REVIEW: Sharing information about captive-breeding and ranching operations

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Executive summary

This study investigated existing information systems for captive-bred animals. Various databases of zoos, studbooks, and commercial livestock systems were analysed. Relevant institutions were surveyed and additional literature research was carried out. Special emphasis was laid on the UNEP-WCMC Captive-Breeding Database. The results indicated that the UNEP-WCMC Captive-Breeding Database is not being used to its full potential and requires in its current form additional administrative workload. There is a significant trend towards real-time databases including validation tools, and optional modules for interoperability to reduce administrative workload. For the advanced development of the Captive-Breeding Database these trends should be considered. Interoperability in particular with national CITES databases are highly recommended.

Introduction

The aim of this study was to investigate existing systems which share information concerning captive breeding of animals. Various software packages of zoos, studbooks and commercial tracking systems were analysed. A survey was carried out via phone and/or email-correspondence asking for the following parameters: range of species, likely comprehensiveness, ease of access, maintenance of systems and cost for data collection and management. The questions asked, cover a wide variety of issues from each institution, and required co-operation of several people involved at different institutional levels. Due to the short time given for this study (1 month), some institutions (e.g. VIS) were not able to respond in full or to all questions in time. Particularly, questions about costs of data management and system maintenance were seldom answered. A summary table of all investigated information systems provides an overview after which every system is described in detail including its strengths and weaknesses. Facts of each database, which could be promising for the advanced development of a captive-breeding information system for CITES Parties, are summarised in grey information boxes after every represented system. The information systems are ordered according to their complexity, starting with simple databases and ending with the most complex and high-end solutions of databases. The supplementary material provides contact details to all information systems and further figures.

Summary Investigated Information Systems

Name of Information System	Tracks Software®	SPARKS Single Population Analysis & Record Keeping System	PopLink	Cattle database, Austria	Captive-breeding Database	Consumer Health Information System, Austria	ZIMS Zoo Information Management System	TRACES Trade Control and Expert System
Purpose	Collection and management system for zoos and aquaria. Only used at institutional level.	Software for studbooks	Software for studbooks and also tool for genetic analysis.	National cattle database of Austria	Monitors captive breeding for multilateral environmental agreements	Prevention and control of epizootic diseases. Complete register for all farmed animals within Austria.	Information system for animal management and conservation activities	Tracks trade movements of animals, products of animal origin, food and feed, live plants and plant products imported from outside the EU or travelling through the EU.
Category	Zoos & Aquaria	Zoos & Aquaria	Zoos & Aquaria	Livestock	CITES listed species	Livestock	Zoos & Aquaria	Trade in animals, animal products
Publisher	Tracks Software®	ISIS International Species Information System	Lincoln Park Zoo	AMA Agrarmarkt Austria Marketing	UNEP-WCMC United Nations Environment Programme - World Conservation Monitoring Centre	Austrian Federal Ministry of Health	ISIS International Species Information System	European Union
Data entry by	Zoo or Aquarium	Zoo or Aquarium	Zoo or Aquarium	Cattle farms	EU CITES Autohrities, UNEP-WCMC	Livestock owners	Zoo or Aquarium, 800 members	Livestock owners, traders 29.100 users
Number of species	Depends on institution	WAZA: 132 active international studbooks (including 163 subspecies) EAZA: 198 EEPs, 196 ESBs, 75 studbooks with low management level	AZA: 328 regional studbooks	1	215	No data provided	16.400 (contains historical and currently living species)	No data provided
Total number of records	Depends on institution	No data provided	No data provided	2 Million cattle	No data provided	No data provided	3.34 Million (historical + currently)	No data provided
Database format / ease of access	Computer based installation with option for SQL database (at institutional level)	Computer based installation, updates can take a long time until available	Computer based installation with option for SQL database	Relational real-time database (Oracle Database Management®), internet connection required	Relational SQL database, internet connection required	Relational real-time database, internet connection required	Relational real-time database with different modelstructures, internet conncection required	Web-based central database, internet connection required
Information transfer	Information transfer only possible within single institution	Information transfer occurs manually, WAZA and regional Zoo Associations coordinate and distribute studbook data	Information transfer occurs manually, AZA coordinates and distributes studbook data	Automated information transfer, data are pooled online	Automated information transfer, data are pooled online	Automated information transfer, data are pooled online	Automated information transfer, data are pooled online	Automated information transfer, data are pooled online
User-friendliness	Good feedback	Dos-based software, can cause difficulties	Good feedback, provides very detailed manual	Very good acceptance	Good feedback, but improvement required for search tools	No data provided	Good feedback; easy user interface, similar to MS Windows	Good feedback and support system
Tendency of comprehensiveness	Low, because only used at institutional level	High tendency, due to connection with ISIS	High tendency within North-america	High tendency for purpose, low in regard to CITES	Low tendency, but high potential	High tendency for purpose, low in regard to CITES	High tendency, as many institutions wordwide use ZIMS	High tendency, used by 43 countries
Cost for data collection and management	Data collection occurs without direct costs, as staff supply data directly. No management costs provided.	Data collection occurs without direct costs, as member institution staff supply data. No management costs provided.	Data collection occurs without direct costs, as member institution staff supply data. Programming costs: 152,000 USD	Data collection occurs without direct costs, data entry is complusory for farmers. No management costs provided.	Data collection occurs without direct costs, data is either entered by EU Authorities or UNEP-WCMC. Maintenance of IT-Infrastructure costs £ 5k/year.	Data collection occurs without direct costs, data entry is complusory for livestock owners and traders. No management costs provided.	Data collection occurs without direct costs, as member institution staff supply data directly. Funding of ZIMS: 8M USD for design, review and user training Server running costs (including 1 employee): 152,000 USD/year	Data collection occurs without direct costs, as entry is compulsory for official veterinary offices and traders. No management costs provided.

EEPs... European Endangered Species Programmes
ESB... European Studbooks
AZA... Association of Zoos & Aquariums

Represented Information Systems increase in Complexity

Information Systems relevant for Zoos & Aquaria
Information Systems relevant for Livestock

Tracks Software®

Name of Information System	Tracks Software®
Purpose	Collection and management system for zoos and aquaria. Only used at institutional level.
Category	Zoos & Aquaria
Publisher	Tracks Software®
Data entry by	Zoo or Aquarium
Number of species	Depends on institution
Total number of records	Depends on institution
Database format / ease of access	Computer based installation with option for SQL database (at institutional level)
Information transfer	Information transfer only possible within single institution
User-friendliness	Good feedback
Tendency of comprehensiveness	Low, because only used at institutional level
Cost for data collection and management	Data collection occurs without direct costs, as staff supply data directly. No management costs provided.

Used by Zoos and Aquaria but only at institutional level.
Tracks Software provides complete inventory management tools, medical records, nutrition records, enrichment notes and reporting and scheduling features.

Costs for membership:

- Institutions 75 > full time employees - $18.250 per year
- Institutions 75 < full time employees - $10.500 per year

Tracks is a subscription-based software package and has to be renewed annually.

Information transfer: No information transfer between institutions.

Software development: Tracks software is also available for tablet and mobile devices.

Motivation to provide correct information: Institutions which use Tracks have an interest to provide correct information, as it serves their own management purposes.

Animal registration – registration numbers of individuals: There are no determined registration numbers allocated by the system. ID numbers, housenames, transponder numbers etc. can be entered to Tracks.

Strengths of Tracks Software:	**Weaknesses of Tracks Software:**
• Practical at an institutional level for management purposes	• No data-sharing possible • Computer-based installation

SPARKS

Single Population Analysis & Record Keeping System

Purpose	Software for studbooks
Category	Zoos & Aquaria

SPARKS is designed as a studbook software and used by WAZA (World Association of Zoo and Aquariums) and EAZA (European Association of Zoos and Aquaria).

Cost for membership: SPARKS is available to ISIS members at no additional charge and $250 for non-ISIS members.

Publisher	ISIS International Species Information System
Data entry by	Zoo or Aquarium
Number of species	WAZA: 132 active international studbooks (including 163 subspecies) EAZA: 198 EEPs, 196 ESBs, 75 studbooks with low management level
Total number of records	No data provided
Database format / ease of access	Computer based installation, updates can take a long time until available
Information transfer	Information transfer occurs manually, WAZA and regional Zoo Associations coordinate and distribute studbook data
User-friendliness	Dos-based software, can cause difficulties
Tendency of comprehensiveness	High tendency, due to connection with ISIS
Cost for data collection and management	Data collection occurs without direct costs, as member institution staff supply data. No management costs provided.

Information transfer: The updated studbook dataset (in SPARKS-format) is submitted to ISIS annually and then distributed among its members. A designated studbook keeper is responsible for one studbook each.

Software development: All studbook data will soon be incorporated into ZIMS (see Page 9), which is a real-time database. After the launch of the ZIMS studbook module, the institutional registrar as well as the studbook keeper will effectively use the same database. A current alternative to SPARKS is the Sebag studbook, a Windows-version of the DOS-program SPARKS.

Motivation to provide correct information: Access to accurate and up-to date studbook data is important to each member of WAZA and EAZA.

Animal registration – registration numbers of individuals: Permanent numbers are allocated by the respective studbook keeper.

Strengths of SPARKS:

- Used by many institutions

Weaknesses of SPARKS:

- DOS-based program, which is not very user-friendly
- Due to local installation data mismatch can occur easily
- Updates have to be collected and processed manually – Updated versions may not be available for longer periods of time

PopLink

Purpose	Software for studbooks and also tool for genetic analysis.
Category	Zoos & Aquaria
Publisher	Lincoln Park Zoo
Data entry by	Zoo or Aquarium

Software for studbooks and also used as a tool for genetic analysis considering breeding decisions. PopLink is used by AZA (Association of Zoos & Aquariums) as a studbook software.
It is a computer based installation, providing an option to store data in SQL databases.

Cost for membership: Shareware, distributed by Lincoln Park Zoo.

Number of species	AZA: 328 regional studbooks
Total number of records	No data provided
Database format / ease of access	Computer based installation with option for SQL database
Information transfer	Information transfer occurs manually, AZA coordinates and distributes studbook data
User-friendliness	Good feedback, provides very detailed manual
Tendency of comprehensiveness	High tendency within North-america
Cost for data collection and management	Data collection occurs without direct costs, as member institution staff supply data. Programming costs: 152,000 USD

Information transfer: Data can be exported into SPARKS-format. Studbook keepers are required to publish a current studbook report with AZA every third year and to ensure that data are up to date before population planning meetings (e.g. prior to implementing a Species Survival Plan).

Software development: PopLink aims to complement ZIMS (see Page 9).

Motivation to provide correct information: Access to accurate and up-to date studbook data are important to each member of AZA.

Animal registration – registration numbers of individuals: No registration numbers assigned by PopLink but local IDs, housenames etc. may be allocated by users.

Strengths of PopLink:

- Shareware
- Provides tools for genetic analysis for breeding decisions
- Compatible with SPARKS
  PopLink can import studbook data from SPARKS
- PopLink data can be exported into SPARKS-format

Weaknesses of PopLink:

- Computer-based installation, data mismatch can occur easily
- Updates have to be collected and processed manually

PopLink is available free of charge. Apart from being used for studbook purposes, it is a powerful tool for facility management and a similar program could be of interest for commercial captive-breeding facilities. That program could also provide an option to export application forms for CITES permits which are accessible for the captive-breeding database. This could mitigate the administrative workload for CITES purposes.

Cattle database

Purpose	National cattle database of Austria
Category	Livestock
Publisher	AMA Agrarmarkt Austria Marketing

The Austrian national cattle database is a register to monitor all cattle within Austria. It was first launched after the occurrence of BSE in 1997 to enable traceability of beef production. VIS (see Page 8) was later developed, as the Austrian register for all other livestock.

Cost for membership: No direct costs.

Data entry by	Cattle farms
Number of species	1
Total number of records	2 Million cattle
Database format / ease of access	Relational real-time database (Oracle Database Management®), internet connection required
Information transfer	Automated information transfer, data are pooled online
User-friendliness	Very good acceptance
Tendency of comprehensiveness	High tendency for purpose, low in regard to CITES
Cost for data collection and management	Data collection occurs without direct costs, data entry is complusory for farmers. No management costs provided.

Information transfer: Data can be either entered directly into the online database (40.000 farms), or via mobile-app (700-1.000 farms) or handed in via a written form (30.000 farms). Submitted data are immediately available to official veterinary offices and may be used for annual surveys.

Software development: The European Union is working on BOVEX, a software which is part of TRACES (see Page 11) designed to exchange data between European national bovine databases.

Motivation to provide correct information: Farmers are obliged to enter all cattle related data within seven days. Negative consequences such as the allocation of funds apply in case of non-compliance. Random inspections cover 3% of all farms annually. Farmers in good standing may print trade certificates provided by the cattle database.

Animal registration – registration numbers of individuals: Identification numbers are allocated by AMA (Agrarmarkt Austria Marketing).

Strengths of cattle database:

- Approved register which is constantly developing
- Real-time database
- Easy data entry because of different possibilities (in electronic form or by paper form)
- Electronic certification

Weaknesses of cattle database:

Registration numbers of individual animals are allocated by AMA and if used, they will be listed in the database. Data can be entered into the cattle database online via computer or mobile app or in paper, each following a standard format. Additionally, inspections serve as a tool to ensure data quality. All of this may serve as a model for CITES.

Captive-Breeding Database by UNEP-WCMC

Purpose	Monitors captive breeding for multilateral environmental agreements
Category	CITES listed species
Publisher	UNEP-WCMC United Nations Environment Programme - World Conservation Monitoring Centre
Data entry by	EU CITES Autohrities, UNEP-WCMC
Number of species	215
Total number of records	No data provided
Database format / ease of access	Relational SQL database, internet connection required
Information transfer	Automated information transfer, data are pooled online
User-friendliness	Good feedback, but improvement required for search tools
Tendency of comprehensiveness	Low tendency, but high potential
Cost for data collection and management	Data collection occurs without direct costs, data is either entered by EU Authorities or UNEP-WCMC. Maintenance of IT-Infrastructure costs £ 5k/year.

The Captive-Breeding Database has been developed by UNEP-WCMC to serve EU CITES authorities. It enables member states to share relevant information on animal species listed in the EU Wildlife Trade Regulations that have been produced by captive breeding facilities. The data can be queried by species, facility or country.

Initially the database was populated by UNEP-WCMC with information related to captive breeding facilities derived from emails circulated by EU Member States and from information entered into CIRCA up to April 2011.

Data entry is structured in three main components:
1) Information of facility (facility name, date of establishment, address, description)
2) Species information (scientific name, information of founder breeding stock, CITES permit number, information of current breeding stock)
3) Application information (importing member state, quantity, source code, appendix…)

Up to date only five member states have entered data into the Captive-Breeding Database with seven individuals being the highest number of users in one member state. Due to lack of participation and input of EU Member States the database is not used on a regular basis.

Currently the database lists around 165 captive-breeding facilities and 215 species. Data mismatch and duplication occurs due to missing validation tools.

The data from exporters are entered by member states and can be peer reviewed. Entry of wrongful data may be corrected by UNEP-WCMC. Member states can enter and edit their own data.

UNEP-WCMC encourages member states to use the database and offers appropriate training on how to use the database.

No other database in comparison to the UNEP-WCMC database contains as much CITES relevant information, although ZIMS and TRACES can be a useful source. Widespread and efficient use among member states could make this real-time database an important and useful tool and resource to the work of CITES.

Cost for membership: No direct costs.

Information transfer: EU CITES authorities and UNEP-WCMC can access the database.

Software development: There are opportunities to integrate with other platforms and databases, as well as restructuring the database. UNEP-WCMC newly developed the platform Species+, which is a centralized portal for accessing important information of species of global concern. Species+ contains relevant information on all species that are listed in the Appendices of CITES, CMS, other CMS family listings and species included in the Annexes to the EU Wildlife Trade Regulations.

Motivation to provide correct information: Currently the database is not used on a regular basis and the CITES authorities of the EU Member States are urged to populate the database.

Animal registration – registration numbers of individuals: No numbers allocated by database, but CITES permit numbers can be entered.

Strengths of Captive-Breeding Database:	**Weaknesses of Captive-Breeding Database:**
• Management aspect in database – can add generation of captive-bred animal • Ability to add permits	• Not sufficiently used • Search function needs improvement • Data entry is time consuming, as the data has to be entered manually • No validation tools

Consumer Health Information System, Austria

VIS Veterinaer-Informationssystem

Purpose	Prevention and control of epizootic diseases. Complete register for all farmed animals within Austria.
Category	Livestock
Publisher	Austrian Federal Ministry of Health
Data entry by	Livestock owners
Number of species	No data provided
Total number of records	No data provided
Database format / ease of access	Relational real-time database, internet connection required
Information transfer	Automated information transfer, data are pooled online
User-friendliness	No data provided

The consumer health information system is used by official veterinary offices to monitor and control diseases.

Costs for membership: No information provided.

Information transfer: Information is accessible online by responsible veterinary offices.

Software development: The consumer health information system of Austria uses and used data of already existing information (e.g. AMA cattle database) and combines the data in a central system. It is a modular structured software open to add further modules to the database. Currently it contains four main elements:

1) Business register: basic data, operating data
2) Event register: incomings and outgoings, slaughtering, birth
3) Animal register: data of each animal with official identification
4) Epizootic disease register

Tendency of comprehensiveness	High tendency for purpose, low in regard to CITES
Cost for data collection and management	Data collection occurs without direct costs, data entry is complusory for livestock owners and traders. No management costs provided.

Motivation to provide correct information: Information report is compulsory for farmers of certain livestock species.

Animal registration – registration number of individuals: Identification numbers are allocated by the Consumer Health Information System for certain species (sheep, goats, pigs).

Strengths of Consumer Health Information System:	**Weaknesses of Consumer Health Information System:**
• Ability to use existing information • Easy accessible information for competent authorities	

The Consumer Health Information System is listed in this review study, because of the ability to use already existing information from other databases. It is modular structured and leaves possibilities open to add further modules. This saves a lot of workload. If the captive-breeding database would be able to use already existing information from e.g. national CITES databases, the information transfer could proceed more efficiently.

ZIMS

Zoo Information Management System

Purpose	Information system for animal management and conservation activities
Category	Zoos & Aquaria
Publisher	ISIS International Species Information System
Data entry by	Zoo or Aquarium, 800 members
Number of species	16.400 (contains historical and currently living species)
Total number of records	3.34 Million (historical + currently)
Database format / ease of access	Relational real-time database with different modelstructures, internet conncection required
Information transfer	Automated information transfer, data are pooled online
User-friendliness	Good feedback; easy user interface, similar to MS Windows

ZIMS software is the latest generation of ISIS (International Species Information System) recordkeeping software. It is modular structured and has three main modules: 1) husbandry information 2) medical information 3) studbook information.

Cost for membership: The annual fees are determined by a certain percentage of the operating budget of each institution.

Information transfer: Data sharing is one of the major advantages of ZIMS. Core data (e.g. animal birth date, parent notation, physical and legal ownership etc.) are accessible and visible to all ISIS members, institutions may choose not to share institution specific data (e.g. collections, enclosures, life support systems, husbandry notes etc.) but the information is submitted to ISIS.

An institution can choose to activate external sharing which allows institutions to specifically share individual records or entire taxa with other institutions selected for this purpose. Medical data are shared separately, allowing institutions to share husbandry data, but keep medical data to themselves. If chosen to share medical information (this again can be done per record or per taxon towards specifically chosen institutions), an institution may select one of three levels of medical information sharing.

Tendency of comprehensiveness	High tendency, as many institutions wordwide use ZIMS
Cost for data collection and management	Data collection occurs without direct costs, as member institution staff supply data directly. Funding of ZIMS: 8M USD for design, review and user training Server running costs (including 1 employee): 152,000 USD/year

These levels are Bronze, Silver and Gold (Gold = shares all medical information). If one institution is sharing on Gold level, but the co-operating institution shares at Bronze level, both institutions will only see the shared data at the lowest common level. This is to motivate institutions to share information at the highest level.

Software development: All previous ISIS programs eventually merge into ZIMS. The data of ARKS (husbandry data) is transferred to ZIMS and more than 90% of the member institutions have successfully performed the change from ARKS to ZIMS over the last years. A few users have not moved to ZIMS yet. Mainly because of insufficient internet connection, insufficient internet speed, or similar reasons.
Since April 2014 MedARKS (medical data) is now slowly replaced by ZIMSmedical. Currently ISIS is in the design phase for replacing the outdated SPARKS software.

Motivation to provide correct information: To enter correct information has multilevel benefits for each institution such as:

- Complete husbandry picture of each animal
- Comprehensive history on health issues, training events, etc.
- Inter-institutional data cooperation to assist projects aiming to improve welfare, reproduction, animal exchange transaction history.
- Ensuring DNA diversity to prevent inbreeding and to maintain healthy captive populations

Animal registration - registration numbers of individuals: Every record receives a unique, automatically assigned database number, which will stay attached to that record, even if the animal dies. These numbers are called GAN (Global Accession Numbers) and institutions may assign additional identifiers to the record e.g. number of transponder, studbook-number, legbands, housenames, CITES permit numbers etc.

Strengths of ZIMS:	**Weaknesses ZIMS:**
• Data sharing between institutions is very fast and efficient • Very high tendency of comprehensiveness • Very user-orientated and user-friendly (e.g. easy user interface, similar to MS Windows layout which allows people to navigate quickly and it is possible to work on multiple parts of the data)	• Membership is expensive for small institutions

The modular structure of ZIMS and the connection to ISIS make it a very promising tool to provide efficient information transfer between Zoos & Aquaria. Further, the different levels of data sharing encourage cooperation. The modular structure (medical data, husbandry data etc.) and also the handling of information in different categories could be of interest for the redesign of the captive-breeding database.

TRACES

Trade Control and Expert System

Purpose	Tracks trade movements of animals, products of animal origin, food and feed, live plants and plant products imported from outside the EU or travelling through the EU.
Category	Trade in animals, animal products
Publisher	European Union
Data entry by	Livestock owners, traders 29.100 users
Number of species	No data provided
Total number of records	No data provided
Database format / ease of access	Web-based central database, internet connection required
Information transfer	Automated information transfer, data are pooled online
User-friendliness	Good feedback and support system
Tendency of comprehensiveness	High tendency, used by 43 countries
Cost for data collection and management	Data collection occurs without direct costs, as entry is compulsory for official veterinary offices and traders. No management costs provided.

TRACES was introduced in 2004 and is obligatory for all EU member states since 1 January 2005. It is a trans-European network for veterinary health that notifies, certifies and monitors imports, exports and trade in animals and animal products. It is used by commercial operators and relevant authorities.
Health certificates can be displayed and printed out in different languages used by TRACES (currently 35 languages).

Costs for membership: There are no direct costs for the individual user. The entire costs are paid by European member-countries.

Information transfer: Commercial operators can enter data themselves and the relevant veterinary office only needs to certify the consignment. All involved authorities are permanently aware of the current status of a specific trade transaction which involves TRACES. They receive automatically triggered notifications at every stage of the particular process, and the authorities are able to communicate with each other. All persons involved have direct online access to certificate data via TRACES.

Software development: Prior to TRACES, the EU tried to implement a trans-European network for veterinary health with two computer-based systems:
1) ANIMO – **Ani**mal **Mo**vement system to trace animal transports
2) SHIFT – **S**ystem to assist with the **h**ealth controls of **i**mports of items of veterinary concern at **f**rontier inspection posts from **t**hird countries
Both systems were unable to provide real-time data transfer. For example it could take several days to transmit ANIMO message data.
TRACES is successfully in use for the past 10 years and there are plans to incorporate several adaptions into the TRACES network. An interesting example for this review is BOVEX – data exchange between bovine databases. Paper passports are still in use for cattle movement between EU-member states, which holds a source of inaccuracy. With BOVEX it will be possible to enable multilateral exchange via electronic passports between different national authorities of different European countries.

Motivation to provide correct information: If wrong data is provided, then penalty fees will be collected.

Animal registration - registration numbers of individuals: Identification numbers are allocated by responsible national authority.

Strengths of TRACES:	Weaknesses TRACES:
• Data sharing between institutions is very fast and efficient • Simplification of tasks for official services through reduction of data entry and automatisation • Electronic certification • Updated information and alert awareness • Interoperability • Multi-criteria search engine • Multilingualism (35 languages)	

TRACES is a very powerful tool and reduces administrative workload significantly. This point should be carefully considered for the captive-breeding database.

Conclusion

The UNEP-WCMC Captive-Breeding Database has great potential but is certainly not sufficiently used. The authors of this review assume that the low usage of this database is due to administrative workload for EU Member States. However, the Captive-Breeding Database has promising properties (real-time database) and it could be efficiently used if carefully adapted. The main goal when adapting the database should be to mitigate the administrative workload, and to enable efficient data transfer.

At CoP14 UNEP-WCMC mentioned that many member states submit their annual reports in electronic format. Behind these reports are usually national databases, which member countries had developed to meet the requirements of CITES. They are used at national level to coordinate CITES permits and to create annual reports. In regard to the Captive-Breeding Database, the member countries are required to re-enter initial information manually into this database, which increases administrative workload. Implementation of a plugin to automatically allow relevant data of available national CITES databases to be incorporated into the Captive-Breeding Database, could make the information transfer far more efficient. Countries lacking such national databases could be encouraged to use already existing national database systems. However, a paper form for data entry has to be provided to Parties with limited access to technology.

Interoperability with national CITES databases and relevant databases developed by UNEP-WCMC (e.g. Species+, CITES trade database …) as well as other databases (e.g. customs, TRACES) seems to be a key to successful information transfer. Use of management software compatible with the Captive-Breeding Database and national CITES databases for captive-breeding facilities should be encouraged. Basic monitoring and random inspections appear to be appropriate tools to ensure data quality. Collaborations between officials (veterinary offices, customs) may generate additional synergies.
As Phelps et. al [2010] mentioned, CITES lacks internal and external checks. The improved UNEP-WCMC Captive-Breeding Database could function as a 'CITES stock account' for captive bred species, showing active and passive balance and setting off an automatic warning system in the case of misbalances in import and export data, e.g. if animals are imported by one party but have never been reported as exported from the stated country of origin.

Supplementary Information

Contact details of all reviewed databases:

iBase data collection software by TRAFFIC

Contact details:

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Cattle database by AMA (Agrarmarkt Austria Marketing)

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Consumer Health Information System (AUT)

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International studbooks (WAZA) and regional studbooks (EAZA)

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PopLink

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TRACES (Trade Control and Expert System)

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Tracks Software

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ZIMS - Zoological Information Management System

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Website: www.isis.org

Supplementary figures

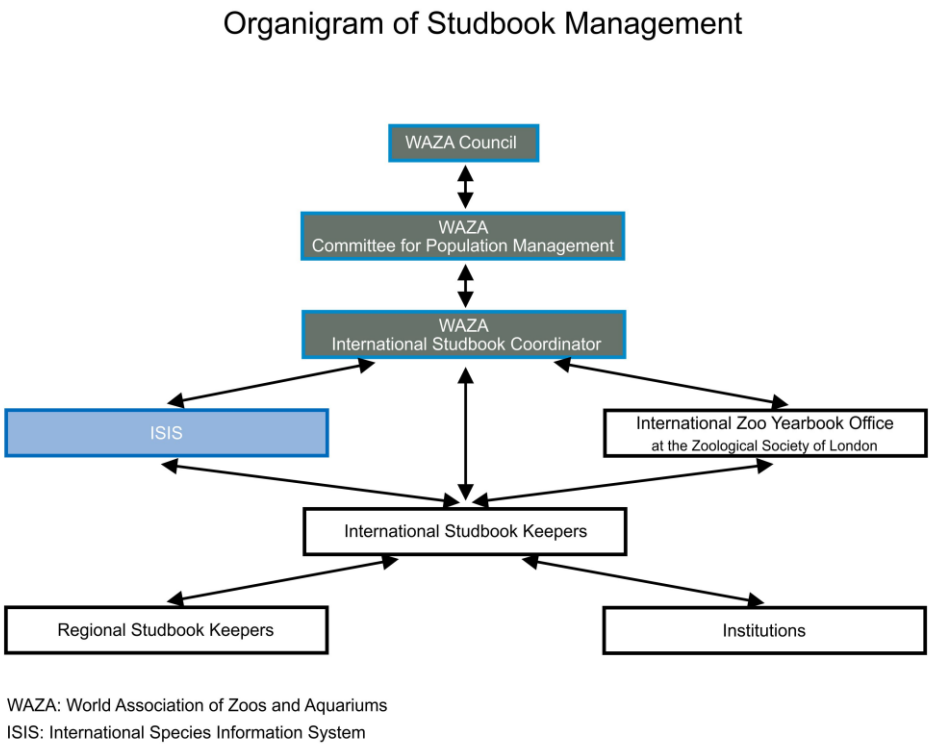

Figure1: Organigram of Studbook Management. Adapted after: Manual for International Studbook Keepers 2012.

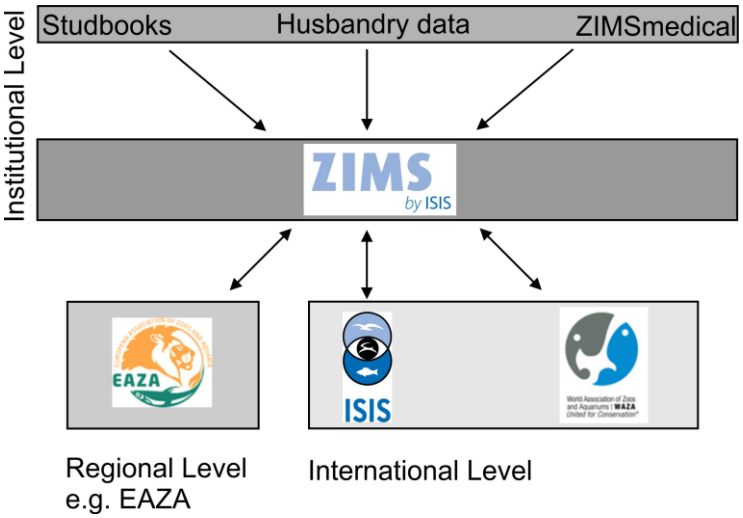

Figure 2: Transfer of Information via ZIMS at different Levels. Data sharing between institutions is not illustrated.

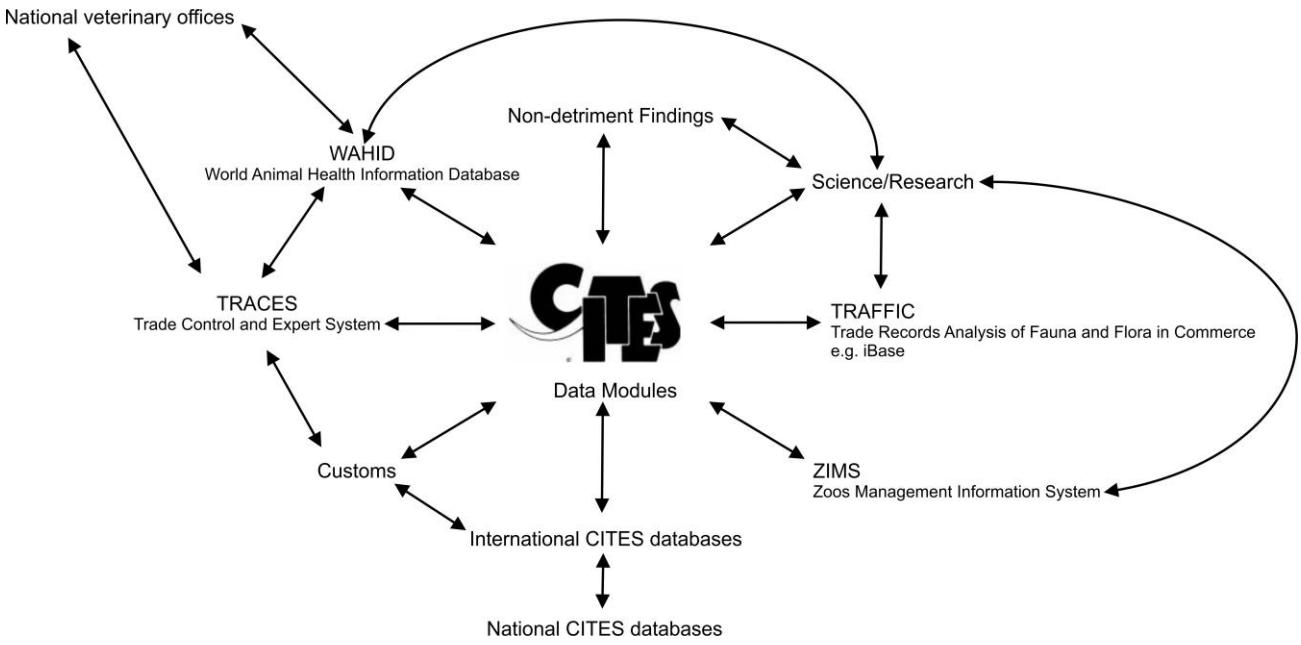

Figure 3: Possible networks for an information system with specified data modules. No guarantee for correct- nor completeness.

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