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TOWARDS THE DEVELOPMENT OF A EUROPEAN IKB DATABASE

Recommendations Report

Ref.t2021.2190.1

BirdLife International

May 2022

TOWARDS THE DEVELOPMENT OF A EUROPEAN IKB DATABASE - Recommendation Report

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Background

Illegal Killing of Birds (IKB) occurs whenever birds are killed or removed from the wild due to actions that are prohibited by national legislation. Activities such as illegal shooting, trapping, poisoning and nest robbing are widespread around the world, although there are significant differences in motivation, methods and scale between regions. IKB is one of the main threats to bird populations (BirdLife International 2018), and it produces cumulative effects with other threats (mainly habitat loss, climate change, pollution, invasive species and collisions with infrastructures or vehicles) pushing species to extinction.

Legislation regarding the taking of birds is very different from one country to another, even in Europe, making it difficult to come up with actions that may be universally applied. However, IKB has been one of the main drivers for the development of international policy instruments such the European Bird Directive, the Bern Convention and the Conservation of Migratory Species of Wild Animals (BirdLife International 2019).

Since there is no systematic record of wildlife crime across the whole of the EU, several projects and studies have been undertaken in recent years aiming to determine the true scale of the problem. Over 30 LIFE and wildlife crime projects in the EU have addressed IKB (European Union 2018).

These studies revealed that in each country the problem is unique due to cultural and social differences (BIO Intelligence Service 2011, Brochet *et al.* 2017, 2019). These studies also identified a second issue, regarding the collection, handling and types of data in each country or project. The different data formats, the disperse/scattered information available and the incompatible existing databases within countries makes the continuous communication between different EU countries difficult (BIO Intelligence Service 2011, Brochet *et al.* 2017, 2019, UGOCO-WebMedia 2021).

Figure 1: Illegal poisoning is one of the main threats for Eastern Imperial Eagles in a few European countries (photos: Marton Horvath and Mila Rajic).

Figure 2: Common quail and Blackcaps are frequently caught in the Mediterranean region using illegal traps (photos: Watter Al-Bahry and RSPB).

1.2 Scope and objectives

To overcome and provide a possible solution for the disperse information available, BirdLife International has set the development of a European IKB database as an output of the LIFE against Bird Crime project (LIFE18GE/NL/000599). The

With the aim of reducing the illegal killing, trapping and taking of birds in the EU and neighboring Mediterranean region the project “Delivering the EU Biodiversity Strategy: Awareness and Capacity Building against Bird Crime in Priority Flyway Countries” (LIFE against Bird Crime project LIFE17GE/NL/000599), funded by the EU, started in 2018. Specific objectives include expanding and improving knowledge on the IKB in the region; raising awareness and stimulating public demand to stop IKB; supporting increased international and national advocacy efforts to ensure political commitment and technical capacity to enforce actions to end IKB; designing and implementing pilot projects with key stakeholders in priority countries to demonstrate, share and promote effective approaches to reduce IKB; contributing towards achieving the objectives of the Birds Directive, the EU roadmap for combating IKB and the EU 2020 biodiversity strategy; maintaining and strengthening the networks of civil society organizations and stakeholder groups working together to address IKB.

The development of a European IKB database was proposed as one of the expected outputs of this project. On a first phase of this assignment the following tasks were undertaken (UGOCO-WebMedia 2021):

- detailed review of existing documentation
- list of relevant stakeholders
- familiarization with relevant existing databases.

The present assignment, which is embedded in this project, consists of detailed technical recommendations for the development of an EU IKB database to comply with the following task: “Develop a written plan for the development of an EU-level bird crime database”.

2 METHODOLOGY

2.1 Approach Towards an EU IKB database

The following stages and tasks were taken into account during the development of the present recommendation report for an EU IKB database:

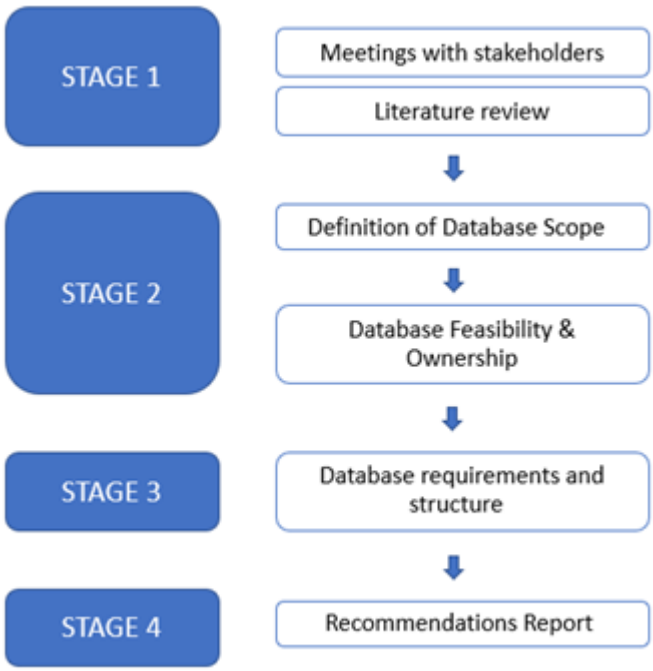

Figure 3: Stages of the approach towards an EU IKB database

2.2 Literature review and stakeholder meetings

On a first stage of this project a literature review was conducted to familiarize with the depth of the IKB problem and existing IKB databases.

On the first phase of this project's approach towards an EU IKB database (previous to this consultancy) a report was produced (UGOCO-WebMedia 2021) which constitutes an essential reference for this assignment.

Along with the literature review, several meetings with key stakeholders were promoted to incorporate their experience and expertise on the development and use of existing databases. These meetings once again confirmed the main challenges linked to data collection and harmonization between existing databases. Urging towards the need of a standardized database for IKB. The key stakeholders that were consulted included current LIFE projects (SWIPE, Nature Guardians and LIFE PannonEagle) and international multilateral agreements (Convention on Migratory Species and CITES).

2.3 Definition of database scope, feasibility and ownership

In order to provide recommendations for an EU IKB database it is necessary to define the scope of the database and what are the requirements for this database.

The criteria that guided every choice that was taken along the process of producing these recommendations were necessity to provide the required information for the IKB Scoreboard, to have a simple format and to be easy to use (input and output of data), in order to appeal to all stakeholders.

2.4 Database requirement and structure

Alternative technical solutions were compared to provide the best answer, to our knowledge, to meet client, end-user and maintenance requirements.

3 ASSESSMENT OF THE CURRENT SITUATION

3.1 Review from the first phase of the project

During the first phase of this project (UGOGO-Web Media 2021), meetings with stakeholders such as the European Commission and the Bern Convention were held to inform of the project and discuss ongoing projects. Other stakeholders and database holders, such as: EU BirdLife partners and two ongoing LIFE projects ("Nature Guardians /Guardianes de la Naturaleza" and "Successful Wildlife Crime Prosecution in Europe" - SWIPE) were also involved in this stage to identify other possible stakeholders and provide input for an EU IKB database questionnaire.

The objective of the questionnaire was to: i) identify a more significant number of IKB-relevant databases across the EU and the UK held by Governmental and non-governmental organizations, and; ii) collect information sufficiently detailed to define a clear picture of the characteristics of the data collected and of the structure of the databases.

A total of 91 questionnaires were sent out to organizations known or expected to hold and manage relevant databases. And a second letter was sent to a broader group of 50 addresses, which included potential regional (sub-national) database holders. Feedback including answers from 14 countries and information for 28 databases (a total of 24 organizations: 11 NGOs, one hunter's association and 12 government agencies).

A BirdLife IKB Database expert workshop (Mechelen meeting, November 2019) was also held. This meeting included 19 experts from 14 NGOs and the European Commission to discuss the nature and structure of a potential international IKB Database. The main focus points identified were: "Defining the problem and the purpose of the database, identifying the pre-requisites to build a standardized database; defining the scope and level of details, identification of data fields and an ideal structure". According to the outcomes of the Mechelen workshop and conversations with the stakeholders, the IKB database would not be focusing on the international trade of species covered by Conventions of International Trade of Endangered Species (CITES) and EU-TWIX (managed by TRAFFIC). This meeting also provided relevant information on existing databases in the EU (UGOCO-Web Media 2021).

Results from the questionnaires revealed that most databases are collected on a national level, updated manually, either online or offline. The majority are not publicly accessible, and the willingness to share this sensitive data is limited. Most countries with IKB problem seem to have taken some steps to collect and organize information on the issue (UGOCO-Web Media 2021).

Two main challenges were identified: data collection (type and field) and data harmonization (different types of data and formats available from each country). The differences encountered in national and regional databases causes data standardization to be very difficult to implement. Thus, both merging databases and comparing results from different sources are extremely difficult. Other difficulties encountered include unwillingness to replace current databases, information scattered among

stakeholders, ownership issues, budget to establish and register data holders (including maintenance costs) and also technical aspects, such as software/server type and data management.

However, all responses recognized the importance of standardized IKB data collection and that this is fundamental for the development of an international database.

3.1 Meetings with stakeholders

The stakeholder meetings revealed the existence of several complex databases. The existing databases are, however, quite well established and reveal a joint effort and expertise in many cases. Most of the existing databases are specific to a certain scope/project, country or neighboring countries.

Existing databases may involve very different institutions such as governmental institutions (national or regional), NGOs, police forces and wildlife recovery centers.

It became clear that one of the main challenges towards an international or EU IKB database is the difficulty to obtain data from institutions, local authorities, governments or NGOs. On the other hand, even with the existing information it would be difficult to harmonize the data from different institutions (or projects), as these collect and report data in their own way, using their own methodology (online/offline; paper or platform based). These databases are therefore quite specific, designed for each specific project, using their own fields and tables to answer project objectives, therefore, making them extremely difficult to merge.

Also, the scope of these databases may have significant differences regarding:

- What type of actions are included - illegal killing, accidental killing (e.g., roadkill, collisions with infrastructures, poisoning with legal chemicals, deaths resulting from agricultural activities, etc.), trade, even forest fires and pollution events;
- What taxa are included - all animals, birds, some bird taxa (e.g., raptors);
- Stage of prosecution – all cases, only cases that have been or are being prosecuted.

The stakeholder meetings were extremely valuable to identify, and point out the difficulty of the existence of only one specific database to respond to the IKB problem.

In these meetings it was also pointed out the importance of a database that provides data/information for the IKB scoreboard (scoreboard to assess the progress in combating illegal killing, taking and trade of wild birds).

4 OVERVIEW OF THE DATABASE PROPOSAL

4.1 Database scope

One of the main issues identified during the first stages of this project is the broad scope and definition of “bird crimes”, “illegal killing of birds (IKB)” or “wildlife crime”. Thus, the first task was to define the focus of the database, and consequently the different types of illegal actions to include. This proposal for the database will consider only Bird Crimes resulting in the Illegal Killing of Birds related to the following offences/actions:

- Illegal killing, shooting, poisoning and trapping;
- Illegal nest destruction or taking (predator control, pests and pets);
- Illegal egg collection;

Regarding, bird crime offences, the database will not include the trade of species, as these are already covered by two well established networks, Conventions of International Trade of Endangered Species (CITES) and EU-TWIX.

Since one of the main challenges faced by the EU IKB database is the difficulty in harmonization between all regional and national databases, the recommended strategy for this database is to be based on an accessible, simple and user-friendly approach, yet with sufficient information to be provide the essential data for the IKB scoreboard.

The database will form part of a **platform** consisting of the database itself, whose outputs will be available on an attractive, user-friendly web portal.

This platform will be developed considering EU countries, however the structure proposed takes into account the development of a future international IKB database.

4.2 Ownership

The implementation of a standardized long-term database will require a **high-profile institution**, with excellent relations with key stakeholders (governments, public institutions, NGOs, international agreements, etc.) and outstanding networking skills. The database owner does not require understanding in database management as this component may be subcontracted. However, the database owner should have top organization skills to ensure reporting and distribution of IKB information and events, reinforcing the importance and need of such a database and raising awareness for more contributors to submit data.

This owner should not be dependent or part of a short-term project, but instead be part of a well-established entity to guarantee the long-term management of an IKB database, providing input for other national /international reports and/or scoreboards (e.g., IKB Scoreboard).

4.3 Roles and responsibilities

The **Owner** will nominate a **Data Base Administrator** (from this point on referenced as DB Admin) that has full control over the database and registered users. DB Admin is supported by a **maintenance team** (maintenance officer(s) appointed by Owner of the DB Admin), to approve IKB cases on the database and solve technical issues that arise from data insertion or platform problems/updates.

The DB Admin does not need to provide data, as the database receives information on IKB cases from several registered **contributors** or **partners**. These **contributors** may be institutions such as Public Agencies, NGOs, Law Enforcement Agencies, Academic Institutions, Consultancies or Researchers.

Ideally contributors should be connected to a Regional or National **Partner** nominated/approved for each country or region by the DB Admin. These partners must be high level institutions such as Public Agencies or International/National well-established NGOs. Partners can insert and/or upload data own data and also data received from registered contributors. Partners also identify possible local contributors and validate local IKB cases (e.g., unreliable IKB case information or sensitive court cases that should not be public). As not all information should be accessible to the general public, and also taking into account the need to comply with General Data Protection Regulation (GDPR) data.

Registered contributors can submit and edit their own data directly or submit them to Regional or National Partners who can be responsible for submitting and editing all the data on a regional or national level.

The general public will be invited to consult the database through the web portal. Users will not be allowed to upload information, but can however view low level IKB case information (e.g., by country or IKB motive, etc.).

4.4 Data fields

Regarding the data fields, the database was structured to provide information / outputs for the IKB Scoreboard.

The data structure is oriented to **cases**, meaning the central focus is a case to which the remaining fields are related to.

If datasets are inserted regularly for each country, it will be possible to contribute with outputs for the following indicators of the IKB Scoreboard:

- **National monitoring of IKB** - data management of scope and scale of IKB (Number of cases, estimates, trends, prosecuted cases reported, etc)
- **Prosecution and sentencing** – effectiveness of judicial procedures (Source of information, Prosecution Status)
- **Prevention** (Drivers of bird crime).

4.4.1 Inputs

When contributor reports a **case**, this constitutes a record in the database. A case consists of a situation reported or found that can involve one or many birds.
Each case submitted should include at least the following information (if possible):

- Who reported the case (contributor: government authorties, NGO's, law enforcement, etc);
- Case type (e.g., illegal shooting, poisoning, etc.);
- Information about the species involved;
- The number of individuals involved;
- Location (or approximate location);
- Date;
- Information about prosecution and case status (if known).

4.4.2 Outputs

The database can be consulted as responsive web portal, with different privileges and accessibility depending on the role of the user.
There will be a public area, where basic statistics (in the form of maps or charts) will be visible to all users. The public area will not require logging in / or registration on the portal. However, users that chose to register will have access to more statistics and ways to filter the data.

Some examples of statistics that may be presented on the portal for public users, with the suggested data structure are:

- Total number of IKB cases per country;
- Number of IKB cases per year;
- Motivation of IKB cases;
- Family/ species most affected.

The data presented will depended on the desired statistics defined by the user. Some examples of statistics that may be presented on the portal for registered users, with the suggested data structure are:

- Number of IKB cases per country (additionally adding filters by date and / or species and/or case types):
    - Number of IKB cases between two dates/interval in a certain country;
    - Number of IKB cases of a given species between two dates (e.g., number of illegally poisoned Common Buzzards between 2017 and 2018);
- Trends along the time for the number of IKB cases for a given species (also with the possibility of adding filters);
- Number of prosecuted cases or convictions (with the possibility of adding filters).

4.5 Technical Considerations

4.5.1 Requirements

The aim of this platform is to provide an EU IKB database. The data must be, not only easy to access but also easy to input. It must also be possible to add additional data or even update the existing records.

On the other hand, the data must be secured and have automatic backups so it can be easily recovered in case something undesired happens.

There will be a considerable amount of data in the database, meaning that the chosen platform must be scalable to dynamically allocate resources to handle all the data.

Some of the data will be public, some will be available to registered or certified users and some just to the owner. Likewise, some users will be able to add records to the database and a restrict group of users will also be able to manage the meta data and edit previously inserted data.

The database must be available online, so anyone can access it anytime, whether it is to view information or to contribute with new data. In order to read the data from the database in a readable way and using charts or maps to easily interpret the data it is necessary to have a platform that also adapts the information, to show to who is accessing/reading it.

The database must also allow several users to access it at the same time.

In addition to the previous topics, and taking into account the current use of mobile devices such as tablets or smartphones, it is also advisable to have the platform adaptable to the screen size of the device used.

4.5.2 Platform Specification

In order to accomplish the requirements, the platform should consist on a Responsive Web Portal to connect to the database and both should be hosted in a secure Cloud Solution Provider.

The database should consist on a relational database which can handle a big amount of data and can handle concurrent access by multiple users.

A Responsive Web Portal solution to connect to the database ensures continuous connectivity and allows the users to access the platform from a variety of different devices. The responsive design will accommodate the content to fit the screen.

To host the platform, it is advisable to hire a Cloud service to a Cloud Solution Provider, in this way all the management of the hardware, security and scalability would be delivered to the Cloud Solution Provider specialists, without the need of the database owner to have all the hardware and IT know-how/skills “in-house”.

4.5.3 Access Control

To manage the access to the database, the platform must have *Access Control*. This can be done via Role assignment, meaning that each/every user has a role and is allowed (or not) to perform certain actions, whether it is accessing information or statistics or updating data of the database.

On the platform it will be possible to manage user access, making it possible to create and assign users to different roles. The users can then login in the platform via the Web Portal and depending on the assigned role will have access or not to different features.

5 TECNICAL RECOMMENDATIONS

5.1 Generic Recommendations

The proposed technical solution provides an answer to the client, end-user and maintenance requirements. This solution's highest priority is: proper storage of the project data, while maintaining data integrity, assuring scalability, operability, shareability and maintainability. The recommendations will take into consideration not only the pros and cons of technologies, but also other relevant aspects, including:

- Resource availability
  - Availability of specialists for the proposed technology
  - Competition for these specialists' resources
  - Adoption growth in this technology stack
- Timeline
  - How likely is a certain technology to be replaced in the projects time frame by a newer technology? Will this require a major overhaul to maintain software up to date?
- Data requirements
  - Amount of data expected to be inserted per year
  - Scalability of the solution scalable?
  - Backups preventing data loss from malicious actors or catastrophic events
  - Expected load of the system: how many simultaneous users can be expected and how this changes year by year
- Maintenance
  - Keeping system updated preventing virus and exploits from malicious actors
  - Possibility to maintain the software, while in production, with minimal technical support
- Costs
  - Development Costs
  - Licensing Costs
  - Maintenance Costs

5.2 Database Platform Technical Recommendations

Depending on data complexity, data size, users base and how it is expected to be used, the solutions to store data range from the basic spreadsheet to complex distributed relational databases.

These are the main advantages of using Databases compared to Spreadsheets:

- Data Volume - It is possible to use Spreadsheets to store and manage large quantities of raw data. However, as the data volume increases the processing time grows;
- Data Integrity - Data integrity as a process denotes the rules that ensure validity and accuracy of the data in the database. These rules may include unique column names, primary key values, and other logical integrity. For example, it is not possible to delete a row that has any references in other tables. Databases validate the data when it is being inserted and can reject the value if it doesn't correspond to the type of the data in the column. This saves potential errors from happening;
- Data Shareability - Database management systems let multiple users access and edit data. DBMSs keep logs of every change, which maintains the integrity of the data;
- Data Filtering and Querying - In databases, you can make specific and fast queries without affecting the data using SQL (Structured Query Language).

5.2.1 What is SQL?

Structured Query Language (SQL) is a standard database language extending its functionality to a mature programming language. It's used to maintain, create, update, modify, and manipulate relational databases. It's easy to learn and use, integrating with scripting languages, and managing vast volumes of data. As a massive amount of raw data is being generated, collected, and stored every day, it's crucial to use proper skill set to fetch useful data for various business purposes. SQL is used in modern relational databases not only to help collect and store the data but also to analyse it so teams can make informed business decisions and increase their profits.

5.2.2 What is a SQL server?

SQL Server is a relational database management system (RDBMS) developed and introduced by Microsoft. It includes its SQL language and Transact-SQL (T-SQL), Microsoft's proprietary language with capabilities of exception handling, declaring a variable, and stored procedures. SQL Server Database Engine is the core component of SQL Server responsible for controlling, processing, and securing the data storage. The database engine is divided into two segments, the relational engine, which is used to process commands and queries. The second is the storage engine designed to manage various database features such as tables, pages, files, indexes, and transactions.

Taking into consideration recent surveys, two major suppliers of SQL solutions stand out, Oracle and Microsoft. Both have enterprise paid solutions and limited use free solutions (Oracle: MySql, Microsoft:SQLExpress).

5.3 User interface platform recommendation

In terms of technologies, Oracle as well as Microsoft provide the most common concurrent solutions. Java as well as ASP.Net have been around for multiple years and have been upgraded regularly with new features and enhancements. Other technologies exist, but at this point, considering maintenability, and a larger pool of resources to develop and maintain the project, only these two will be considered and detailed:

JAVA is a widely used object-oriented programming language and software platform that runs on billions of devices, including notebook computers, mobile devices, gaming consoles, medical devices and many others. The rules and syntax of Java are based on the C and C++ languages.
Java is a technology consisting of both a programming language and a software platform. To create an application using Java, downloading the Java Development Kit (JDK) is required, which is available for Windows, macOS, and Linux. The code is written in the Java programming language, then a compiler turns the program into Java bytecode—the instruction set for the Java Virtual Machine (JVM) that is a part of the Java runtime environment (JRE). Java bytecode runs without modification on any system that supports JVMs, allowing Java code to be run anywhere.

Platform scalability is a key attribute of Java. With Java, it is possible to use one single system across a broad range of use cases. Existing desktop applications can be easily adapted to run on smaller devices that have limited resources. You can also migrate applications from mobile to desktop, developing business apps for the Android platform and then integrating them into your current desktop software, bypassing lengthy and expensive development cycles.

Java has also been proving its ability to adapt to new use cases. For example, Java is widely considered to be an ideal platform for the Internet of Things (IoT). The typical IoT application interconnects a large number of disparate devices, a task that is greatly simplified by the fact that billions of devices run Java. Furthermore, Java's extensive ecosystem of developers is constantly developing and sharing new libraries with functionality specifically targeted at IoT application development.

ASP.NET is an open source, server-side web application framework created by Microsoft that runs on Windows and was started in the early 2000s. ASP.NET allows developers to create web applications, web services, and dynamic content-driven websites.
One of the major concerns about ASP.NET was its lack of flexibility in terms of running platform, so Microsoft created ASP.NET Core. ASP.NET Core is a new version of ASP.NET that runs on every major computing platform, including Windows, MacOS and Linux. Like ASP.NET, it is open source, created by Microsoft and allows developers to create web applications, web services, and dynamic content-driven

websites.
ASP.NET Core released its latest version in November 2021, ASP.NET Core 6, which is Long Term Support (LTS). According to the Microsoft, the quality of all releases is the same, the only difference is the length of support. LTS releases get free support and patches for 3 years.
There are plenty of good reasons to use ASP.NET when developing a website or an application. High speed, low cost, and vast language support are among the most significant benefits. The popularity of ASP.NET makes online resources and skilled developers easy to find.
Websites and applications built with ASP.NET can be faster and more efficient than a website build with PHP, for example. ASP.NET applications are compiled, which means the code is translated into object code, which is then executed. This compilation process takes a small amount of time, but happens only once. After compilation, the code can be executed over and over by the .Net platform very quickly.
Interpreted code is not directly executed by the machine, but must be read and interpreted each time before being executed. Compiled code is usually faster and more scalable than interpreted code, and can do anything interpreted code can do. Examples of interpreted languages include PHP, JavaScript and Ruby.
Software cost is an important factor when developing a website. Websites require web application server software and a hosting server. Most ASP.NET applications use Microsoft IIS (Internet Information Server). IIS is available for all versions of Microsoft Windows at no additional cost. Windows hosting servers are usually more expensive than comparable Linux servers, which are commonly used to run PHP, JavaScript and Ruby applications. However, with the release of ASP.NET Core in 2016, ASP.NET applications are no longer reliant on IIS and can now be hosted on Linux and MacOS as well as Windows.
ASP.NET is written using Object Oriented Programming languages such as C# or VB.net. Object Oriented Programming provides a framework and patterns for code organization and reuse. While VB.net is a holdover from Microsoft's legacy Visual Basic product and has largely fallen out of favor among developers, C# is a first class programming language and consistently ranks among the worlds most in-demand and most-used programming languages.
Finally, even though ASP.NET is open source and free to use, it is actively developed and supported by the world's largest software company, Microsoft. Microsoft has heavily invested in their development platforms, their developer community, and supporting the software companies use to run these applications. This means there is no worry about this software choice becoming deprecated any time soon.
As a whole, ASP.NET is a great framework to use when developing web sites and web applications. It is reliable, fast, easy to use, free and widely known. ASP.NET gives the developer full control of the development and can be used on any project, big or small.

C# (pronounced "See Sharp") is a modern, object-oriented, and type-safe programming language. C# enables developers to build many types of secure and robust applications that run in .NET. C# has its roots in the C family of languages and will be immediately familiar to C, C++, Java, and JavaScript programmers.

C# programs run on .NET, a virtual execution system called the common language runtime (CLR) and a set of class libraries. The CLR is the implementation by Microsoft of the common language infrastructure (CLI), an international standard. The CLI is the basis for creating execution and development environments in which languages and libraries work together seamlessly.
Source code written in C# is compiled into an intermediate Language (IL) that conforms to the CLI specification. The IL code and resources, such as bitmaps and strings, are stored in an assembly, typically with an extension of .dll. An assembly contains a manifest that provides information about the assembly's types, version, and culture.
When the C# program is executed, the assembly is loaded into the CLR. The CLR performs Just-In-Time (JIT) compilation to convert the IL code to native machine instructions. The CLR provides other services related to automatic garbage collection, exception handling, and resource management. Code that's executed by the CLR is sometimes referred to as "managed code." "Unmanaged code," is compiled into native machine language that targets a specific platform.
Language interoperability is a key feature of .NET. IL code produced by the C# compiler conforms to the Common Type Specification (CTS). IL code generated from C# can interact with code that was generated from the .NET versions of F#, Visual Basic, C++. There are more than 20 other CTS-compliant languages. A single assembly may contain multiple modules written in different .NET languages. The types can reference each other as if they were written in the same language.
In addition to the run time services, .NET also includes extensive libraries. These libraries support many different workloads. They're organized into namespaces that provide a wide variety of useful functionality. The libraries include everything from file input and output to string manipulation to XML parsing, to web application frameworks to Windows Forms controls.

The comparison between Java and .NET is a difficult one. Salary ranges from developers don't differ more than 3%, and both technologies are broadly used in enterprise development and web applications.

5.4 General Platform Storage

In order to have a platform available on the internet, there are three main options regarding the hosting:

- Self-Hosting by the company's IT department
- Cloud Computing by a major cloud hosting service provider (Google, Amazon, Microsoft)
- Cloud Computing by a smaller sized cloud hosting service provider.

The choice must be made considering several inputs such as:

- Size of the database
- Number of visitors
- Number of concurrent users
- Allocated memory
- Storage space
- If there is an available internal IT department that can perform the job

5.4.1 Self-Hosting

If the company has an internal IT department, and has technical capabilities of assuring the service, including threat handling, and remote automatic backup systems, then this option incurs minimal costs overhead. As the system scales for more users or more storage space, it is always an option to migrate to a better suited hosting solution.

5.4.2 Cloud Computing (major providers)

Simply put, cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale. Typically, the user only pay for cloud services used, helping lower the operation costs, running the infrastructure more efficiently, and scale as the business needs change.

Cloud computing is a big shift from the traditional way businesses think about IT resources. Here are seven common reasons organizations are turning to cloud computing services:

- Cost - Cloud computing eliminates the capital expense of buying hardware and software and setting up and running on-site datacentres—the racks of servers, the round-the-clock electricity for power and cooling, and the IT experts for managing the infrastructure. It adds up fast;
- Speed - Most cloud computing services are provided self service and on demand, so even vast amounts of computing resources can be provisioned in minutes, typically with just a few mouse clicks, giving businesses a lot of flexibility and taking the pressure off capacity planning;
- Global Scale - The benefits of cloud computing services include the ability to scale elastically. In cloud speak, that means delivering the right amount of IT resources—for example, more or less computing power, storage, bandwidth—right when they're needed, and from the right geographic location;
- Productivity - On-site datacentres typically require a lot of hardware setup, software patching, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals;
- Performance - The biggest cloud computing services run on a worldwide network of secure datacentres, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate datacentre, including reduced network latency for applications and greater economies of scale;
- Reliability - Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network;
- Security - Many cloud providers offer a broad set of policies, technologies, and controls that strengthen your security posture overall, helping protect your data, apps, and infrastructure from potential threats.

There are several Cloud Computing Platforms in the market, being the top three ranking composed by:

- AWS – Amazon Web Services;
- Microsoft Azure;
- GCP – Google Cloud Platform.

In the fourth quarter of 2021, the most popular vendor in the cloud infrastructure services market, Amazon Web Services (AWS), controlled 33 percent of the entire market. Microsoft Azure takes second place with 22 percent market share, followed by Google Cloud with nine percent market share. Together, these three cloud vendors account for 64 percent of total spend in the fourth quarter of 2021. Organizations use cloud services from these vendors for machine learning, data analytics, cloud native development, application migration, and other services.

Comparing the price is not an easy task since each provider has their own services, offers, discounts, and billing. Also a technical expert is required to manage this during project lifecycle, as this is not provided by the cloud computing service providers. Table 1 provides a comparison between cloud providers.

Table 1: Cloud Providers Comparison

	AWS	Azure	Google Cloud
Suite of services	Over 200	Over 200	Over 90
Cloud regions	25	60+	25
Availability zones	81	At least 3 per region	76
Global coverage	245 countries and territories	140 countries	Over 200 countries and territories
Compliance offerings	90 (including security standards)	Over 90	Over 100
Compute	EC2	Azure Virtual Machines	Compute Engine
Relational and non-relational databases	15	10	9
Storage	Simple Storage Service	Azure Blob Storage	Cloud Storage
Hybrid and multi-cloud strategy support	AWS Outposts	Azure Stack	Anthos
IoT	AWS IoT Core	Azure IoT Hub	Cloud IoT Core
Serverless functionality	AWS Lambda	Azure Functions	Cloud Run
Key AI/ML offerings	SageMaker, Amazon Augmented AI	Applied AI Services	Vertex AI, Speech-to-Text, Text-to-Speech, Cloud Translation, Dialogflow
Pay-as-you-go pricing	Yes (plus 12-month Free Tier offers for newcomers)	Yes (plus free credits that equal $200)	Yes (plus free credits that equal $300)

5.4.3 Cloud Computing (small scale providers)

When data, users and server load requirements are relatively light, smaller companies that offer cloud computing and full-service features must also be considered. The running costs of this option are considerably lower than any of the major Cloud Computing service providers. If the project scales at a more mature stage, it remains a possibility to migrate to another service providers that can accommodate the new requirements.

5.5 Full technology Toolset Recommendations

Considering all various aspects of this recommendation, and even though both Oracle and Microsoft solutions are good options for the implementation of this project, one should consider a full toolset from one of these providers. In all aspects both toolsets are quite even. Our suggestion is to use Microsoft Toolset, as .Net has shorter code, which is more readable and maintainable, and in terms of performance, because Java runs on a virtual environment the performance is also slightly worse. Also, the cross-platform benefits of JAVA were not considered to be an advantage for this project. ASP .Net toolset has richer UI tools which is also considered a plus when comparing technologies for this purpose resulting in the following suggestion:

- Development Environment: Linux SO
- Database Engine: SQL Express Server (later can be migrated to SQL Server)
- Development Platform: ASP .Net Core
- Storage Platform: Small Scale Cloud Computing Service providers (later can Migrate to Azure if requirements increase)

6 TECHNICAL IMPLEMENTATION

The following chapter includes the technical approach and design for the proposed platform (database and web portal). The database structure includes five levels, and it is focused on **cases**. This structure is described in detail in the following sub-chapters.

In order to obtain accurate and efficient searches within the platform, it is necessary to establish table relations between the data.

The full list of tables and descriptions is presented in Appendix 1.

6.1 Database structure

6.1.1 Location Management

The database includes information regarding **Case** locations. As mentioned above, it is necessary to have a set of tables related to each other. Location management will include the following structure and table relationships (Figure 4):

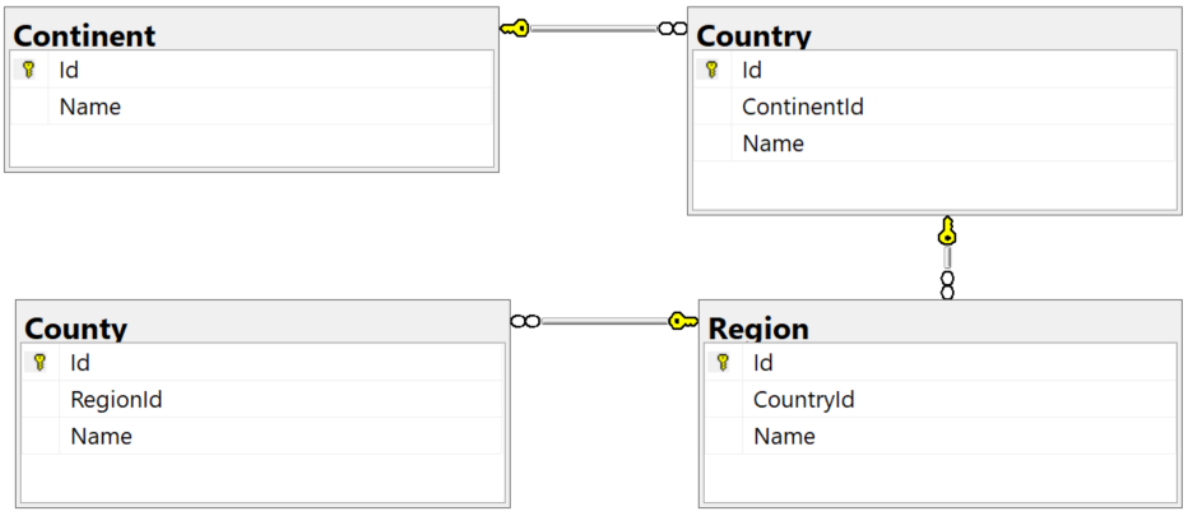

Figure 4: Location Tables

The model will be based on a Country (that belongs to a Continent), and contains two levels of detail "Region" and "County". These major levels were chosen, as different countries have different administrative divisions. Standardized country codes should be used (e.g., ISO 3166-2). This model will make it be possible to filter the same data by any layer of detail.

6.1.2 User Management

In order to successfully manage and access the database, different roles are required. Table 2 shows the content of the User Role table of the database.

Table 2: User Roles

Id	Name	Description
1	Administrator	Appointed by the database owner: Total control over database, data and users
2	Contributor	Includes Government Agencies, NGO's, Law enforcement, Research Institutions, etc.: Insert and edit own data, filter data
3	Maintenance	Nominated by DB Admin: Validates entries/cases, data and users
4	Registered user	Filters and consults data

There will be an **Administrator** (DB Admin) which has full control over the database, this role will be appointed by the Owner of the database. A user with this role is allowed to create new records, update existing ones and even delete data from the database. This user is also allowed to update the meta data tables of the database.

The database will receive data/records from several users of multiple Contributors or Partners. These users are collaborators/employees of partner or contributor institutions that will compile data from their Countries. These users belong to a role called **Contributor**. After uploading or manually inserting data in the database, it will not be immediately visible in the platform as, it will require validation from the DB Admin.

Data uploaded by contributors, may be validated by a user nominated by the DB Admin with a role called **Maintenance**. This user will validate entries/records and users on a regular basis.

In the Portal there will be an option to Register User. Registered Users, will be approved by the DB Admin (or nominated partner). A Registered User will have access to more statistics and information than a Public User. This user will be in the database as a **Registered User**.

Each partner or Contributor, will also be registered and associated with a given institution and country. The Institutions contain Contributors (that are, in fact, Users) that belong to a given Country. These relations are shown in Figure 5.

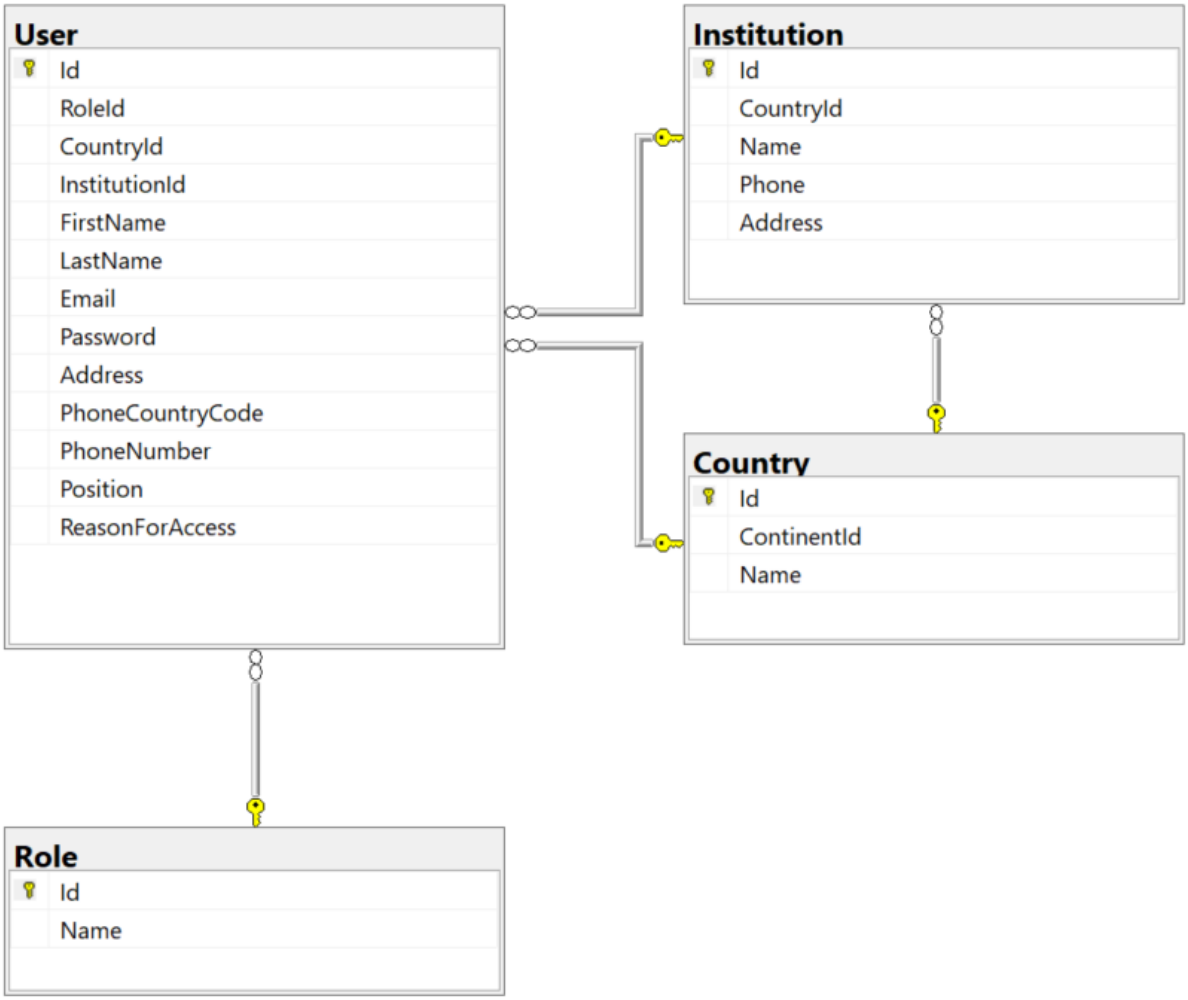

Figure 5: User Tables

At start of the project, the DB Admin or the nominated Maintenance Team will register all the Contributor or Partner Institutions interested in contributing with data (IKB cases) to the database. It will be possible to add New Contributors that arise, or whenever requested. Once a contributor or partner is registered in the database, their participating employees will be able to register in the platform and after submitting the register form, a new record is created in the User table. The new user will be able to access the reserved area of the Portal as soon as the maintenance team validates this user.

6.1.3 Species

In order to have relevant information on the Species involved in the IKB case and to be able to attend several levels of detail the structure follows the scheme presented in Figure 6:

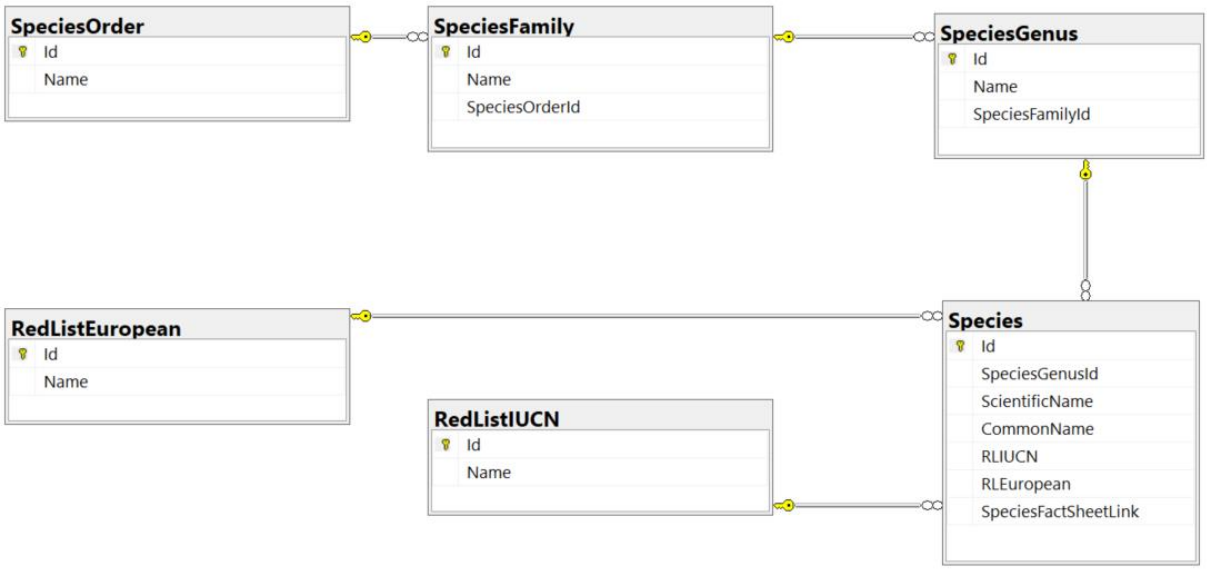

Figure 6: Species Tables

The data base structure will include the taxonomic system, including the following hierarchy levels: "*Order -> Family -> Genus -> Species*". If it is not possible to classify a Case to a given "Species", the next higher hierarchy level identification possible must be used.

Species level will include table relations with IUCN Red List and European Red List (see Table 3), in order to be able to filter cases based on species conservation status (for example: "All IKB cases of "Vulnerable" Birds in a given Country"). Red Lists Status and taxonomic list (e.g., Species Scientific names) will be maintained and updated periodically by the Maintenance team, nominated by the DB Admin. These updates are particularly important to cope with taxonomic updates and reviews on conservation status

Taxonomic lists should follow Birdlife International Taxonomic Checklists most current updated version (see http://datazone.birdlife.org/species/taxonomy)

To allow the users of the platform to read more about each Species, the table includes a *SpeciesFactSheetLink* field which can be updated by the Maintenance team and can contain a link to a Species Fact Sheet. This could contain the link from Birdlife Fact Sheet Website (e.g., http://datazone.birdlife.org/species/factsheet/peregrine-falcon-falco-peregrinus, Figure 7) or the IUCN Website (e.g., "https://www.iucnredlist.org/species/45354964/206217909)".

6.1.4 Cases

As mentioned before, the database structure's core element is a given Case, for each case there are several table relations (e.g., prosecution status, species, country, and more; see Figure 8).

Table 3: Red List Categories

IUCN Red List Categories	
Id	Name
1	Extinct (EX)
2	Extinct in the Wild (EW)
3	RE (Regionally Extinct)
4	Critically Endangered (CR)
5	Endangered (EN)
6	Vulnerable (VU)
7	Near threatened (NT)
8	Least Concern (LC)
9	Data Deficient (DD)
10	Not Evaluated (NE)

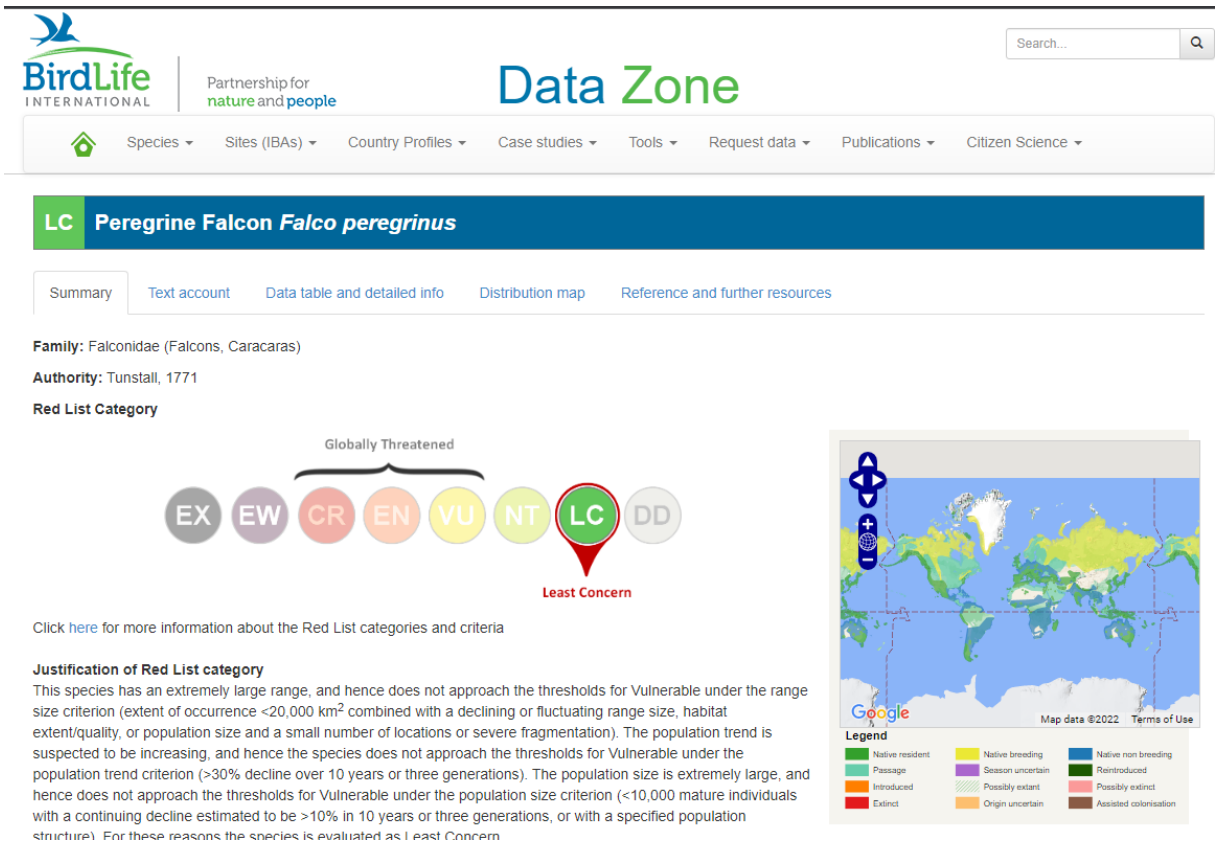

Figure 7: Screenshot of BirdLife International's species factsheet

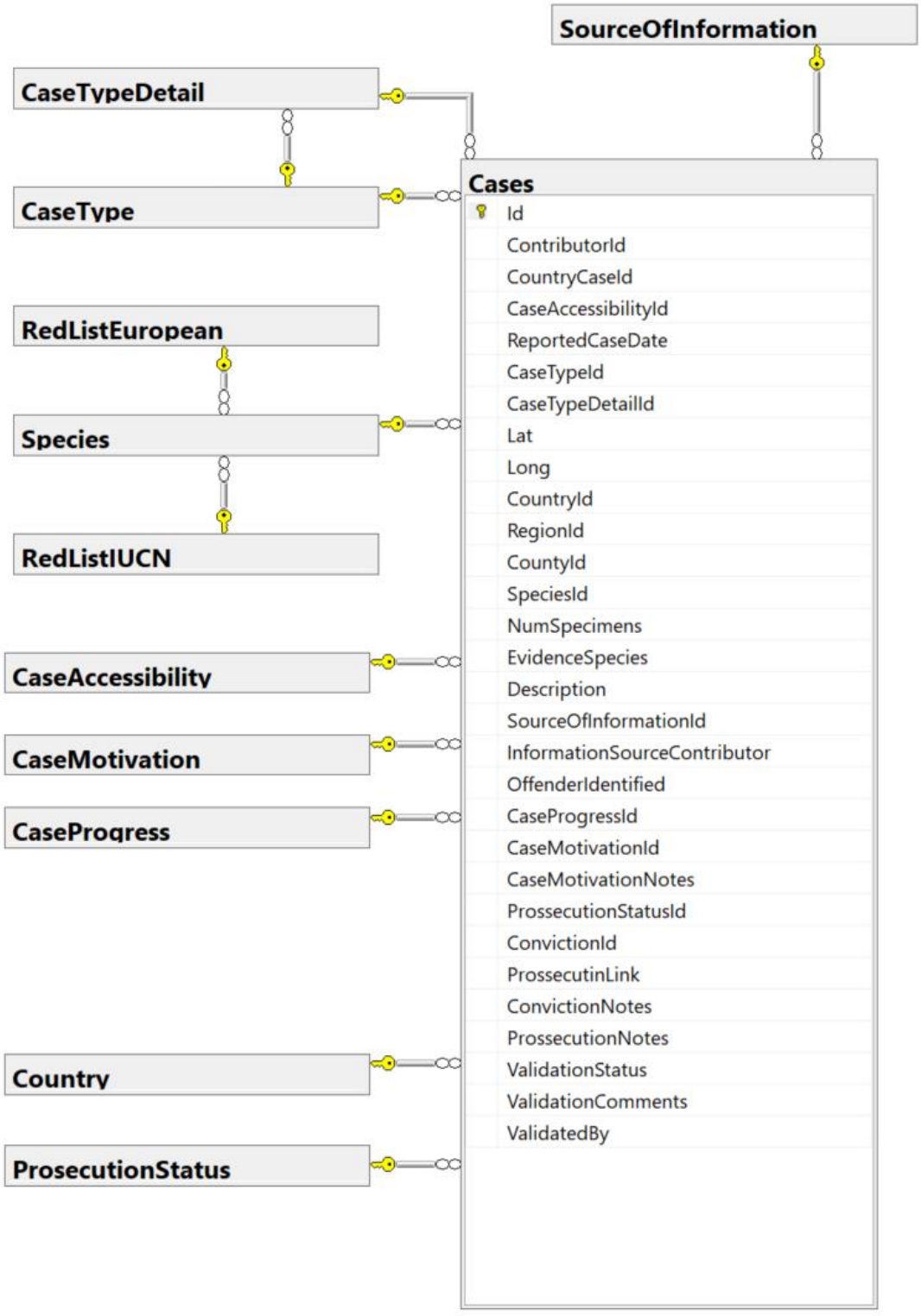

Figure 8: Cases and related tables.

Table 4 contains all the case fields / information reported by the Contributors, and the respective data types (integer, date, float and text).

Table 4: Cases.

Column	Data Type	Description
Id	Int	Unique reference. Auto-generated
Contributor Id	Int	Reference to User table. References the person that inserted the data.
Country Case Id	Int	National Case Id, if exists
Case Accessibility Id	Int	Reference to Case Accessibility table
Reported Case Date	Date	Date of the Case
Case Type Id	Int	Reference to Case Type table
Case Type Detail Id	Int	Reference to Case Type table
Lat	Float	Latitude of the case
Long	Float	Longitude of the case
Country Id	Int	Reference to the Country table
Region Id	Int	Reference to the Region table
County Id	Int	Reference to the County table
Species Id	Int	Reference to the Species table
Num Species	Int	Number of Species of the case
Evidence Species	Bit	If only evidence (remains) were found
Description	Text	Description of the reported case
Source Of Information Id	Int	Reference to Source Of Information table
Information Source Contributor	Text	Information of who reported the accident
Offender Identified	Bit	Was a Suspect/offender identified responsible for the IKB / Case/incident?
Case Progress Id	Int	Reference to Case Progress table
Case Motivation Id	Int	Reference to Case Motivation table
Case Motivation Notes	Text	Additional information related to "other /unknown drivers of IKB"
Prosecution Status Id	Int	Reference to Prosecution Status table. Identification of a conviction
Conviction Id	Int	Reference to Conviction table.

Column	Data Type	Description
Prosecution Link	Text	Link to the prosecution/sentencing information
Conviction Notes	Text	Notes about the Conviction
Prosecution Notes	Text	Notes about the Prosecution
Validation Status Id	Int	Reference to Validation Status table.
Validation Comments	Text	Comments on incident
Validated By	Int	Reference to User table.

The **Case** table (Table 5) includes relations with other tables and is also referenced to other metadata tables such as: Case Type, Source of Information and the Motivation of the IKB Crime.

Table 5: Case Type

Id	Name	Description
1	Illegal shooting	Shooting or attempted shooting incident
2	Illegal poisoning	Poison/pesticide abuse incidents
3	Illegal trapping	Capture of birds with traps, nets, poles, limesticks,etc
4	Nest destruction	Destruction of nests
5	Egg collection	Removal of eggs from nest
6	Other	'Other' persecution incidents
7	Unknown	Mortality caused by unknown incident

The Case type table that includes the indication of the IKB method, includes a second relation to another table "Detailed Case Type" (Table 6). This field includes detailed information on the IKB methods.

Table 6: Detailed Case Type

Id	Name	CaseTypeId	Description
1	Shooting	1	Ilegal hunting, exceeding limit or killed animals, killing protected species, etc
2	Poisoning	2	Use of poision bait; Intentional, Accidental, Substance used
3	Traps (tape lures)	3	Snare/bow traps, Bal-chatri traps, Esh traps, etc

Id	Name	CaseTypeId	Description
4	Limesticks/Glue sticks	3	Illegal trapping with limesticks
5	Nets	3	Illegal trapping with Mist Nets, Eb nets, Clap nets, etc.
6	Nest destruction	4	Pest control, food source.
7	Egg collection	5	Falconry, collections, food source,
8	Other	6/7	Other or unknown

The Case type table also includes reference to another table regarding the Driver or Motivation of IKB (see Table 7).

Table 7: Motivation of IKB.

Id	Name	Description
1	Sport	Driver related to Hunting
2	Food Source	Driver related to Rural poverty, food subsistence or food delicacy
3	Human-wildlife conflict	Driver related to conflicts (e.g., Pest control)
4	Taxidermy	Driver related to taxidermy (and poaching)
5	Other	Driver not listed
7	Unknown	IKB motivation not known

Also linked to each case is the "Source of information" (Table 8), this table includes information regarding "who reported the incident or case".

Table 8: Source of Information

Id	Name	Description
1	Law enforcement	Agencies and employees (e.g., Police, National Guards, etc)
2	Government Authority	Governmental or intergovernmental entity, department, agency, commission or organization
3	NGOS	Non-governmental organization; Conservations groups and partners
4	Wildlife Recovery Centers	Public and/or Private Recovery Centers
5	Other	Other entities, institutions, associations or members of the public

6.1.5 Prosecution and Conviction

The database structure also includes information regarding the Prosecution and Conviction status. For each case, there will be a set of options that can be filled (if known) and updated when there is a change in the prosecution and/or the conviction status. Tables 9 and 10 specify the information required and level of detail.

Table 9: Prosecution Status

Id	Name	Description
1	Yes	People charged with an IKB offence; Yes or No
2	No	No conviction, not charged
3	Unknown	Prosecution status not known/Under investigation
4	Prescribed	

Table 10: Conviction

Id	Name	Description
1	Imprisonment	Case Closed: Imprisonment connected to the incident (additional information: number of years)
2	Fine	Case Closed: Fine connected to the incident (additional information: fine value)
3	Unknown	Conviction not known
4	Other	Sanction, prohibition, suspension (example: loss of permits, hunting prohibition, etc.)

6.1.6 Complete database

In the previous chapters the distinct groups of tables were introduced as independent but in fact the whole database is connected and linked as shown in Figure 9.

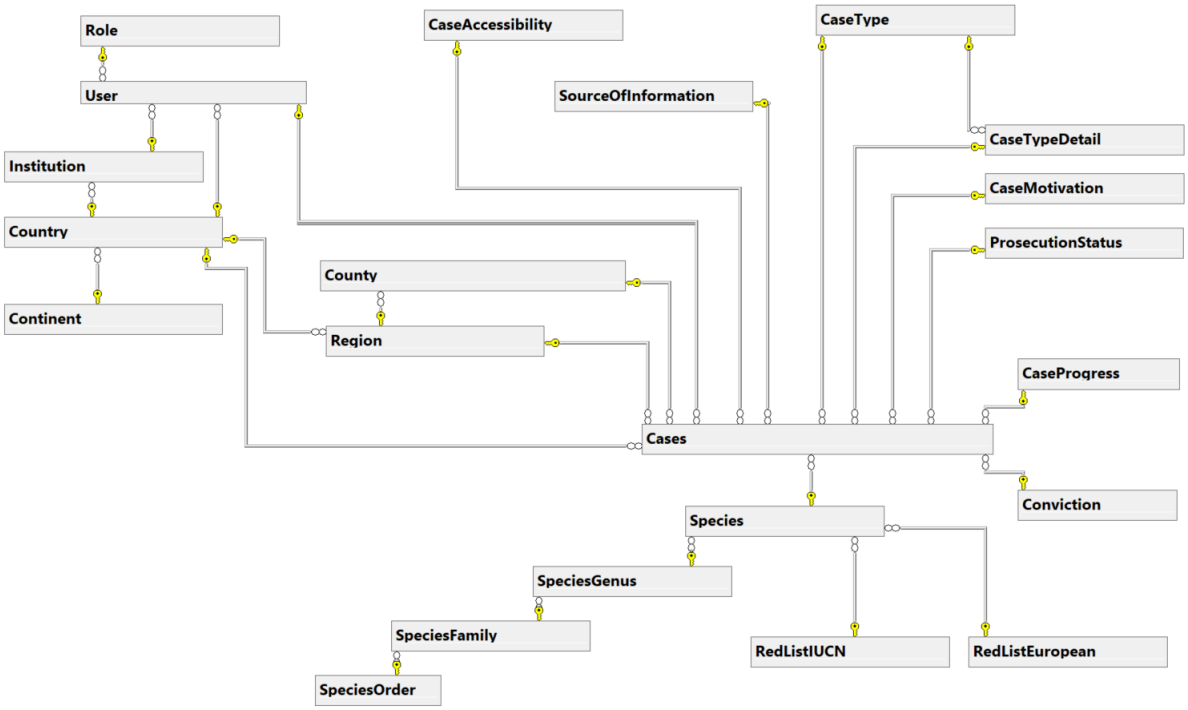

Figure 9: Complete Database

6.1.7 Public Area

The Public Area will consist on a Web Portal with a Home Page, a Registration Page, and Content Pages. This content will be configurable as a CMS (Content Management System) allowing the administrator to change text, images, news, or other content when desired.

The public area should include a page dedicated to presenting the institutions and contributors that contribute/collaborate with IKB information. Each participating partner/contributor will have their logo, title, a small description and contact.

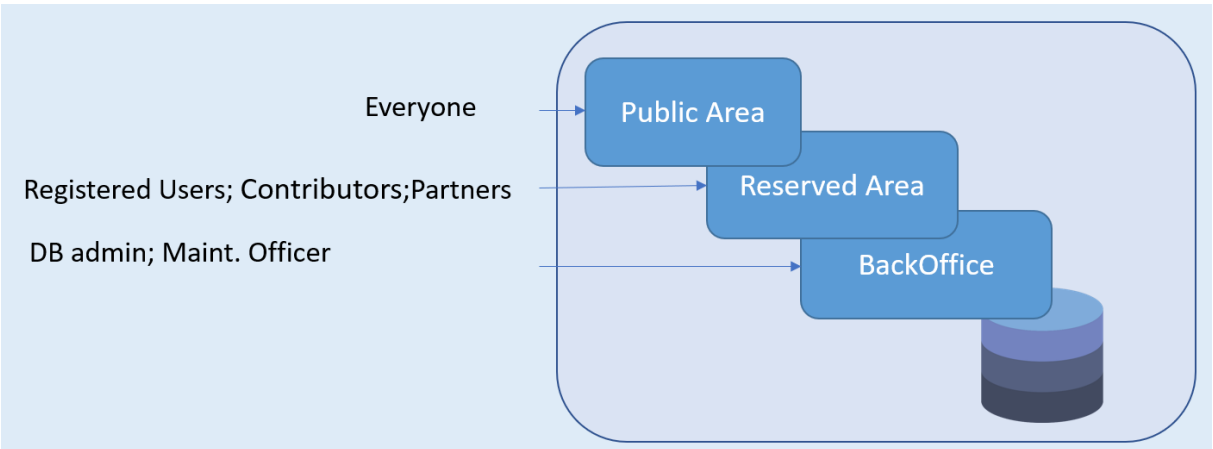

Figure 10: Access Levels.

In the Public Area some statistics will be visible in a read-only mode, meaning that the filtering (of the data) will be disabled.

Example of statistics visible on the Public Area include:

- Map with the number of IKB cases per country;
- Map with the location of the participating institutions;
- Map with the number of IKB cases per year;
- Column chart with number of prosecuted cases per country;
- Column chart with the drivers (motivation) of IKB cases;
- Column Chart with the Family/ Species most affected.

In order to be able to filter data a user must have an account in the platform. To have an account it is necessary to register on the platform. After registering this user will have a "Registered user" Role in the database. To register on the platform, it is necessary to provide user information such as: Name, Email, Institution, Address, position and provide a Reason for database access.

6.1.8 Reserved Area for a Registered Users

When logging in the platform a registered user will access the Reserved Area. This area will include more features.

It will be possible to have access to all the publicly available data in table format with filters so the user can easily access and visualize data. Some statistics will be available with the possibility of filtering by Date, Case type, Species, Country, Contributor Institution, Conservation Status, Prosecution Status and more, depending on the statistic objective or user requirements. Some examples of statistics on the Reserved Area include:

- Map with the Number of IKB Cases per Country (with the possibility of filtering - adding filters by date and / or species and/or case types, Figure 11).

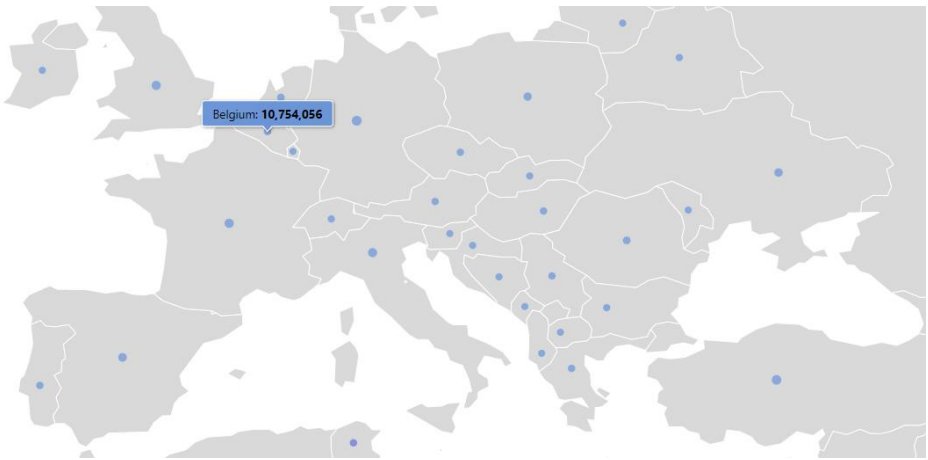

Figure 11: Example of data presentation in the reserved area of the web portal: IKB Cases per Country

- Map with the Location of the Institutions that contribute with information (Figure 12).

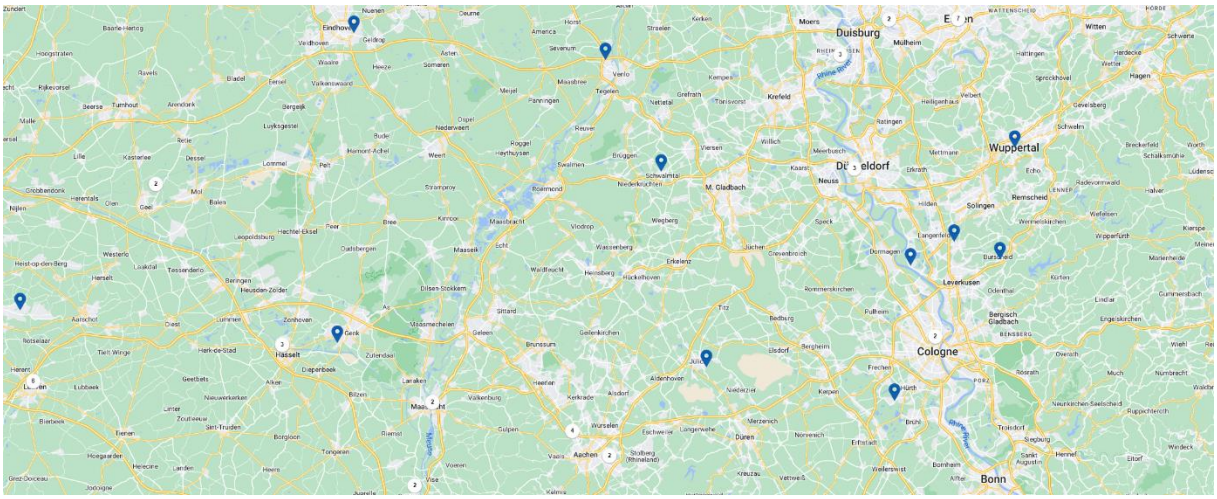

Figure 12: Exmple of data presentation in the reserved area of the web portal: Contributor institutions location.

- Column chart with the Number of Contributions per Institution;
- Pie chart with Number of Cases per Country (Figure 13)- with the possibility of using additional filters/queries;

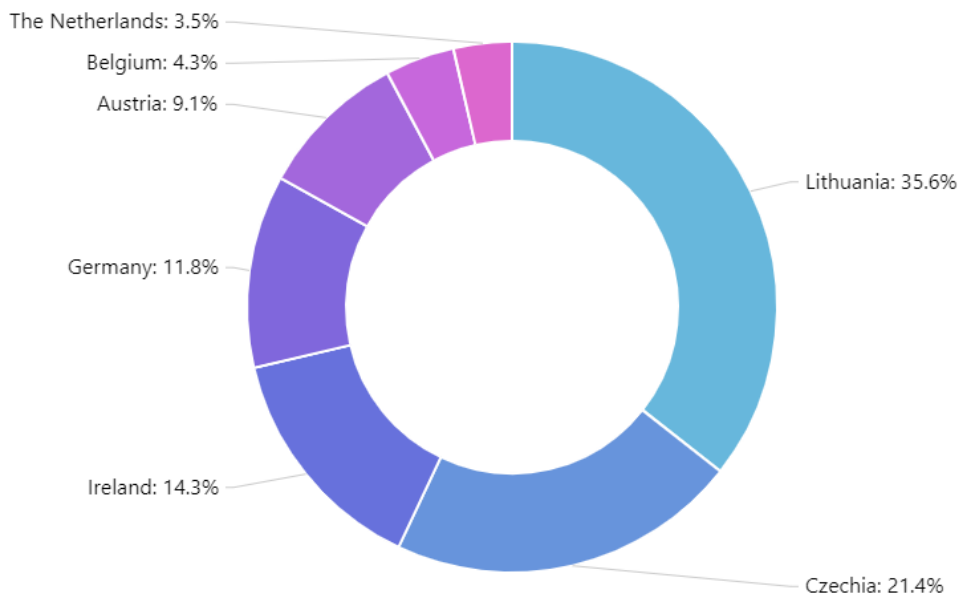

Figure 13: Example of data presentation in the reserved area of the web portal: IKB Cases per Country Pie Chart.

- Number of IKB cases per Species by date (Figure 13) with the possibility of using additional filters/queries);

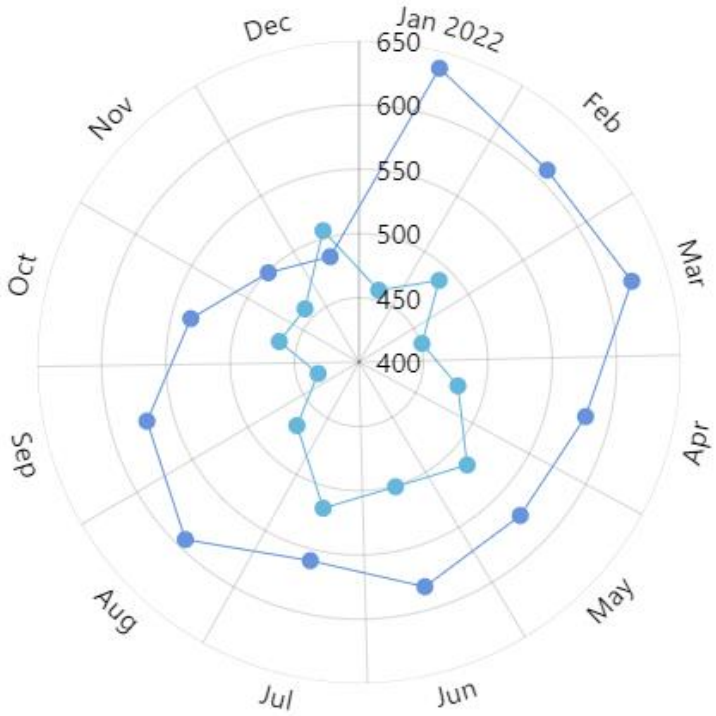

Figure 14: Example of data presentation in the reserved area of the web portal; IKB Cases per Species by Date.

- Number of cases per species(Figure 15), including **species** trends with the possibility of using filters/queries.

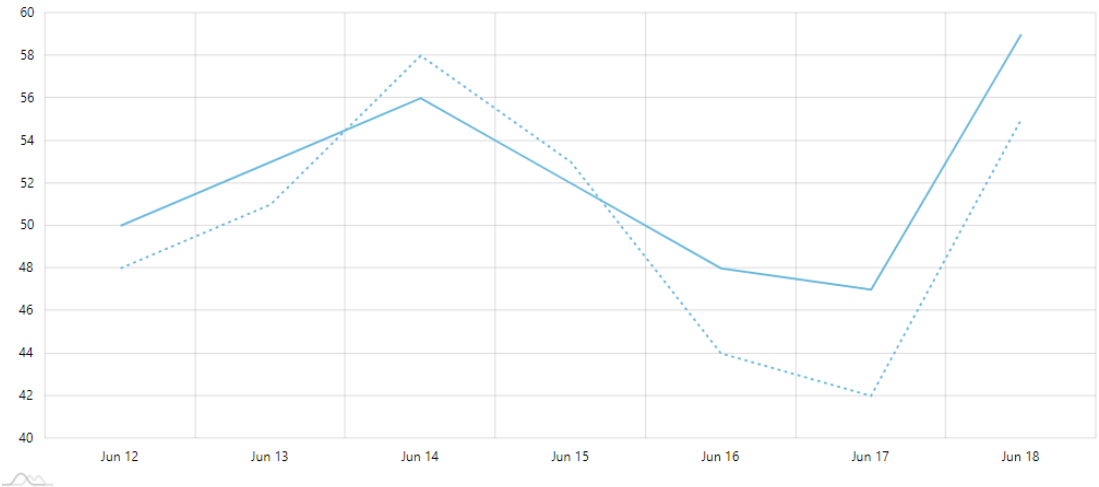

Figure 15: Example of data presentation in the reserved area of the web portal: IKB Cases Trend.

6.1.9 Reserved Area for a Contributor User

A Contributor User can achieve this Role by direct invitation from the DB Admin or by submitting a request via the Web Portal. This request depends on the approval by the DB Admin.

A Contributor User will have all the permissions of a Registered User and will also be able to upload data and request changes to previously uploaded/existing data.

There will be two possibilities to upload data to the database: i) The first is manually submitting a form for each reported case and ii) the second one, via an excel file, that is more recommended for cases where it is necessary to upload several records.

6.1.9.1 Forms

To upload data manually a set of forms (Figure 16) will be available to allow the user to insert the complete data of the case.

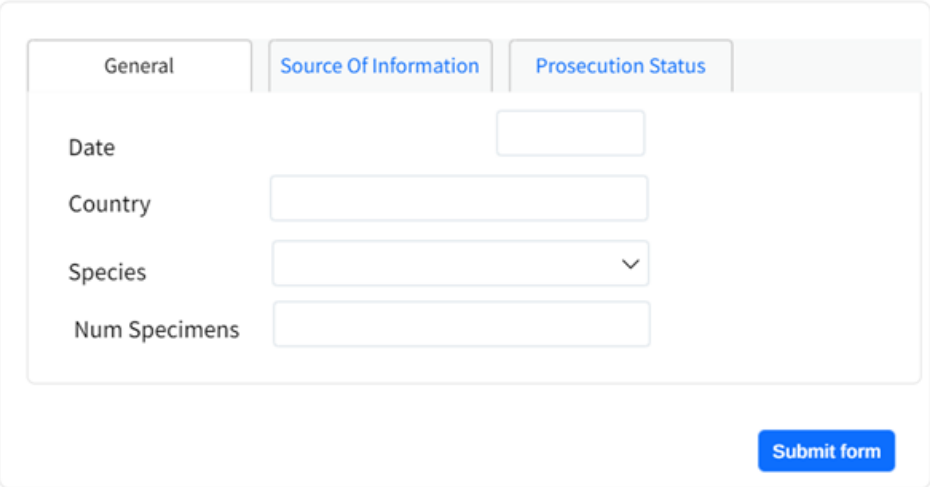

Figure 16: Upload form example.

6.1.9.2 Bulk Upload

To upload data in bulk, the Reserved Area will have a pre-configured Excel file available for download. This Excel file will be pre-configured with the structure needed to upload data to the database. The Contributor must download the file, fill it with data and upload again to the platform.

By uploading the file, the platform will upload the data to the database making it available for the owner to approve. If approved, the new data will be part of the database and available for searches/further queries and statistics.

6.1.10 BackOffice

The Backoffice can be accessed by two types of users (Roles), both of them part of the Owner structure: DB Admin and Maintenance team.

The Backoffice is where the Maintenance team updates information of the Database or the Web Portal. It will be possible to not only manage the content of the Web Portal, such as texts and images but also

to manage/edit the information of the database, for example approve/ disapprove Contributor, users or the data uploaded waiting for approval.

The DB Admin will also have access to the Backoffice, and consequently to all the data of the database.

6.2 Planning and Tasks Description

Apart from the roles and responsibilities described earlier, in order to develop and implement the platform additional tasks will be performed, requiring specific human resources.

Figure 17 details these tasks as well as the timeline to implement them.

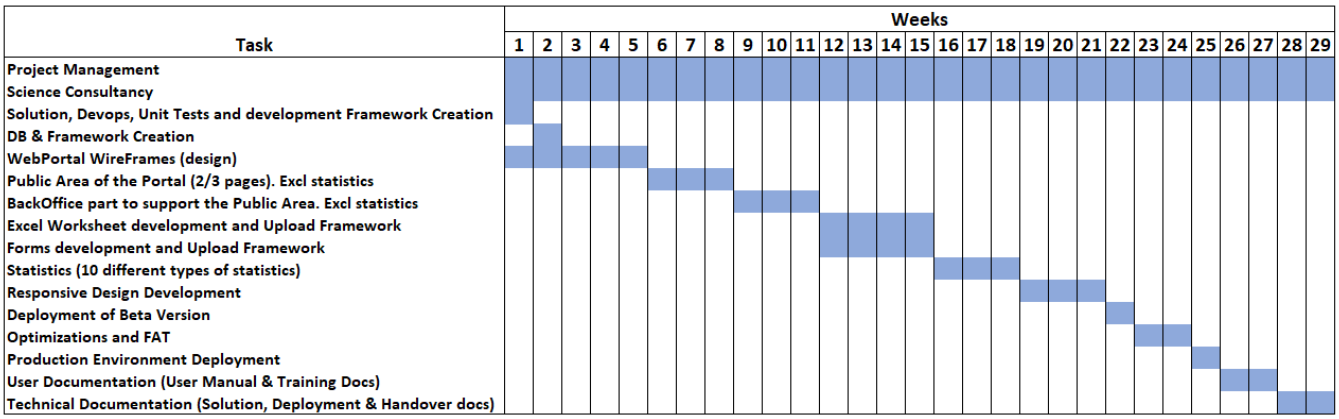

Figure 17: Timeline of tasks to develop and implement the platform.

6.2.1 Project Management

A Project Manager will be responsible for interacting with the development team as well as the client (DB owner) and other stakeholders, assuring the project is delivered on time, on budget and according to specifications. The project manager will also be responsible for quality assurance of the deliverables and approval of project milestones.

6.2.2 Science Consultancy

Throughout the project development an IKB consultant will work with the development team to clarify any outstanding issues.

6.2.3 Development

The development tasks will be performed by a team of two engineers. A Senior Software Engineer, with the role of Technical Lead will perform architecture and technical design decisions, as well as development and supervision of a Junior Software Engineer tasked with implementation of code, unit

tests and also integration tests of each development task. This team will also produce documentation of the project, namely, user manual and training materials as well as all technical documentation required for a proper handover of the project.

6.2.3.1 Solution, DevOps, Unit Tests and development Framework Creation

This task includes all the preparation work and configuration of the development environment, compilers, and tools required for the development process.

6.2.3.2 DB & Framework Creation

This task includes the creation of the database as well as project framework, including architecture of backend.

6.2.3.3 Web Portal Wireframes (design)

This task includes the design of the website, including icons, charting layouts and animations.

6.2.3.4 Public & Private Areas of the Portal

This task includes the implementation of the design in the Private and public areas of the portal the website, including icons, charting layouts and animations.

6.2.3.5 BackOffice part to support the Public Area

This task includes the development of a Content Management System to allow the DB Admin to change the content of the public Area.

6.3 Workflow

In this chapter, the workflow of data insertion in the database is described as an example, detailing the role and responsibilities of the different players in the process. It is also intended to work as a summary of the concepts introduced in this document.

6.3.1 Responsibilities

Here we detail all the users that interact with the platform:

- Database Owner: Institution that owns the platform.
- Database Admin: User(s) nominated by the Owner Institution that has full privileges over the database.
- Contributor: Institution that owns and shares data.
- Partner: National or regional institution which is can act as a Contributor, but who also challenges other Contributors to share their data directly or through the Partner.
- Maintenance Officer: User(s) nominated by the Owner institution who have permissions to update data of the database. One of the most important activities of this user is to Approve data uploaded from Contributors / Partners.

- Registered User: A registered user is someone that does not play any contribution role for the platform. It is an interested person who registered in the platform. After registering, this user will be able to access statistics and to filter them.
- Public User: A public user is someone who only accesses the public part of the platform.

6.3.2 Platform Access Layers

As previously described, there are three main layers in the Platform:

- Public Area: Everyone can access it. It is a Web Site on the Internet. It has some content describing the Platform and the benefits of having such a Database as well as some basic statistics;
- Reserved Area: Everyone can access it, but in order to do so, it is necessary to register in the platform. Also, the Contributors and Partners will have access to it. This area contains more statistics than the Public Area and offers the option to filter data in the statistics;
- BackOffice: Only users that belong to the Owner Institution or nominated by them (DB Admin / Maintenance Officer) can access it. In this area it is possible to change the public content of the platform as well as to upload and update data from the database.

6.3.3 Data Contribution

There are several ways to insert data in the database. In the following chapter each one of them is described. Figure 18 illustrates the process of data contribution.

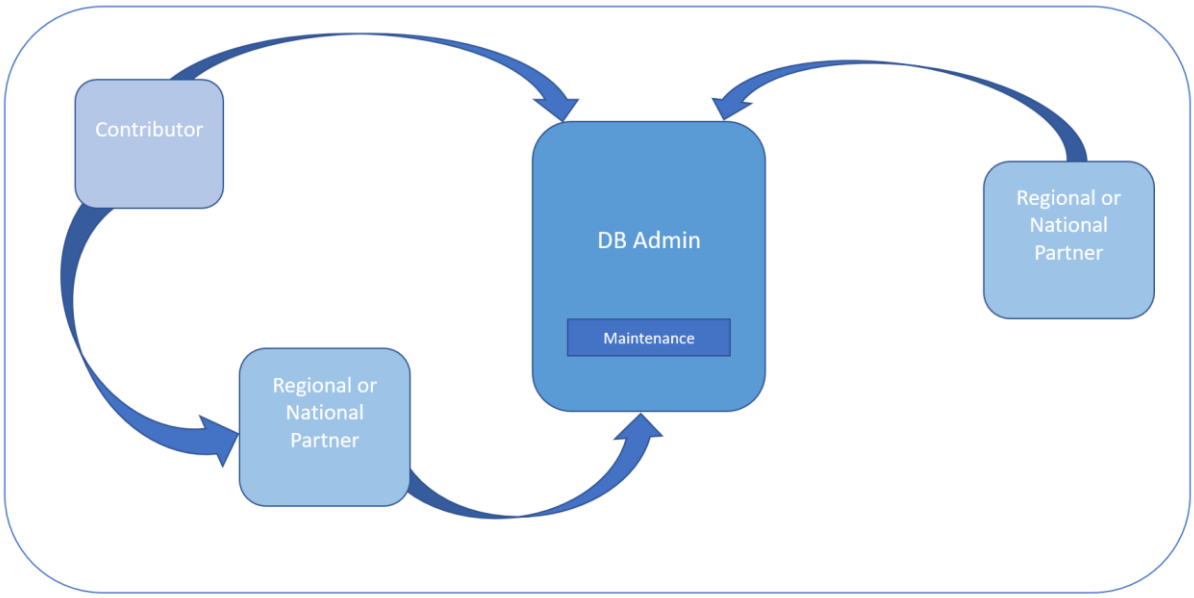

Figure 18: Data Contribution.

6.3.3.1 A Contributor inserts data directly

A Contributor can achieve its role by direct invitation from the Owner Institution or request via the portal. After becoming a Contributor this user is allowed to contribute via the Portal (Figure 19).

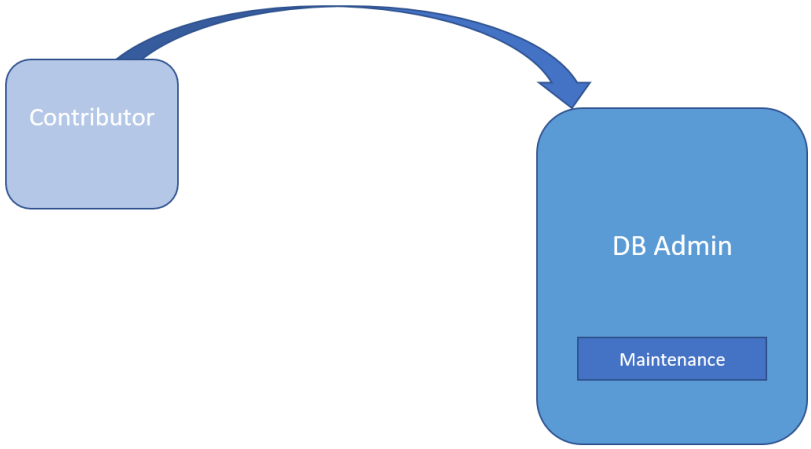

Figure 19: Contribution directly from a Contributor.

6.3.3.2 A Contributor provides data via a Partner

Some Institutions may have information regarding IKB but are not interested in sharing it directly or do not have the means to do so. These data may be shared with a Partner who can contribute the data to the database.

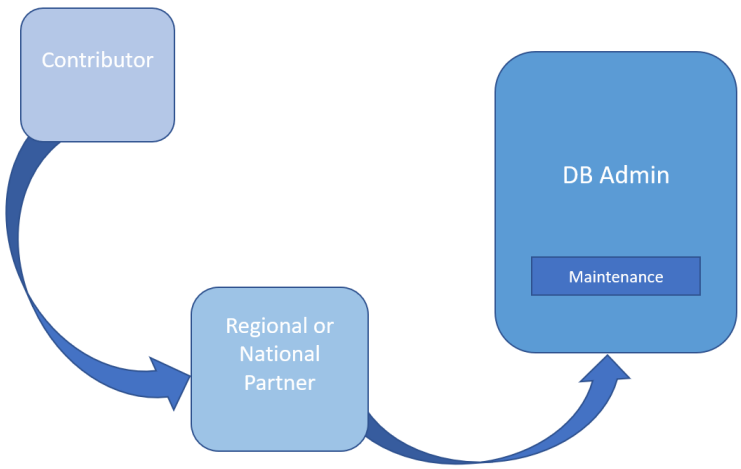

Figure 20: Contribution by a Contributor via a Partner.

6.3.3.3 A Partner Contributes directly

The Partner itself may have important data to contribute. When it occurs, the Partner will access the Private Area of the Platform and Contribute directly (Figure 21).

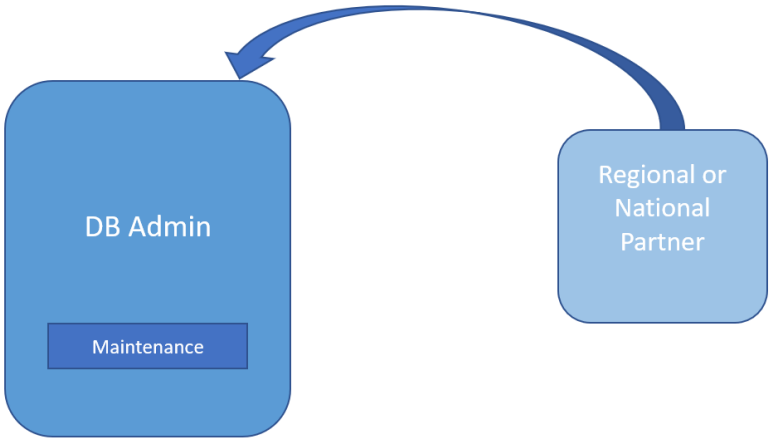

Figure 21: Contribution by a Partner.

6.3.3.4 The Contribution

Accessing the Reserved Area, the contribution can occur in one of two ways:

- Via Forms: manually filling the online forms;
- Via Spreadsheet: Downloading a sample template, filling it with adapting the format, and uploading in the Reserved Area.

After Contributing, the data will be in the database waiting for approval.

6.3.4 Data Approval

This Chapter describes how the data can be approved and, consequently, be part of the data shown in the statistics.

After a Contributor / Partner contributes data to the platform, the data will be in a state “Waiting for Approval”, which means that the data exists on the database but it is not shown in the Public or the Reserved area and it is not considered in any statistic. Only users from the Owner Institution (DB Admin / Maintenance Officer) may access this data.

After insertion, the Maintenance Officer will access the BackOffice and check for data to be approved. If the Maintenance Officer confirms the data is correct, this data will be approved and will become available in the platform. If not, the contributor will be contacted to have a chance to provide the appropriate corrections.

7 FINANCIAL CONSIDERATIONS

7.1 Implementation costs

In order to develop this platform some players with different roles and actuation areas should be involved as well as software development licenses.

- Project Team:
  - Project Manager
  - UI-UX Designer
  - Senior Full-Stack Developer
  - Junior Full-Stack Developer
  - Scientific Consultant
- Software Development Licenses
  - SQL Server License (Lifetime)
  - Charting & Mapping Library

The implementation of the platform, depending on some fine-tuning decisions (e.g., what statistics will be available, what charts and maps will be used), may take around 29 weeks to develop. The costs estimate for the implementation is detailed in Table 11:

Table 11: Implementation Costs.

Description	Cost estimate (€)
Platform Development	[90 000 : 120 000]
Licenses	[4 000 : 6 000]

7.2 Operational costs

When the database is made available to the public, several operational costs must be covered to ensure undisturbed operation at the IT level, but also in terms of the network of contributors and users that interact with the database.

7.2.1 Management and networking costs

During operation, an active maintenance of the network that feeds the database is required. It is foreseeable that this activity requires a part-time dedicated person to contact the various contributors and to pursue new institutions that could collaborate as contributors, new collaborations, new

applications and new consumers of the database capabilities. A cost estimate for these activities is is detailed in Table 12.

Table 12: Management and Networking Costs

Description	Cost estimate (€/year)
Platform Promotor (part-time)	[15 000 : 25 000]
Travelling and Subsistence	[10 000 : 20 000]

7.2.2 Maintenance costs

During operation, the IT infrastructure must be maintained, therefore a Hosting service must be contracted, which includes:

- Hosting Services
  - Web Portal hosting with public access
  - Database hosting
  - Infrastructure Updates
  - Weekly Backups
- Yearly Licenses
  - Web Domain
  - SSL certificate

The inputs and contents of the database must be reviewed and approved by the Maintenance Officer, with an estimated part-time dedication to this task. The annual cost for these activities is detailed in Table 13.

Table 13: Maintenance Costs

Description	Cost estimate (€/year)
Hosting & Yearly Licences	[400 : 800]
Maintenance Officer	[10 000 : 2 000]

7.3 Total costs

In this chapter we present a summary of all the estimated costs (Table 14) presented in the previous chapters, as well as an estimate of the first (Table 15) and the following years' costs (Table 16).

Table 14: Totals costs

Description	Description	Cost estimate (One time)	Cost estimate (€/year)
Implementation	Platform Development	[90 000 : 120 000]	-
	Licenses	[4 000 : 6 000]	-
Management & Networking	Platform Promotor (part-time)	-	[15 000 : 25 000]
	Travelling and Subsistence	-	[10 000 : 20 000]
Maintenance	Hosting & Yearly Licences	-	[400 : 800]
	Maintenance Officer	-	[10 000 : 20 000]
Total		[94 000 :126 000]	[35 400 : 65 800]

Table 15: Costs during the first year.

Description	Description	Cost estimate (€)
Implementation	Platform Development	[90 000 : 120 000]
	Licenses	[4 000 : 6 000]
Management & Networking	Platform Promotor (part-time)	[15 000 : 25 000]
	Travelling and Subsistence	[10 000 : 20 000]
Maintenance	Hosting & Yearly Licences	[400 : 800]
	Maintenance Officer	[10 000 : 20 000]
Total		[129 400: 191 800]

Table 16: Annual costs for the remaining years

Description	Description	Cost estimate (€)
Management & Networking	Platform Promotor (part-time)	[15 000 : 25 000]
	Travelling and Subsistence	[10 000 : 20 000]
Maintenance	Hosting & Yearly Licences	[400 : 800]
	Maintenance Officer	[10 000 : 20 000]
Total		[35 400 : 65 800]

8 TIMELINE

Figure 22 shows the schedule for platform development and deployment activities.

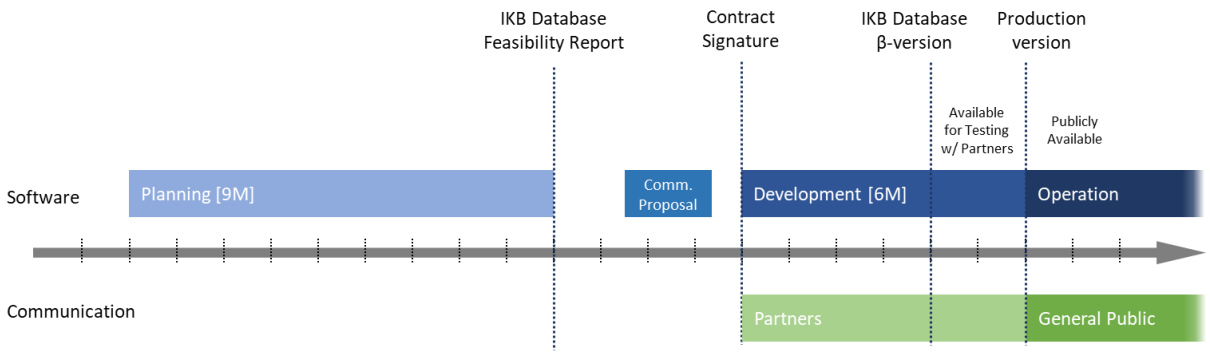

Figure 22: Timeline of the Project

Platform development starts with the planning activity that is concluded after the issuance of the present document. The promoter will start a procurement process to implement the platform in accordance with the requirements stated in the document. In the last phases of development, tests will be performed with the Partners to ensure the platform is working properly and is able to handle the required data volume and number of simultaneous users. After a successful conclusion of all tests, the production version will be made available to the general public with no restrictions.

During this process, the partners should be contacted to prepare their interactions with the database/software, preparing their internal processes and the datasets to be introduced in the database. After the restricted testing phase, as the database/software becomes publicly available, communication and dissemination activities should be performed to ensure the platform reaches its intended audience.

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10 APPENDIX 1 – DATABASE DIAGRAM

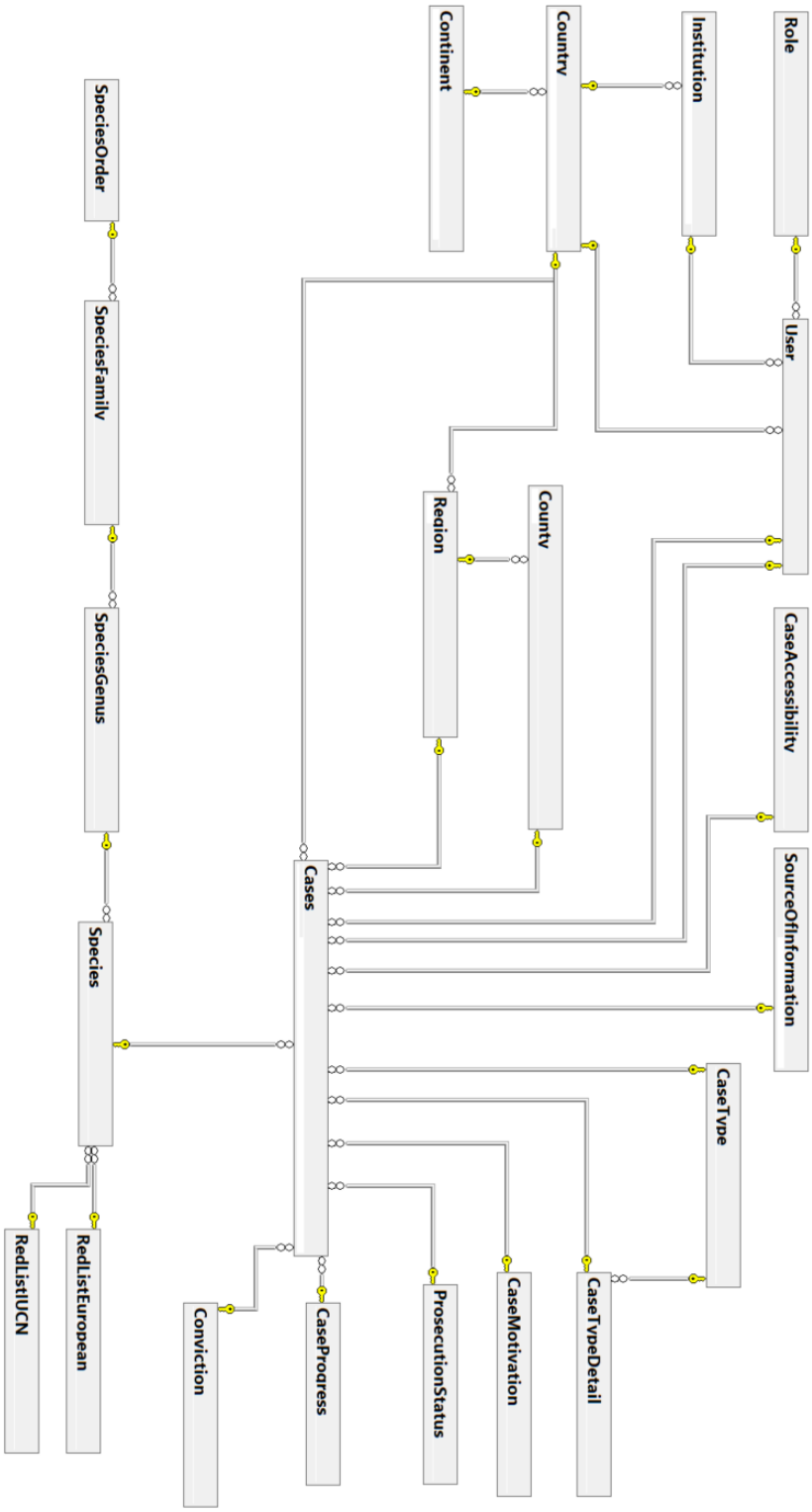

Figure 23: Database Diagram

11 APPENDIX 2 – SUMMARY OF THE TECHNICAL IMPLEMENTATION

Development Environment: Linux SO

Database Engine: SQL Express Server (later can be migrated to SQL Server)

Development Platform: ASP .Net Core

Storage Platform: Small Scale Cloud Computing Service providers (later can Migrate to Azure if requirements increase)

12 APPENDIX 3 – SUMMARY OF DATABASE TABLES

12.1 Location

12.1.1 Continent

Fields	Description
Id	Unique reference. Auto-generated
Name	Continent name

12.1.2 Country

Fields	Description
Id	Unique reference. Auto-generated
Name	
Continent Id	Country where case was reported

12.1.3 Region

Fields	Description
Id	Unique reference. Auto-generated
Name	
Country Id	Region where case was reported

12.1.4 County

Fields	Description
Name	
Region Id	County where case was reported

12.2 User Management

12.2.1 Role

Fields	Description
Id	Unique reference. Auto-generated
Name	

12.2.2 Role Content

Content	Description
Id	Unique reference. Auto-generated
Admin	Total control over database, data and users
Contributor	Insert and edit own data, can filter data
Partner	Insert and edit own data. Insert and filter contributors' data.
Maintenance Officer	Validates entries/cases, data and users
Registered user	Can filter and view data

12.2.3 User

Fields	Description
Name	
Email	Field used to Login in the platform
Password	Field used to Login in the platform (Encrypted)
Role Id	User Role
Country Id	Country of user
Institution Id	User Institution/entity name
Address	User Institution/entity Address
Phone Country Code	Institution/entity country code
Phone Number	Institution/entity phone number
Position	Academic Position
Reason for Access	Brief motive to access the database

12.2.4 Institution

Fields	Description
Name	
Description	Brief description of Institution/entity
Country Id	Institution/entity Country
Address	User Institution/entity address

12.3 Species Details

12.3.1 Species Order

Fields	Description
Id	Unique reference. Auto-generated
Name	Order Taxon

12.3.2 Species Family

Fields	Description
Id	Unique reference. Auto-generated
Name	Taxonomic rank below Order
Order Id	From OrderId

12.3.3 Species Genus

Fields	Description
Id	Unique reference. Auto-generated
Name	Taxonomic rank below family
Family Id	From Family Id

12.3.4 Species

Fields	Description
Scientific Name	Species name
Common Name	Common name of the species
Genus Id	Genus Taxon
Family Id	Family Taxon
Order Id	Order Taxon
IUCN Red List Id	IUCN RedList Classification
European Red List Id	European RedList Classification
Subspp Id	Taxonomic rank below species

12.4 Red lists

12.4.1 European Red List

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Name
1	Extinct (EX)
2	Extinct in the Wild (EW)
3	RE (Regionally Extinct)
4	Critically Endangered (CR)
5	Endangered (EN)
6	Vulnerable (VU)
7	Near threatened (NT)
8	Least Concern (LC)
9	Data Deficient (DD)
10	Not Evaluated (NE)

12.4.2 IUCN Red List

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Name
1	Extinct (EX)
2	Extinct in the Wild (EW)
3	RE (Regionally Extinct)
4	Critically Endangered (CR)
5	Endangered (EN)
6	Vulnerable (VU)
7	Near threatened (NT)
8	Least Concern (LC)
9	Data Deficient (DD)
10	Not Evaluated (NE)

12.5 Case Type Detail

12.5.1 Case Accessibility

Content	Description
Public	Accessible to Everyone
Contributors Access	Accessible to Contributors and partners
Admin Access	Accessible to Admin

12.5.2 Source Of Information

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Name	Description
1	Law enforcement	Agencies and employees (e.g., Police, National Guards, etc)
2	Government authority	Governmental or intergovernmental entity, department, agency, commission or organization
3	NGOS	Non-governmental organization; Conservations groups and partners
4	Wildlife Recovery centers	Public and/or Private Recovery centers
5	Other	Other entities, institutions, associations or members of the public

12.5.3 Case Type

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Name	Description
1	Illegal Shooting	Shooting or attempted shooting incident
2	Illegal Poisoning	Poison/pesticide abuse incidents
3	Illegal Trapping	Capture of birds with traps, nets, poles, limesticks,etc
4	Nest destruction	Destruction of nests
5	Egg collection	Removal of eggs from nest
6	Other	'Other' persecution incidents
7	Unknown	Mortality caused by unknown incident

12.5.4 Case Type Detail

Fields	Description
Id	Unique reference. Auto-generated
Name	
Case Type Id	Reference to the Case Type

Id	Content	CaseTypeId	Description
1	Shooting	1	Illegal hunting, exceeding limit or killed animals, killing protected species, etc
2	Poisoning	2	Use of poison bait; Intentional, Accidental, Substance used
3	Traps (Tape lures)	3	Snare/bow traps, Bal-chatri traps, Esh traps, etc
4	Limesticks/Glue sticks	3	Illegal trapping with limesticks
5	Nets	3	Illegal trapping with Mist Nets, Eb nets, Clap nets, etc
6	Nest destruction	4	Pest control, Food source.
7	Egg collection	5	Falconry, keeping, food source,
8	Other	6/7	Other or unknown

12.5.5 Case motivation

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Content	Description
1	Sport	Driver related to Hunting
2	Food Source	Driver related to Rural poverty, food subsistence or food delicacy
3	Human-wildlife conflict	Driver related to conflicts (e.g., Pest control)
4	Taxidermy	Driver related to taxidermy (and poaching)
5	Other	Driver not listed
7	Unknown	IKB motivation not known

12.5.6 Prosecution Status

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Content	Description
1	Yes	People charged with an IKB offence; Yes or No
2	No	No Conviction, not charged
3	Unknown	Prosecution Status not known/Under Investigation
4	Prescribed	

12.5.7 Case Progress

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Content	Description
1	Open	People charged with an IKB offence; Yes or No
2	Closed	No conviction, not charged
3	Unknown	Prosecution Status not known/Under investigation

12.5.8 Conviction

Fields	Description
Id	Unique reference. Auto-generated
Name	

Id	Content	Description
1	Imprisonment	Case Closed: Imprisonment connected to the incident (additional information: number of years)
2	Fine	Case Closed: Fine connected to the incident (additional information: fine value)
3	Unknown	Conviction not known
4	Other	Sanction, prohibition, suspension (example: loss of permits, hunting prohibition, etc)

12.5.9 Cases

Column	Data Type	Description
Id	Int	Unique reference. Auto-generated
Contributor Id	Int	Reference to User table. References the person that inserted the data.
Country Case Id	Int	National Case Id, if exists
Case Accessibility Id	Int	Reference to Case Accessibility table
Reported Case Date	Date	Date of the Case
Case Type Id	Int	Reference to Case Type table
Case Type Detail Id	Int	Reference to Case Type table
Lat	Float	Latitude of the case
Long	Float	Longitude of the case
Country Id	Int	Reference to the Country table
Region Id	Int	Reference to the Region table
County Id	Int	Reference to the County table
Species Id	Int	Reference to the Species table
Num Species	Int	Number of Species of the case
Evidence Species	bit	If only evidence (remains) were found
Description	Text	Description of the reported case
Source Of Information Id	Int	Reference to Source of Information table
Information Source Contributor	Text	Information of who reported the accident
Offender Identified	bit	Was a Suspect/offender identified responsible for the IKB / Case/incident?
Case Progress Id	int	Reference to Case Progress table
Case Motivation Id	int	Reference to Case Motivation table
Case Motivation Notes	Text	Additional information related to "other /unknown drivers of IKB"
Prosecution Status Id	Int	Reference to Prosecution Status table. Identification of a conviction
Conviction Id	Int	Reference to Conviction table.
Prosecution Link	Text	Link to the prosecution/sentencing information
Conviction Notes	text	Notes about the Conviction
Prosecution Notes	text	Notes about the Prosecution

Column	Data Type	Description
Validation Status Id	int	Reference to validation status table.
Validation Comments	text	Comments on incident
Validated By	int	Reference to user table.