Turkey with information on its structure. The alien flora of Turkey comprises 340 taxa, among which there are 321 angiosperms, 17 gymnosperms and two ferns. Of the total number of taxa, 228 (68%) are naturalized and 112 (32%) are casual. There are 275 neophytes (172 naturalized and 103 casual) and could not be classified with respect to the res potential to escape are also listed. The richest f and *Solanaceae* (22). As for the naturalized alien (31 taxa), *Poaceae* (22), *Amaranthaceae* (18) a (63.8% of the total number of taxa with this life annuals contribute 33.8% and 2.4% are biennials and phanerophytes, of which 20.3% are trees and plants are comparatively less represented. Mos ranges in Americas (44.7%) and Asia (27.6%). 3.8% in Australia and Oceania and 3.5% in the intentionally, whereas the remaining (28.1%) intentionally, the vast majority are ornamental 6.7% as crops. Casual alien plants are most co naturalized taxa are also often recorded (27 naturalized rather than casual (16.0% vs 7.1%, often invaded by alien taxa, especially by those

**Internal Seed Structure of Alpine Plants and Extreme Cold Exposure**

Jaganathan, G. Dalrymple, S. (2019) Data

Cold tolerance in seeds is not well understood compared to mechanisms in aboveground plant tissue but is crucial to understanding how plant populations persist in extreme cold conditions. Counter-intuitively, the ability of seeds to survive extreme cold may become more important in the future due to...

climate change • endosperm • intracellular ice formation • seed mass • snow bed • temperature minima

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**Complex agroforestry systems against biotic homogenization: The case of plants in the herbaceous stratum of cocoa production systems**

Fridley JD, Peet RK, Wentworth TR, White PS. 2005. Connecting fine- and broad-scale species-area relationships of southeastern U.S. flora. *Ecology* 86: 1172–1177.

Friedman JH. 2002. Stochastic gradient boosting. *Computational Statistics & Data Analysis* 38: 367–378.

Freeman S, Garrouette MD. 2012. Vascular plants of Buldir Island, Aleutian Islands, Alaska. Unpublished.

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**nature ecology & evolution**

ARTICLES

<https://doi.org/10.1038/s41559-018-0709-x>

Corrected: Author Correction

## A global test of ecoregions

Jeffrey R. Smith<sup>1,2\*</sup>, Andrew D. Letten<sup>1,3</sup>, Po-Ju Ke<sup>1</sup>, Christopher B. Anderson<sup>1,2</sup>, J. Nicholas Hendershot<sup>1,4</sup>, Manpreet K. Dhami<sup>1,4</sup>, Glade A. Dlott<sup>1</sup>, Tess N. Grainger<sup>5</sup>, Meghan E. Howard<sup>1</sup>, Beth M. L. Morrison<sup>1</sup>, Devin Routh<sup>6</sup>, Priscilla A. San Juan<sup>1</sup>, Harold A. Mooney<sup>1</sup>, Erin A. Mordecai<sup>1</sup>, Thomas W. Crowther<sup>4</sup> and Gretchen C. Daily<sup>1,2,7,8</sup>

A foundational paradigm in biological and Earth sciences is that our planet is divided into distinct ecoregions and biomes, marking unique assemblages of species. This notion has profoundly influenced scientific research and environmental policy. Given recent advances in technology and data availability, however, we are now poised to ask whether ecoregions meaningfully delimit biological communities. Using over 200 million observations of plants, animals and fungi we show compelling evidence that ecoregions delineate terrestrial biodiversity patterns. We achieve this by testing two competing hypotheses: the sharp-transition hypothesis, positing that ecoregion borders divide differentiated biotic communities; and the gradual-transition hypothesis, proposing instead that species turnover is continuous and largely independent of ecoregion borders. We find strong support for the sharp-transition hypothesis across all taxa, although adherence to ecoregion boundaries varies across taxa. A single ecoregion's boundaries are tight, linking sharp ecoregion borders, arthropods and fungi show weak associations to this set of ecoregion borders. Our results highlight the central value of ecological data for setting conservation priorities and reinforce the importance of protecting habitats across as many ecoregions as possible. Specifically, we conclude that ecoregion-based conservation planning can guide investments that simultaneously protect species, community and ecosystem-level biodiversity, key for securing Earth's life support systems into the future.

The spatial distribution of species, communities and ecosystems is one of the most fundamental and well-investigated topics in ecology. Previous work has focused on mapping and predicting delineations between ecosystems from one another at regional (ecoregions) and global (biomes) spatial scales<sup>1–3</sup>. These efforts relied principally on topographic features (that is, mountains, rivers and other water bodies), gradients of temperature and rainfall, as well as broad vegetation patterns<sup>4,5</sup>, although more recent efforts have incorporated soil conditions, geologic history and recent human land-management regimes<sup>6,7</sup>. These geographical groupings quickly emerged as significant predictors in the structuring of modern ecological research and modelling<sup>8–11</sup>.

Early ecoregion maps were intended to delineate ecosystems principally from a biological standpoint. The assumption was that similar environmental conditions would lead to similar ecosystem function, regardless of species identity<sup>12</sup>. The resulting concept, terminology and maps, however, were quickly adopted and modified by community and landscape ecologists who compiled data from many disparate data sources to adapt maps of ecoregions to better reflect species- and community-level biodiversity patterns<sup>13,14</sup>. As the field of biodiversity science has evolved, it has become canonical that these modified ecoregion borders represent meaningful and sharp boundaries between biological communities of all taxa<sup>15,16</sup>.

Despite the widespread use of ecoregion maps for guiding decision making throughout environmental sciences and management<sup>17–20</sup>, current research of biodiversity patterns might now suggest that sharp boundaries between ecoregions do not exist<sup>21</sup>. We generated pseudo-random sampling transects by tracing a path through 10-km grid cells within ecoregions and across boundaries, simulating a naturalist moving across the landscape at random, and recording the location and identity of species encountered (Fig. 1a).

We tested these hypotheses using over 200 million point occurrences (including plants, arthropods, birds, mammals, reptiles, amphibians and fungi) from the Global Biodiversity Information Facility (GBIF; Supplementary Table 1)<sup>22</sup> and the most commonly used conservation-relevant map of global ecoregions<sup>23</sup>. We generated pseudo-random sampling transects by tracing a path through 10-km grid cells within ecoregions and across boundaries, simulating a naturalist moving across the landscape at random, and recording the location and identity of species encountered (Fig. 1a).

\*Department of Biology, Stanford University, Stanford, CA, USA. <sup>1</sup>Center for Conservation Biology, Stanford University, Stanford, CA, USA. <sup>2</sup>School of Biological Sciences, University of Canterbury, Christchurch, New Zealand. <sup>3</sup>Landcare Research, Lincoln, New Zealand. <sup>4</sup>Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Canada. <sup>5</sup>Institute of Integrative Biology, ETH Zurich, Zurich, Switzerland. <sup>6</sup>Woods Institute for the Environment, Stanford University, Stanford, CA, USA. <sup>7</sup>The Natural Capital Project, Stanford University, Stanford, CA, USA. <sup>8</sup>e-mail: jsmith7@stanford.edu

NATURE ECOLOGY & EVOLUTION | VOL 2 | DECEMBER 2018 | 1889–1896 | www.nature.com/natecolevol

1889

Kenney LA, Kanner R. 2010. Vascular plants of Agattu Island, Aleutian Islands, Alaska. Unpublished.

Klein DR. 1968. Introduction, increase, and crash of reindeer on St. Matthew Island. *Journal of Wildlife Management* 32: 350–367.

Kreft H, Jetz W. 2007. Global patterns and determinants of vascular plant diversity. *Proceedings of the National Academy of Sciences USA* 104: 5925–5930.

# Цитирование данных: отслеживание и отображение

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Thomas Orrell

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218 CITATIONS

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**Leptodactylus mystaceus (Spix, 1824): Distribution extension for the Brazilian Cerrado (Anura: Leptodactylidae)**

Andreani, T. Borges, R. Santos, L. (2017) Herpetology Notes

Fifty-seven species of anurans belonging to the genus *Leptodactylus* are registered and widely distributed throughout Brazil (Sá et al., 2014; SBH, 2016). Among these species, *Leptodactylus mystaceus* (Spix, 1824) spreads throughout the whole Northern region and some areas of northeastern and central ...

Journal Article

Data used in study DOI [10.15468/dl.s1xtf6](https://doi.org/10.15468/dl.s1xtf6)

**DO ENVIRONMENTAL FACTORS AFFECT THE TAXONOMIC RELIABILITY OF LEAF CUTICULAR MICROMORPHOLOGICAL CHARACTERS? A CASE STUDY IN PODOCARPACEAE**

Clugston, J. Jeffree, C. Ahrends, A. Mill, R. (2017) Edinburgh Journal of Botany

Leaf cuticle micromorphology has been cited as an important set of taxonomic characters in gymnosperms, but previous studies have largely been based on small sample sizes. The premise of this study is to understand whether external factors affect cuticular micromorphology of Podocarpaceae. Two exam...

Journal Article

Data used in study DOI [10.15468/6e8nje](https://doi.org/10.15468/6e8nje) DOI [10.15468/bkzv1l](https://doi.org/10.15468/bkzv1l) DOI [10.15468/dgbpla](https://doi.org/10.15468/dgbpla) DOI [10.15468/dlvu12](https://doi.org/10.15468/dlvu12) DOI [10.15468/hja69f](https://doi.org/10.15468/hja69f) DOI [10.15468/hnhrg3](https://doi.org/10.15468/hnhrg3) DOI [10.15468/i9bj5r](https://doi.org/10.15468/i9bj5r) DOI [10.15468/ib5ypt](https://doi.org/10.15468/ib5ypt) DOI [10.15468/ly60bx](https://doi.org/10.15468/ly60bx) DOI [10.15468/mug7kr](https://doi.org/10.15468/mug7kr) DOI [10.15468/nc6rxy](https://doi.org/10.15468/nc6rxy) DOI [10.15468/ucmdjy](https://doi.org/10.15468/ucmdjy) DOI [10.15468/vtfbe3](https://doi.org/10.15468/vtfbe3) DOI [10.15468/x5ucvh](https://doi.org/10.15468/x5ucvh) DOI [10.15468/xy0eo1](https://doi.org/10.15468/xy0eo1) DOI [10.15468/yo3mmu](https://doi.org/10.15468/yo3mmu) DOI [10.15468/ypoair](https://doi.org/10.15468/ypoair) DOI [10.15468/z7ps7](https://doi.org/10.15468/z7ps7)

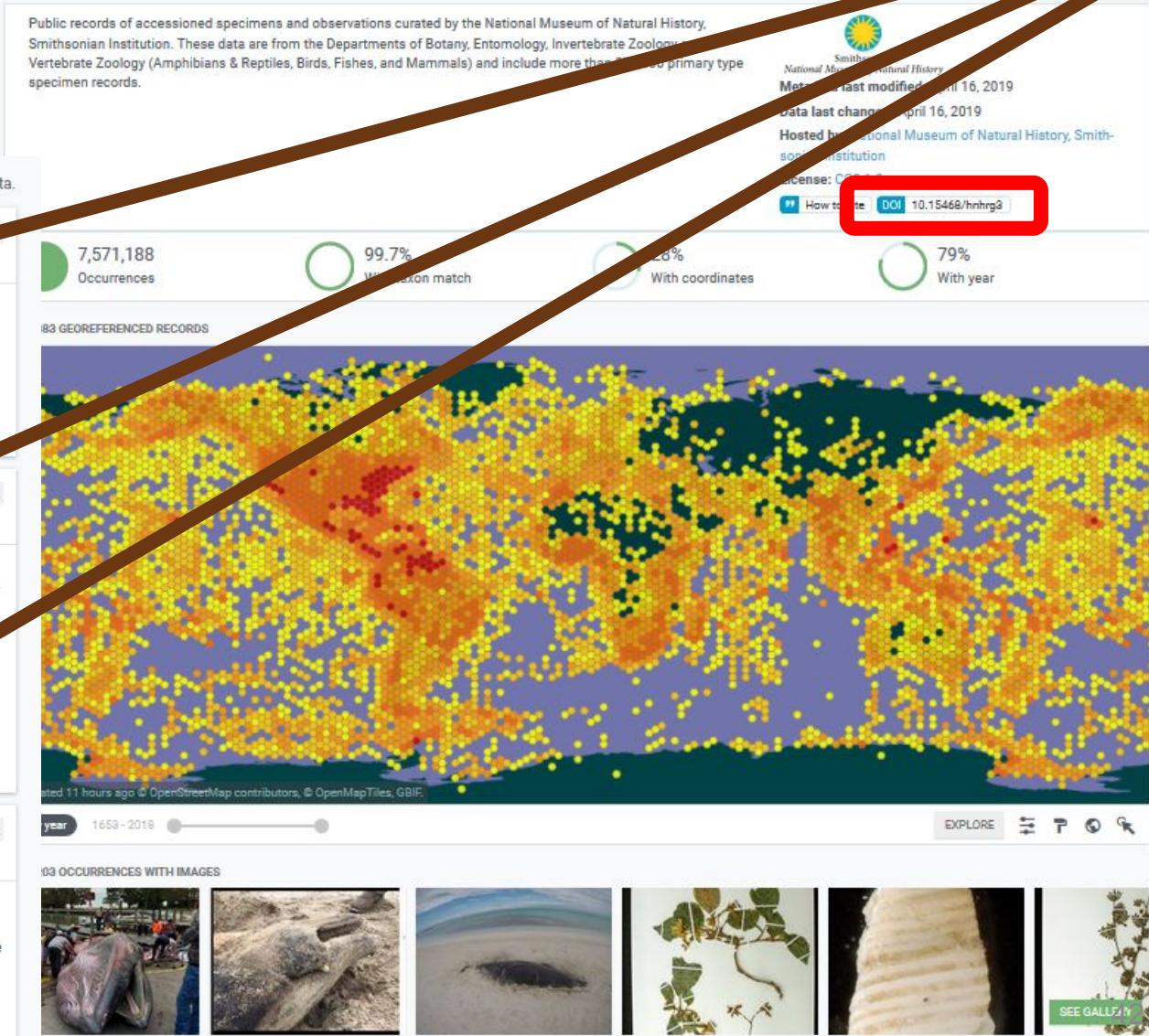
**One for each ocean: revision of the *Bursa granularis* (Röding, 1798) species complex (Gastropoda: Tonnaidea: Bursidae)**

Sanders, M. Merle, D. Bouchet, P. Casteln, M. Beu, A. Samadi, S. - (2017) Journal of Molluscan Studies

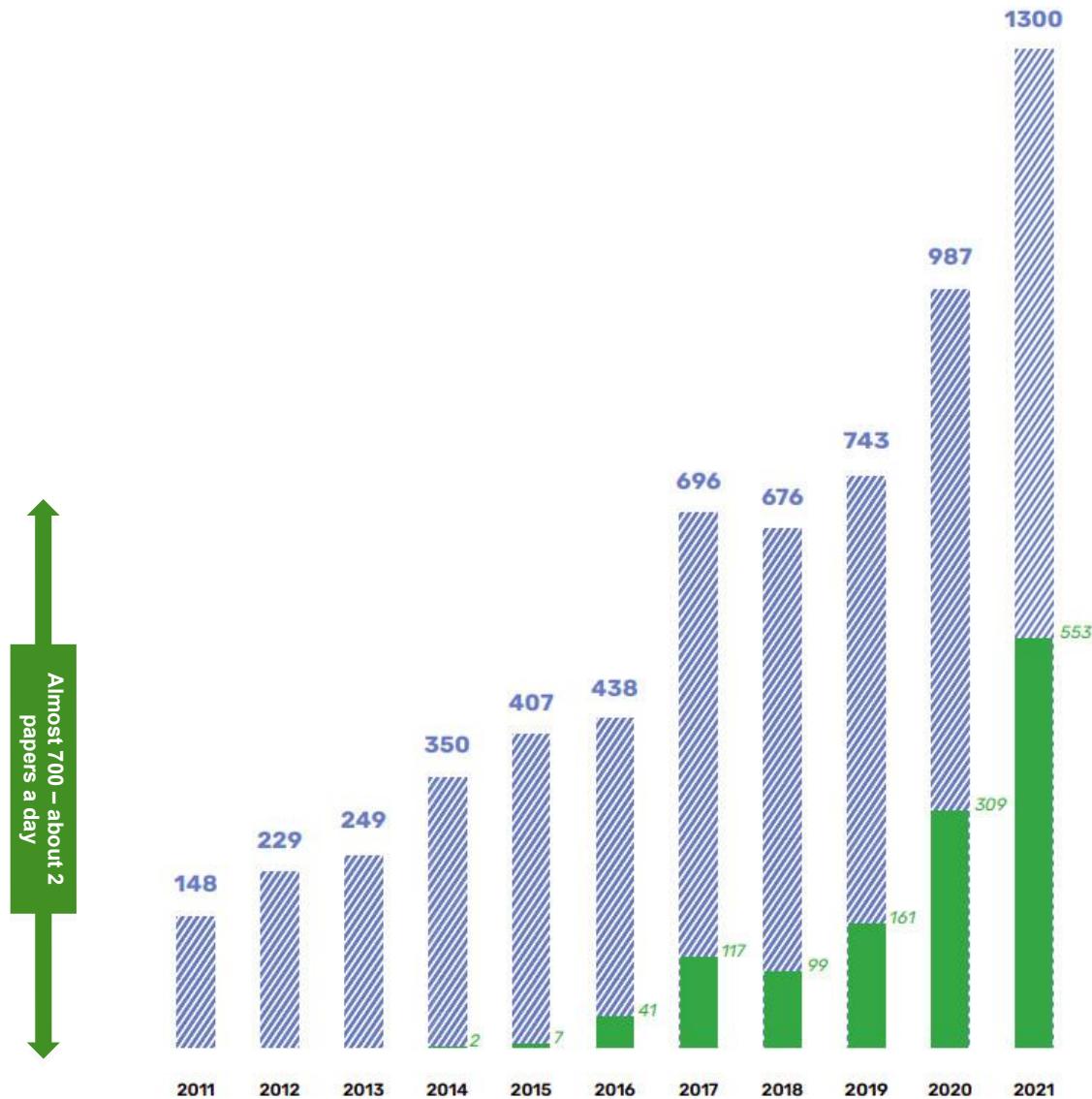
*Bursa granularis* (Röding, 1798) is a tonnaeid gastropod that is regarded as broadly distributed throughout the Indo-Pacific and tropical western Atlantic. Because of its variable shell, it has received no less than thirteen names, now all synonymized under the name *B. granularis*. We sequenced a fra...

Journal Article

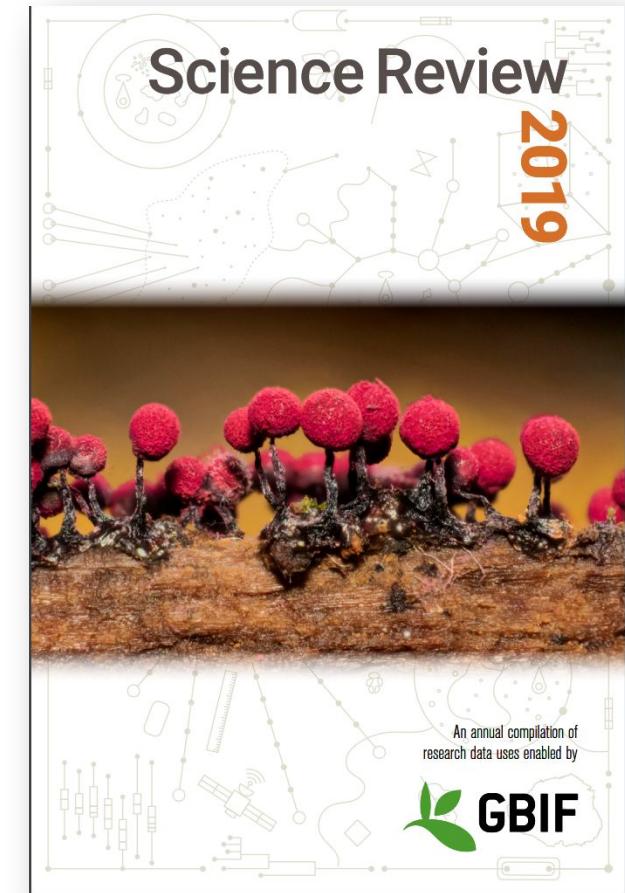
Data used in study DOI [10.15468/dl.ma8d1e](https://doi.org/10.15468/dl.ma8d1e)



# Научные публикации, использующие данные GBIF



<https://www.gbif.org/science-review>  
[https://www.gbif.org/sites/default/files/gbif\\_analytics/country/RU/GBIF\\_CountryReport\\_RU.pdf](https://www.gbif.org/sites/default/files/gbif_analytics/country/RU/GBIF_CountryReport_RU.pdf)



# Big data integration: Pan-European fungal species observations assembly for addressing contemporary questions in ecology and global change biology

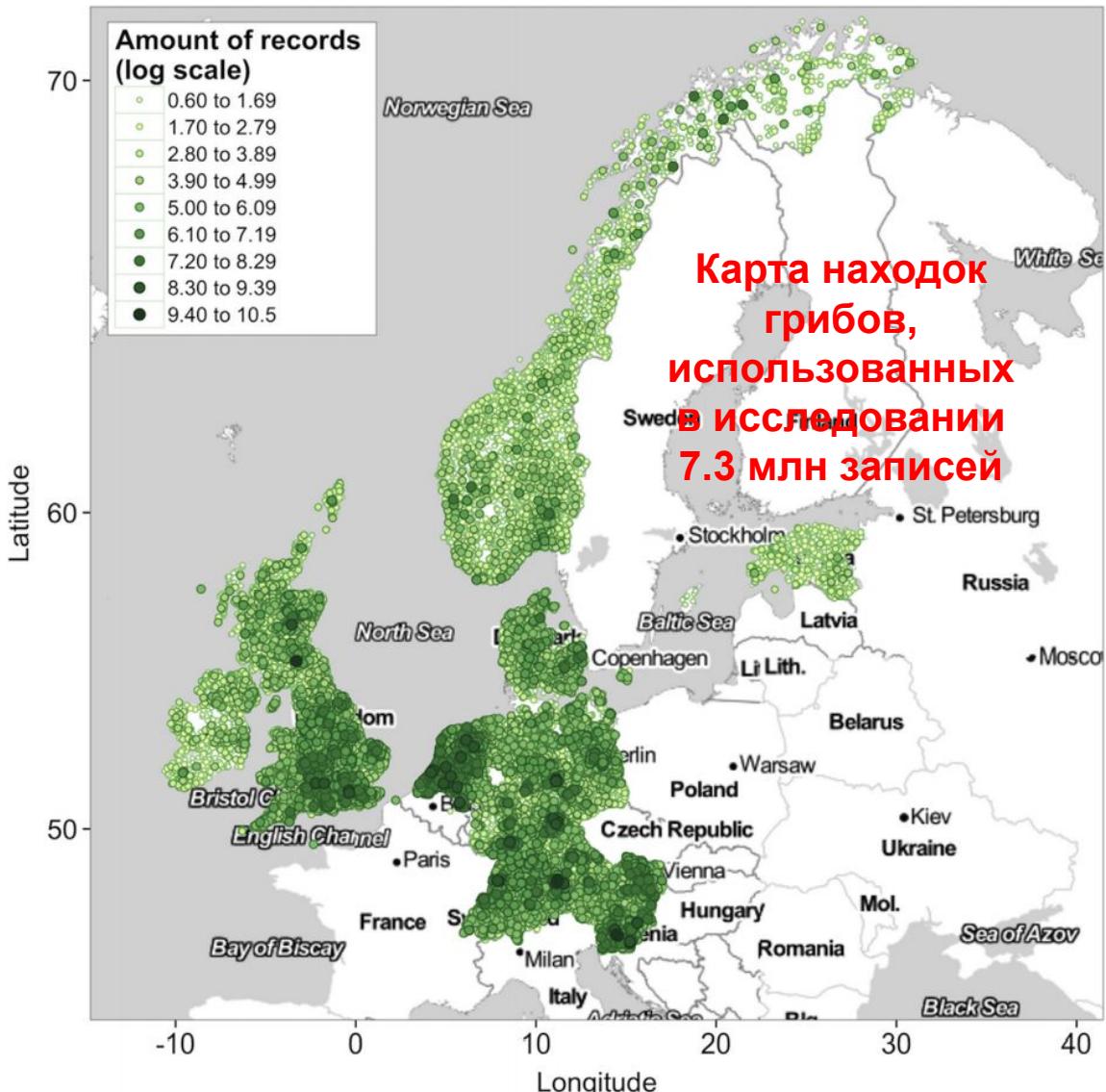
- Таксономический анализ
  - Анализ сходства сообществ грибов в разных регионах
  - Фенология появления плодовых тел
  - Научный потенциал собранного набора данных
  - Анализ данных с позиций глобальных изменений климата



Andrew et al.

Fungal Biology Reviews, 2017

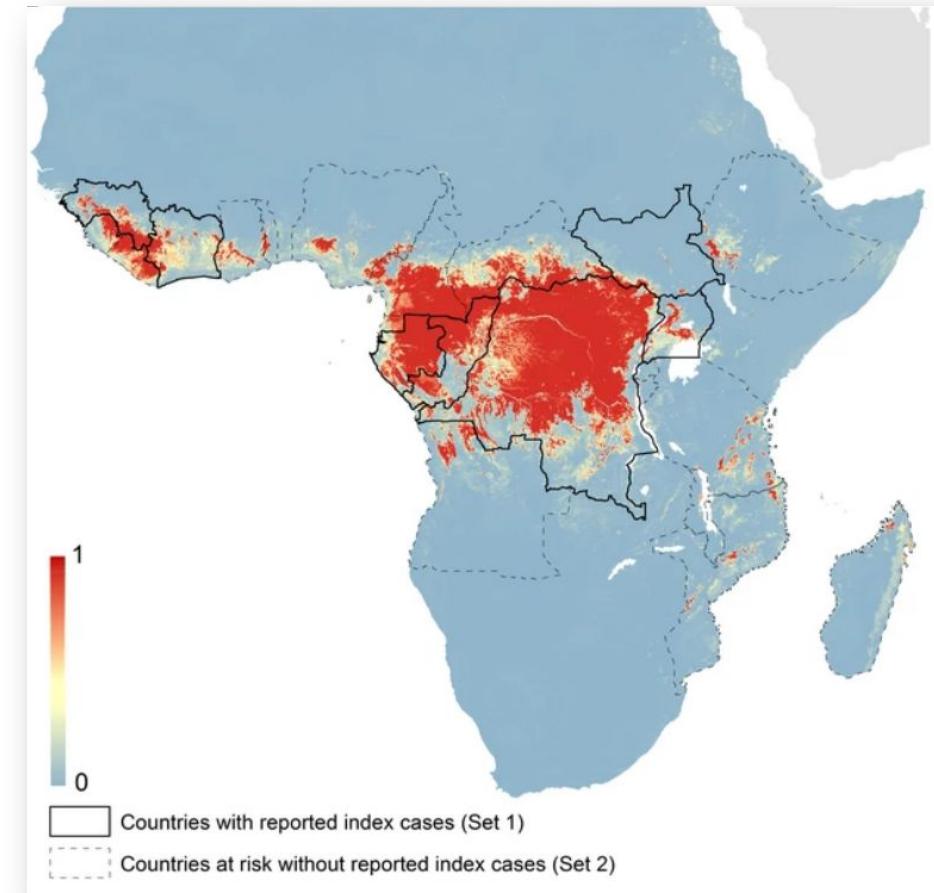
<https://doi.org/10.1016/j.fbr.2017.01.001>



# Mapping the zoonotic niche of Ebola virus disease in Africa

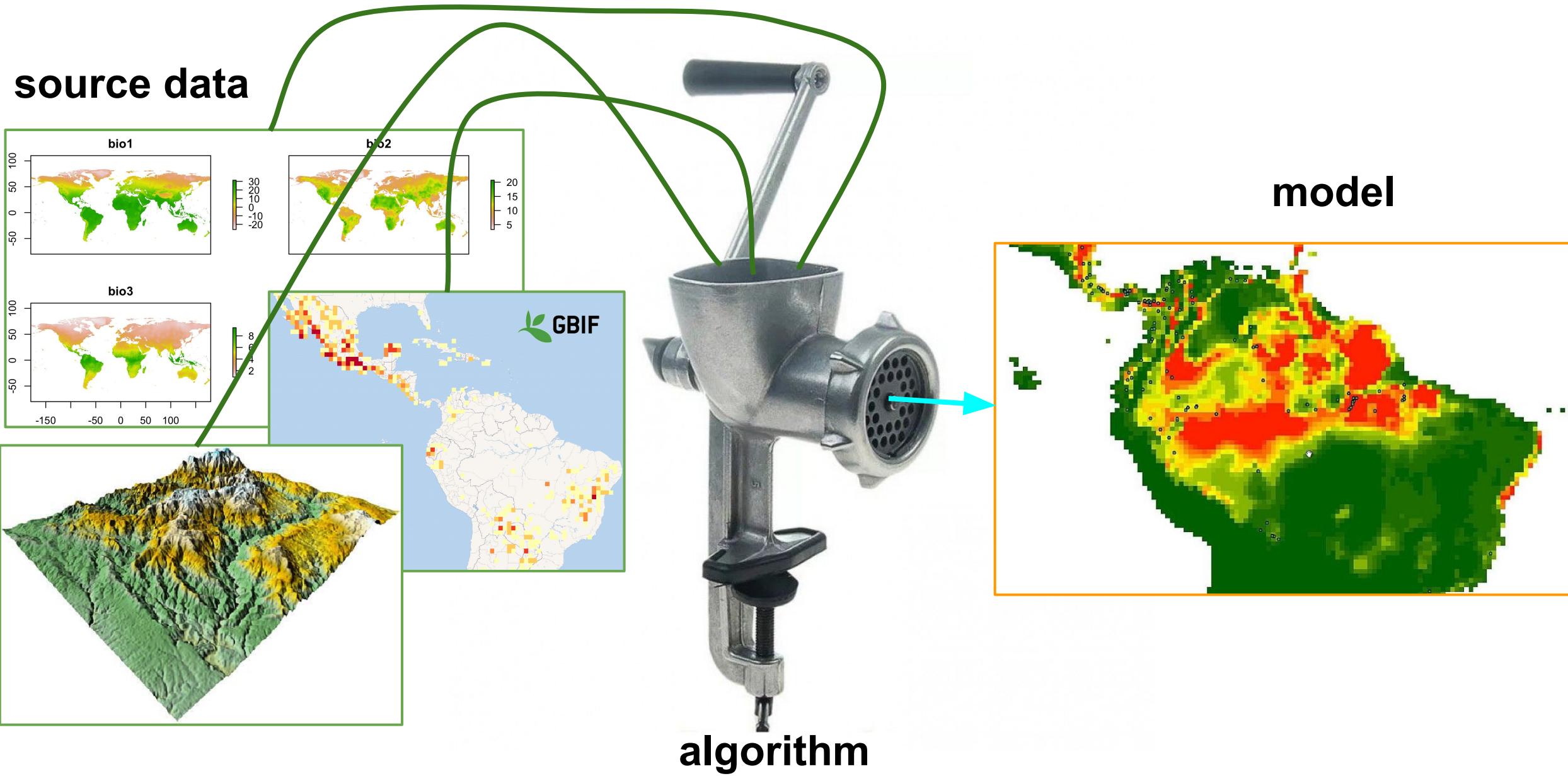


- Смоделированы экологические ниши трех видов летучих мышей, связанных с передачей вируса Эбола
- Данные получены из глобальной базы по биоразнообразию GBIF
- Результаты показали, что зоны риска охватывают 22 страны, население 22 миллиона чел.
- Результаты помогают расставить приоритеты в области эпидем. надзора и диагностики в зонах повышенного риска



Распространение вируса Эбола, предсказанное моделью

# Species Distribution Modelling (SDM)



# Глобальное распределение разнообразия дождевых червей

6928 точек сбора в 57 странах

Three generalized linear mixed-effects models

- A
1. Видовое богатство
  2. Численность
  3. Биомасса

DOI: [10.1126 /science.aax4851](https://doi.org/10.1126/science.aax4851)

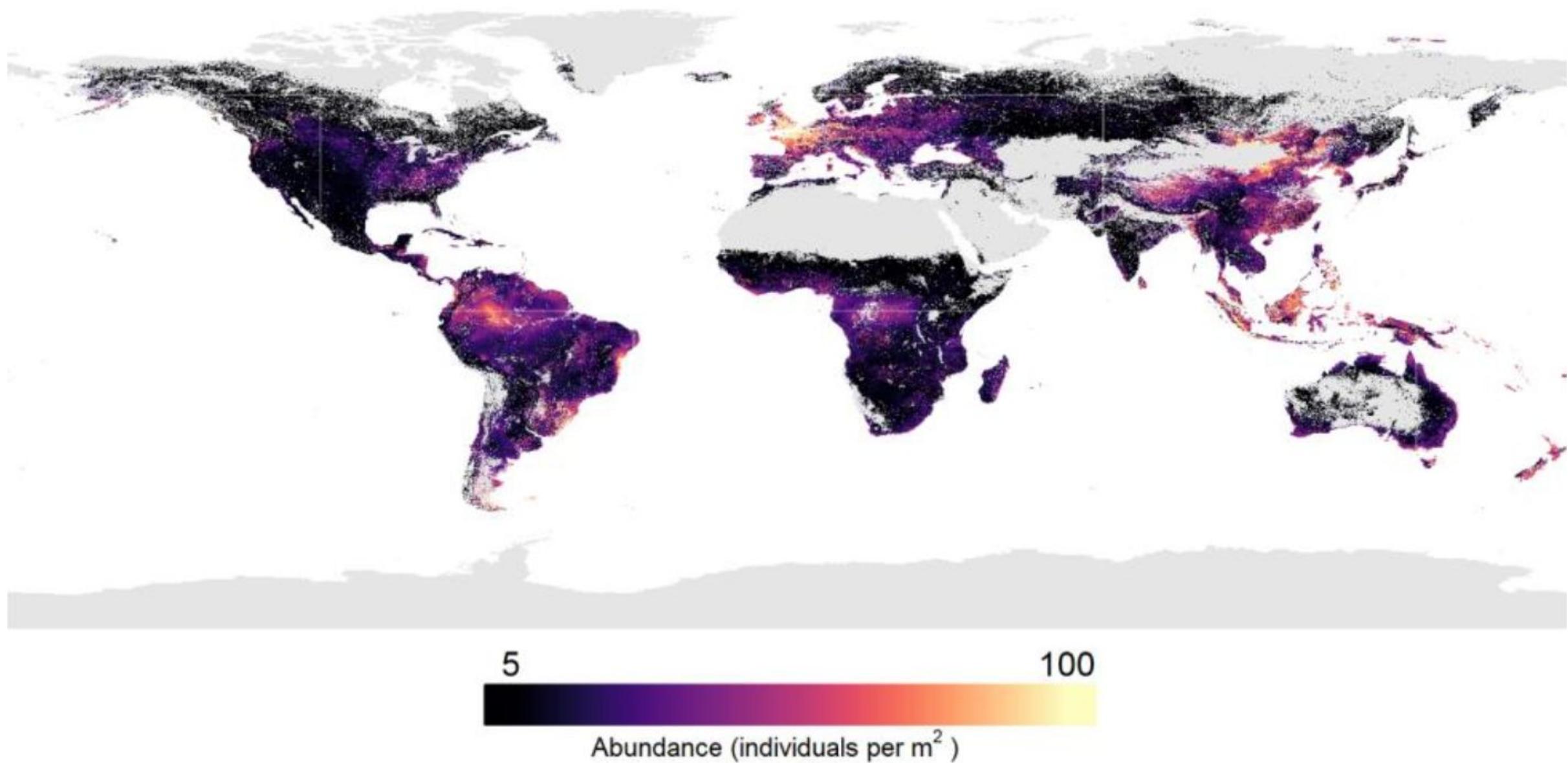
Number Of Sites

- 1
- 100
- 200
- 300
- 400
- 500
- 600

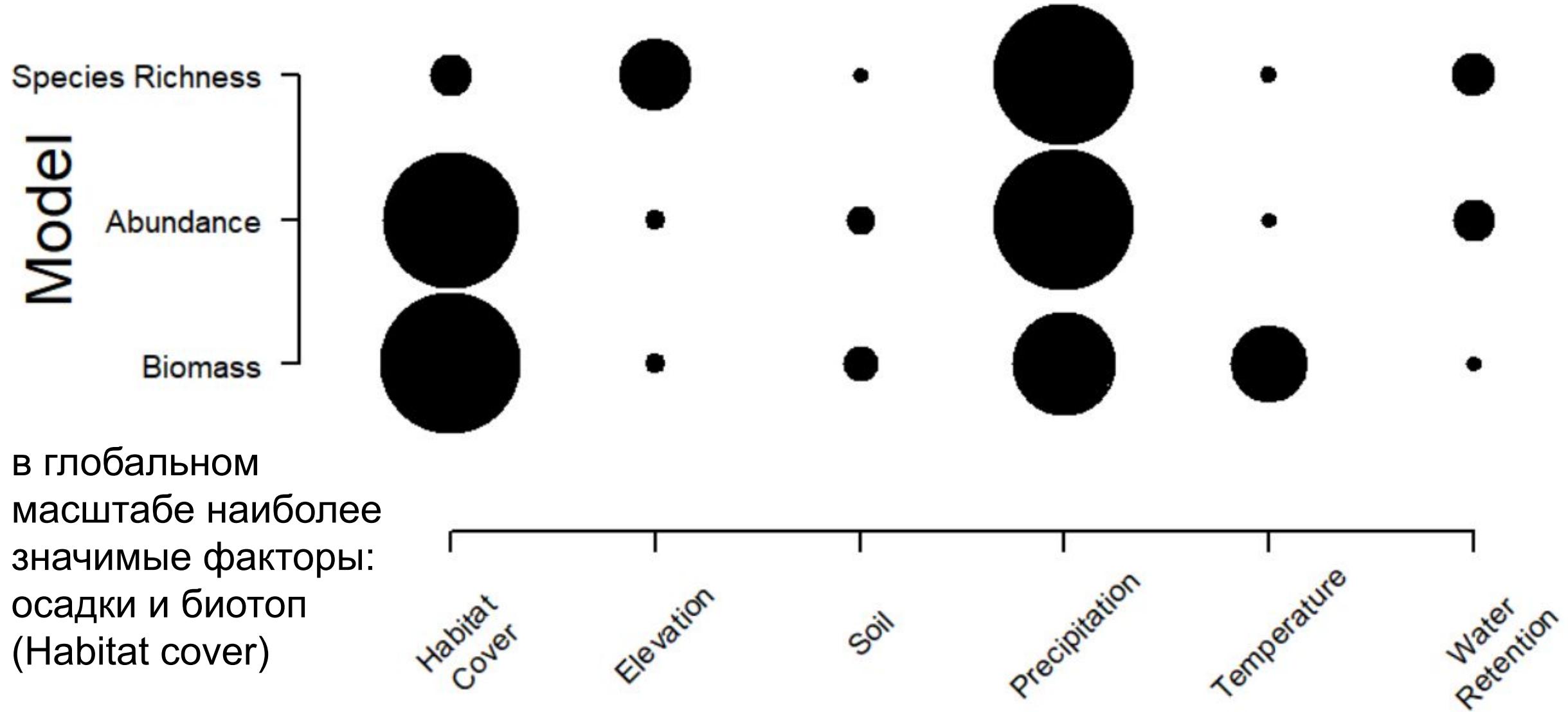
Предикторы:  
Habitat cover  
Elevation  
Soil  
Precipitation  
Temperature  
Water retention



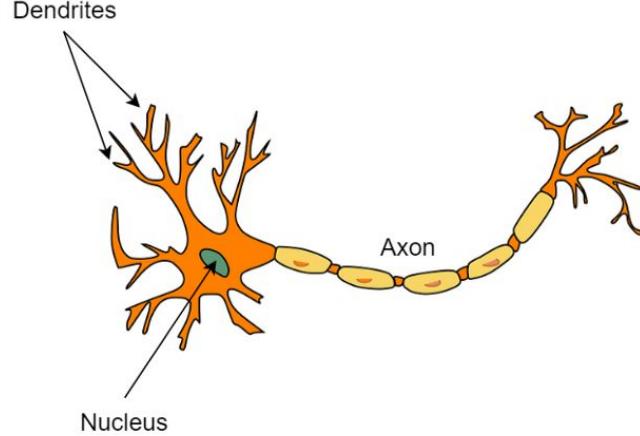
# Распределение обилия, в экз. на кв. м



# Влияние факторов на население дождевых червей



# Искусственные нейронные сети

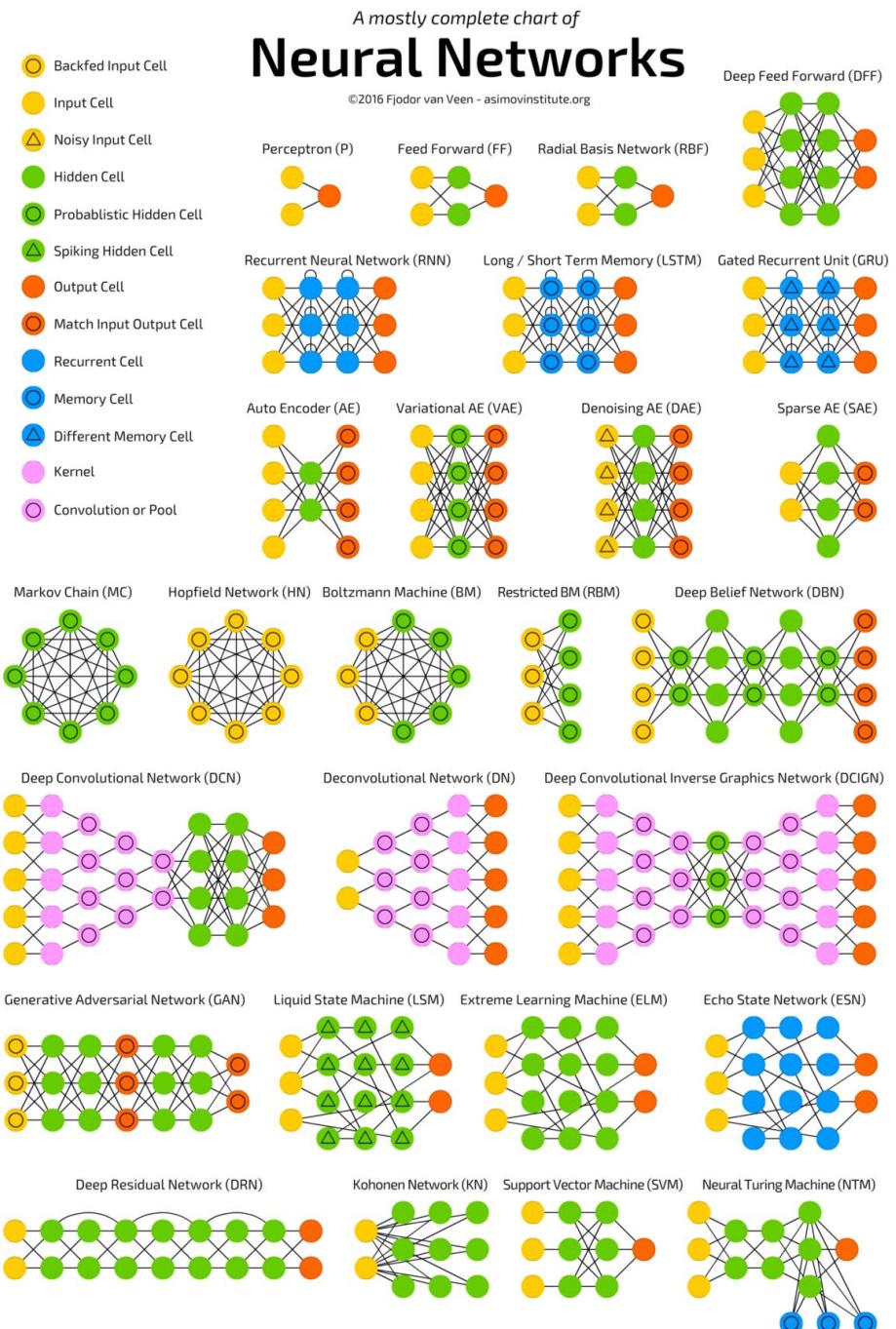


Для выполнения задачи нет заранее определенного алгоритма, но есть архитектура нейронной сети разработанная для решения какого-то определенного класса задач

У каждого искусственного нейрона есть свой вес - "мощность исходящего сигнала"

Обучение нейросети - стохастический процесс, который меняет вес нейронов

В процессе обучения происходит кросс-валидация на тестовой выборке размеченных данных



# Сверточные нейронные сети

|            |            |            |   |   |
|------------|------------|------------|---|---|
| 1<br>$x_1$ | 1<br>$x_0$ | 1<br>$x_1$ | 0 | 0 |
| 0<br>$x_0$ | 1<br>$x_1$ | 1<br>$x_0$ | 1 | 0 |
| 0<br>$x_1$ | 0<br>$x_0$ | 1<br>$x_1$ | 1 | 1 |
| 0          | 0          | 1          | 1 | 0 |
| 0          | 1          | 1          | 0 | 0 |

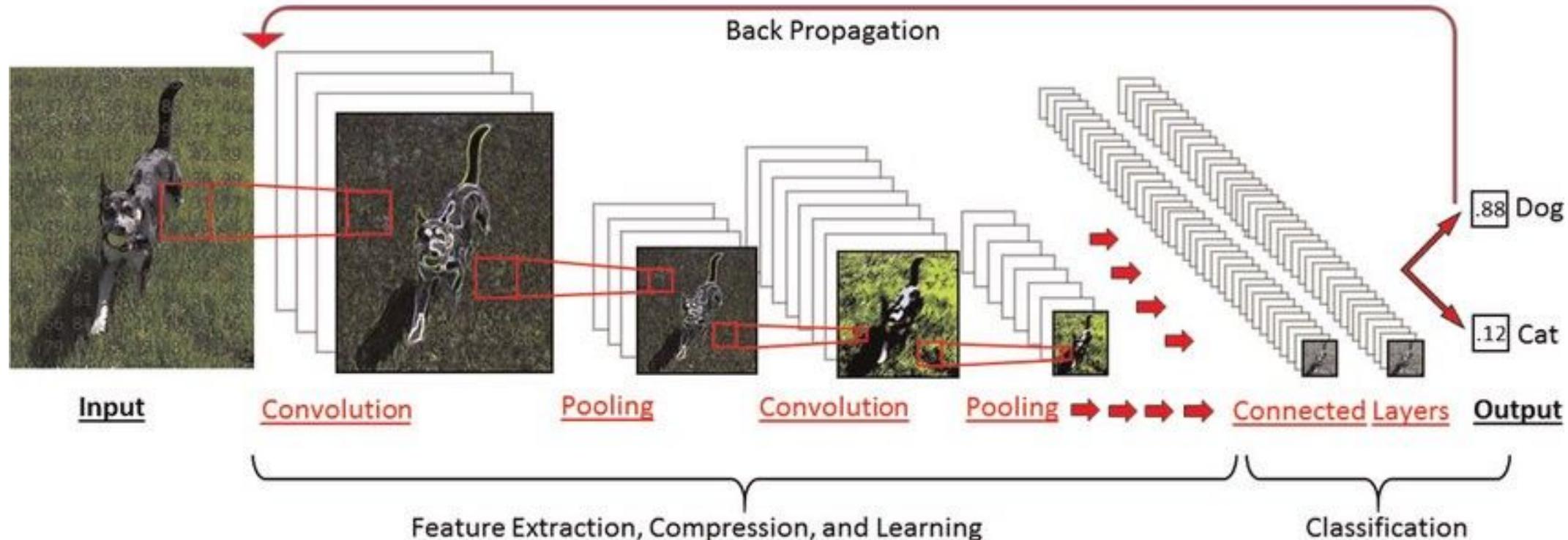
Image

|   |  |  |
|---|--|--|
| 4 |  |  |
|   |  |  |
|   |  |  |
|   |  |  |

Convolved  
Feature

Convolutional Neural Network  
основа работы сети - свёртка изображений

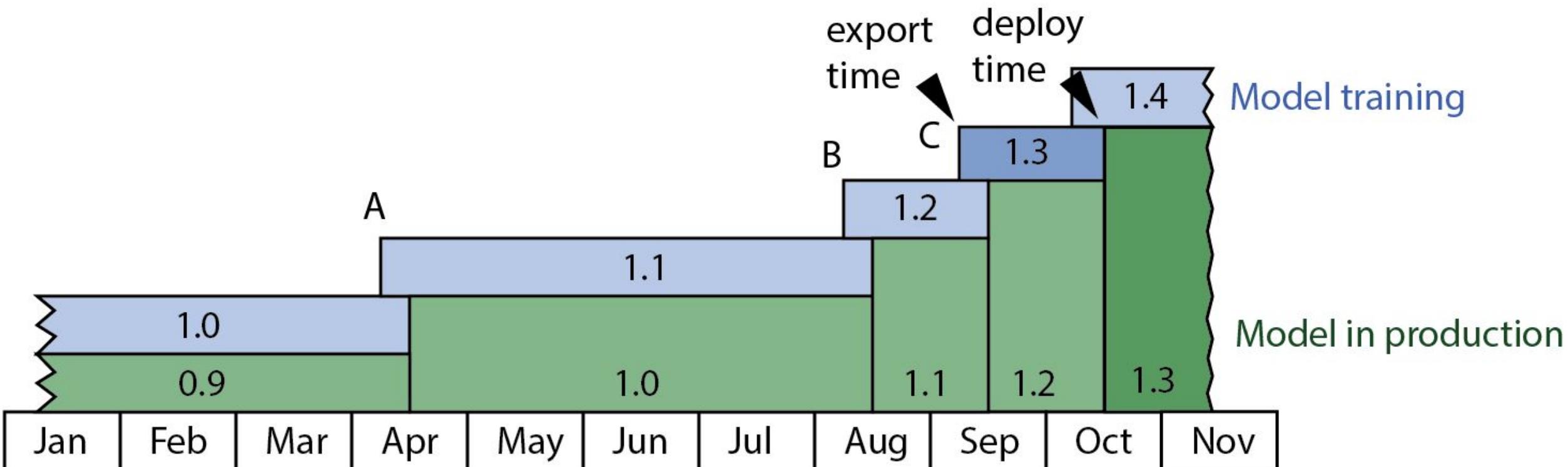
## Deep Learning with Convolutional Neural Networks

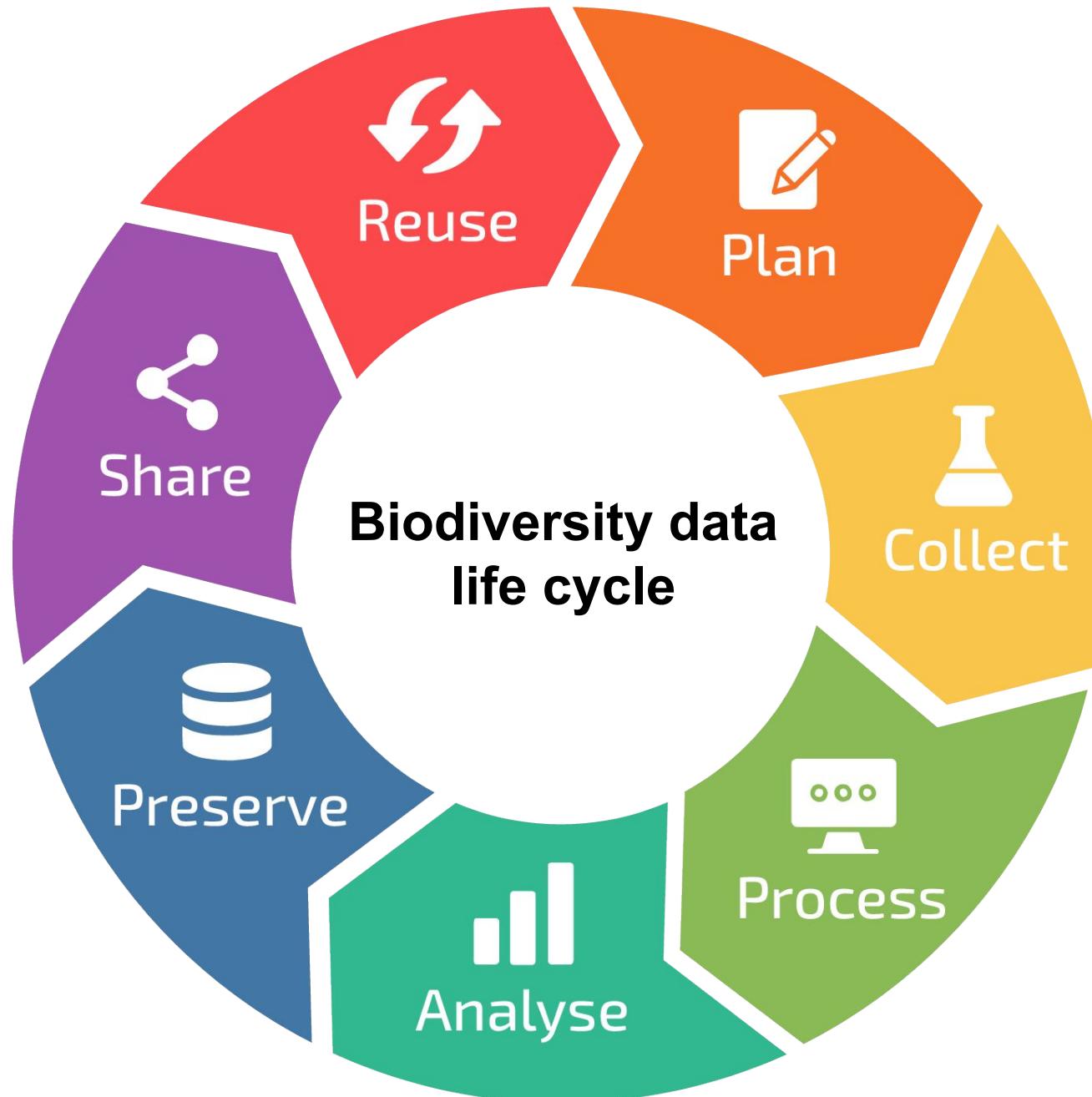


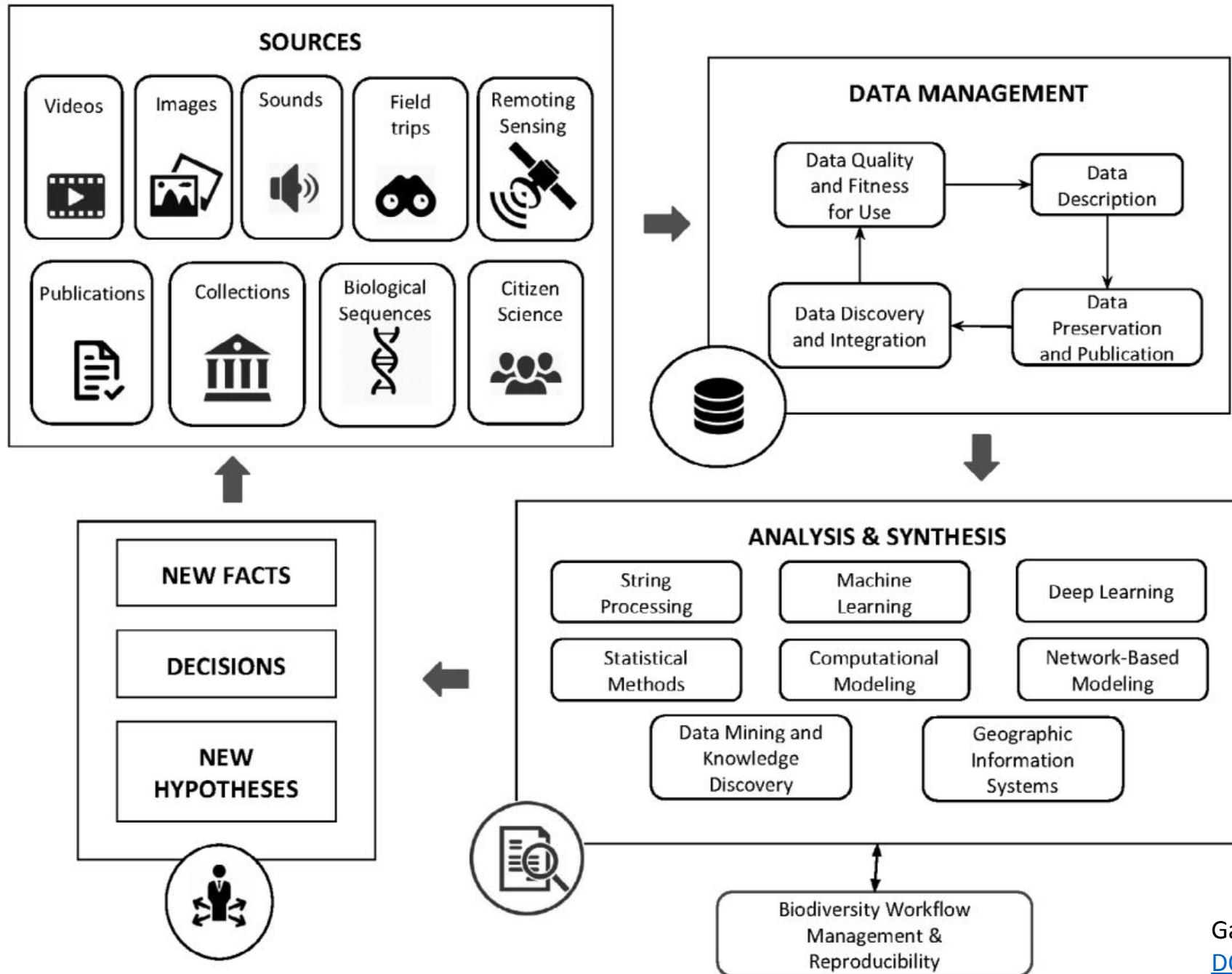
# Нейронная сеть в iNaturalist

первая система распознавания изображений была запущена в 2017 году, включала 5089 таксонов. Обучение проводилось на 579 184 учебных изображений и 95 986 тестовых.

Актуальная Computer Vision Model включает 66 214 таксонов, для каждого из которых отобрано как минимум 50 качественных изображений







# International Biodiversity Informatics Landscape

## Информатика биоразнообразия в мире

### Vocabularies & Standards

Biodiversity Information Standards  
TDWG



Catalogue of Life

### International Portals



**GBIF**

Global Biodiversity Information Facility



**BOLD SYSTEMS**



**OBIS**

OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM

### Soft & Data analysis



### Citizen science

**eBird**



### Digitization



### Share



# Материалы для самостоятельного изучения

Luiz M. R. Gadelha Jr et al., 2020. [A survey of biodiversity informatics: Concepts, practices, and challenges](#)

Bisby F.A. (2000) The quiet revolution: Biodiversity informatics and the internet. *Science*, 289: 2309-2312  
DOI: [10.1126/science.289.5488.2309](https://doi.org/10.1126/science.289.5488.2309)

Edwards J.L., Lane M.L, and Nielsen E.S. (2000) Interoperability of Biodiversity Databases: Biodiversity Information on Every Desktop. *Science*, 289, 5488, 2312-2314 DOI: [10.1126/science.289.5488.2312](https://doi.org/10.1126/science.289.5488.2312)

**The future is already here —  
it's just not very evenly distributed**

*Уильям Форд Гибсон,  
писатель-фантаст*

