Descriptive Analytics on the Endangered Species International Trade

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This paper reveals instant meaningful insights from endangered species international trade using descriptive analytics method using the Power BI analytical tool. The endangered species international trade 2016 dataset is analyzed by creating several Power BI visualizations which display revelations at a glance. Results display instant plots depicting the levels of exported and imported quantities of endangered wild fauna and flora with respect to several aspects such as their family, class, source, purpose and exporter/importer countries. This paper shows that use of Power BI visualizations can display faster analysis results and uncover relevant trade insights which can benefit the trade volume assessment and restriction monitoring process.

Keywords: descriptive analytics, endangered species, Power BI, visualizations

INTRODUCTION

International trade analysis for endangered species has been a critical step in regulating the buying and selling of the 'near extinct' wild fauna and flora. Several researchers have been involved in exploring analytical procedures to better investigate the exploitation practices of the endangered species (Bhammar et al. 2016); Clifton, Rastogi, 2016; Jones, 2018). It has been a need of the law enforcement agencies and organizations to employ appropriate tools to analyze the huge amounts of the trade data stored on electronic platforms such as transnational databases (Jones, 2018).

In this research the powerful analytical tool Power BI is used to perform descriptive analytics and produce valuable insights on the endangered species international trade data stored in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) database (CITES, 2013). This paper is written in sections starting with the literature review explaining the background on the endangered species international trade followed by description of the Power BI analytical tool. The methods section explains the procedure followed in this research starting from data acquisition to creating visualizations. Results and discussion section display screen shots of the Power BI visualizations and discuss the insights obtained followed by the final closing statements in the conclusion section.

LITERATURE REVIEW

Endangered Species International Trade

Endangered species are the wild fauna and flora that are on the verge of becoming extinct mainly due to reasons such as habitat loss, disease, geographic range, climate change and illegal trade. International wildlife trade has adversely affected the populations of the most iconic fauna and flora such as elephants,

rhinos, orchids and many more thereby threatening their survival (Pambo et al., 2016; Jones, 2018). On the other hand, the trade also generates significant profits for all the consumers thriving in countries throughout the world for example United States has been reported as the largest wildlife trader in the estimated $300 billion international trade (Sheikh & Corn 2016). The presence of a thriving international market for wildlife import and export leads to the necessity of monitoring and regulation of the trade to avoid increase in endangered species.

In 1973, due to the growing global concern over increase in the number of endangered wildlife species, 21 nations united and signed an international agreement called the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in Washington DC. Since then the main objective of CITES has been to provide a framework to monitor and regulate the trade levels (Sheikh & Corn 2016). CITES follows the procedure of first identifying the species as needing protection and then assessing the risk posed on their survival due to the trade. CITES maintains a database (Oracle RDBMS) that currently holds over 13 million international records of wildlife trade (CITES, 2013). Annual reports are produced from this database and are used for monitoring the trade levels and identify major anomalies in the reporting of imports and exports. In order to analyze a large database like CITES it becomes beneficial to employ a powerful and easy to use analysis tool that can provide instant insights.

Power BI Analytics Tool

Power BI (Business Intelligence) is a user friendly analytical tool created by Microsoft and first released to public in July 24, 2015 (Microsoft, 2015). This tool is built on advanced algorithms and has the ability and power to transform large amounts of data into insightful data visualizations. A visualization is a graphical representation displaying various patterns or trends of the input data thereby helping in the decision-making process.

Ever since its release several researchers have been using Power BI to uncover fast, meaningful visualizations to provide business solutions. It has also been noted that over 200,000 organizations from 205 countries are using Power BI successfully as a platform for data analysis (Krishnan et al, 2017). Power BI can provide results in the form of reports or dashboards which is a combination of more than one visualization and provides at a glance 360 degree view of the data. There are variety of graphical representations to choose from the Visualization menu where each of them can show further customized view using filtering of the data fields. The uniqueness of the dashboards is their interactive feature where clicking on one visualization displays the related data on all other visualizations along with appearance of tooltips with data displays when mouse is hovered on them.

Researchers have compared Power BI with other tools available and have recommended it to be one of the preferred tools in terms of affordability and adaptability with variety of input sources (Barbulescu et al, 2016; Krishnan et al, 2017; Gowthami & Kumar, 2017).

METHODOLOGY USED

Dataset Acquisition

The dataset used in this analysis was acquired in form of a CSV file from the CITES database (CITES, 2013). It contains 67008 records on the international wildlife trade (import or export) of animal or plant species reported during the year 2016. The columns are as shown in the Figure 1 represent the following: Year column represents the year in which trade occurred; the next column is Taxon denotes the scientific name of animal or plant concerned; Class, Family and Genus indicate the Taxonomic rank of the species; Importer and Exporter represent the respective country codes that are involved in the trade; Import and Export quantity columns represent the quantity of specimens reported as imports or exports; Term denotes the description of specimens traded; Unit represents the quantity unit in Kilograms (Kg) or Grams (g); Purpose codes represent the intention for the imports/exports such as B-breeding, H-hunting, T-commercial, S-scientific, P-personal etc.; Source column codes represents the original source of the species such as A-plants artificially propagated, C-animals bred in captivity etc. The full form for all the codes is available in the CITES Trade Database Guide (CITES, 2013).

FIGURE 1
INTERNATIONAL WILDLIFE TRADE 2016 DATASET (SAMPLE SHOWN)

Year	Taxon	Class	Family	Genus	Importer	Exporter	Importer quantity	Exporter quantity	Term	Unit	Purpose	Source
2016	Aquila heliaca	Aves	Accipitridae	Aquila	TR	NL		1	bodies		T	C
2016	Aquila heliaca	Aves	Accipitridae	Aquila	XV	RS		1	bodies		Q	O
2016	Haliaeetus albicilla	Aves	Accipitridae	Haliaeetus	BE	NO		43	feathers		S	W
2016	Haliaeetus albicilla	Aves	Accipitridae	Haliaeetus	BE	NO		43	specimens		S	W
2016	Haliaeetus albicilla	Aves	Accipitridae	Haliaeetus	DK	IS	700		specimens		S	W
2016	Haliaeetus albicilla	Aves	Accipitridae	Haliaeetus	XV	RS		1	bodies		Q	O
2016	Harpia harpyja	Aves	Accipitridae	Harpia	BR	FR		12	feathers		S	C
2016	Harpia harpyja	Aves	Accipitridae	Harpia	BR	FR		4	feathers		S	U
2016	Harpia harpyja	Aves	Accipitridae	Harpia	BR	FR		2	feathers		S	W
2016	Acipenser brevirostrum	Actinopteri	Acipenseridae	Acipenser	CH	DE		4	live		T	C
2016	Acipenser sturio	Actinopteri	Acipenseridae	Acipenser	US	IR	100		caviar	g	P	I
2016	Ailurus fulgens	Mammalia	Ailuridae	Ailurus	AU	NZ		2	live		Z	C
2016	Ailurus fulgens	Mammalia	Ailuridae	Ailurus	CA	US		1	live		Z	F
2016	Ailurus fulgens	Mammalia	Ailuridae	Ailurus	IL	DE		2	live		Z	C
2016	Ailurus fulgens	Mammalia	Ailuridae	Ailurus	JP	US	1		live		B	C
2016	Ailurus fulgens	Mammalia	Ailuridae	Ailurus	JP	US		1	live		Z	C

Import to Power BI

The dataset CSV file was converted into Excel (table) format and then imported into Power BI using the intuitive process of using the web buttons 'Get data' followed by 'Import Excel data into Power BI'. Although any CSV file can be directly imported into Power BI but Excel conversion was done to view the data and clean up any unwanted columns such as serial number.

Visualization Creation

Power BI offers a whole range of visualization designs such as pie charts, scatter charts, line charts, stacked bar/column charts, tree maps, filled maps, funnel maps, gauge maps, multi-row cards (Microsoft, 2015). These options along with extensive page formatting tools, such as shapes and images were used to create visualizations revealing meaningful insights of the endangered species trade.
Procedure to create a visualization included the following:

- Identification of the central question/objective for each visualization
- Selection of data fields that correspond to the central question/objective
- Selection of the appropriate graphical representation. Several visualizations were tried and the ones that produced meaningful revelations were selected
- Further, filtering and drilling down using filtering tools on each visualization to eliminate any unwanted data category selections
- Formatting of each visualization to project results in standout colors and easy readable font style and sizes.

RESULTS AND DISCUSSION

Meaningful insights about the international trade of endangered species were revealed for the following central questions/objectives through Power BI visualizations (screen shots shown in the following figures).

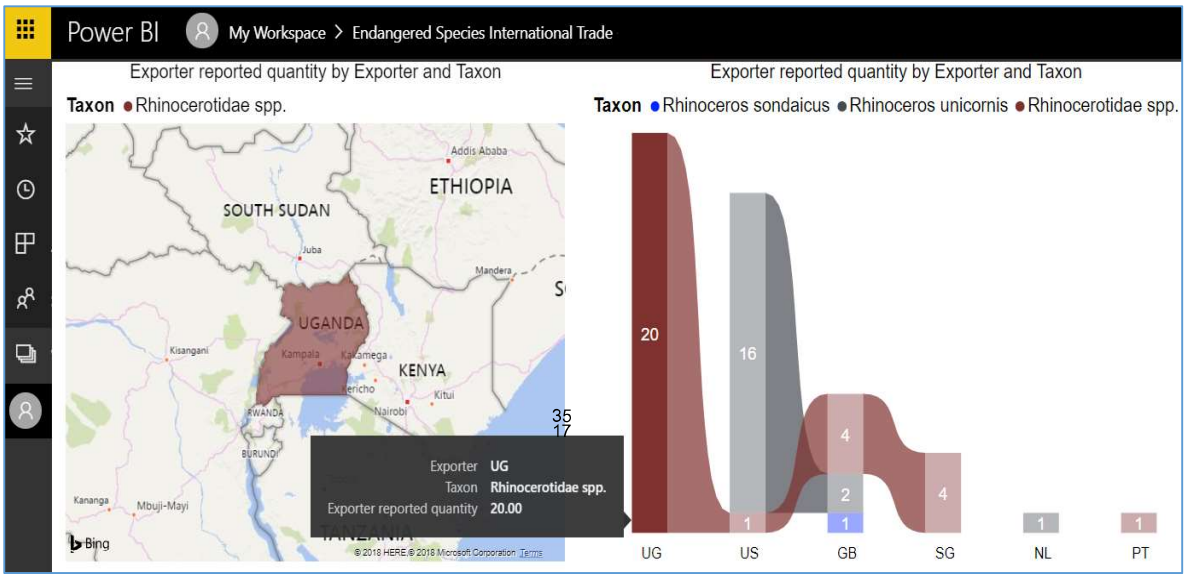
Country That Exported Maximum Number of Rhinos

Figure 2 shows two separate visualizations. The first one (left side) is a 'filled map' visualization displaying the number of species exported categorized by the exporter country and the species taxon. Initially it displayed the whole world map with color markings for each of the species taxon. The second

one (right side) was created using the 'ribbon chart' representing the number of rhinos exported categorized by the exporter country and all the taxon representing rhinoceros. The objective was to determine the country that exported maximum number of rhinos. In order to see the exact country geospatially the taxon showing the maximum number was clicked on the right-side visualization and instantly the left visualization automatically zoomed in and displayed Uganda as the respective country.

- The visualizations clearly displayed that Uganda (country code – UG) exported the maximum numberthat is 20 rhinos followed by USA (US) which exported 16 rhinos and others such as UK (GB), Singapore (SG), Netherlands (NL), Portugal (PT) exported less than 5 rhinos
- The Rhinocerotidae spp. taxon was the maximum exported compared to the other taxon for rhinos.

FIGURE 2
VISUALIZATIONS REVEALING UGANDA EXPORTED MAXIMUM NUMBER OF RHINOS

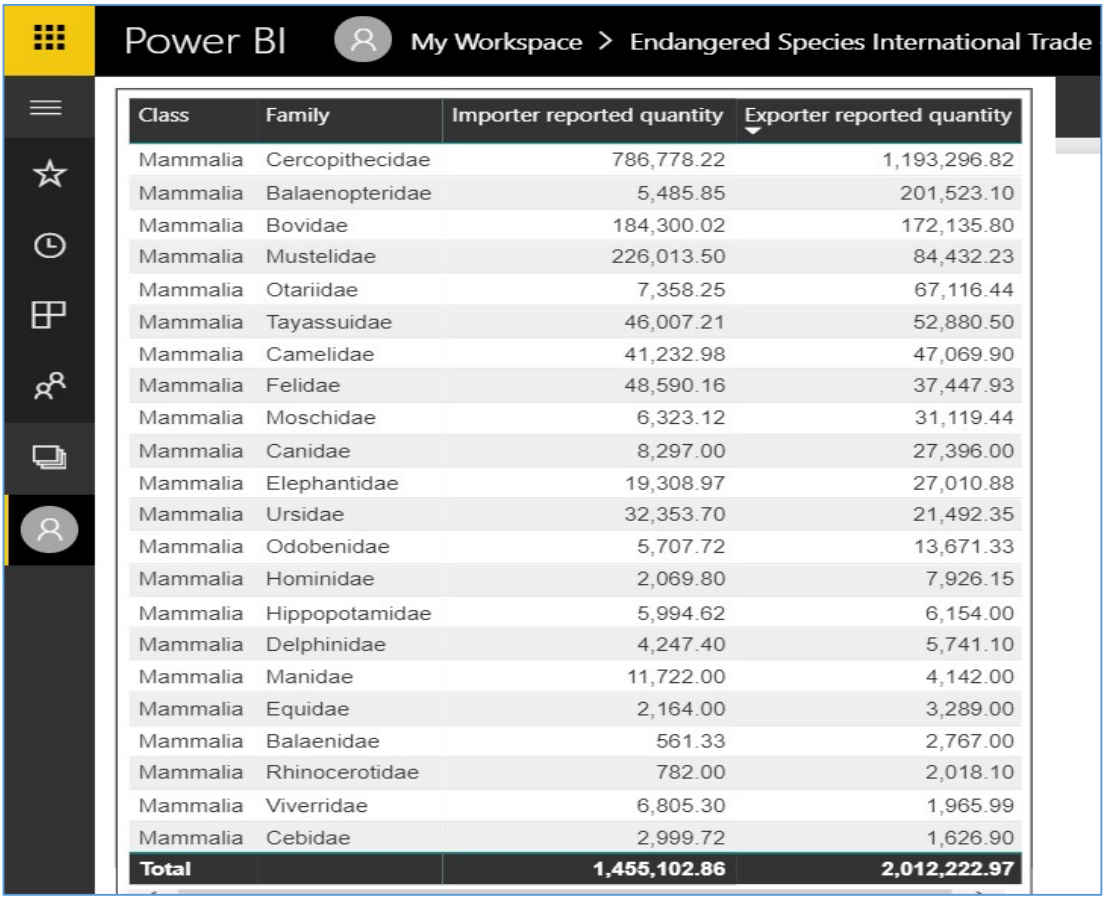


Total Number of Imported and Exported Mammals per Family

Figure 3 displays the 'table' visualization for total number of imported and exported mammals categorized by family.

- It is seen that Cercopithecidae family also known as the old world monkeys are the maximum number of mammals that were imported and exported
- The other species such as Bovidae (bison, African buffalo, water buffalo, antelopes, wildebeest, impala, gazelles, sheep, goats etc) and Mustelidae (carnivorous mammals, including weasels, badgers, otters, martens, mink, and wolverines) are the second highest to be imported and exported
- Rhinocerotidae (rhinos) and Hippopotamidae (hippos) import and export numbers are not as high compared to Elephantidae (elephants).

FIGURE 3
VISUALIZATION REVEALING TOTAL NUMBER OF IMPORTED AND EXPORTED MAMMALS

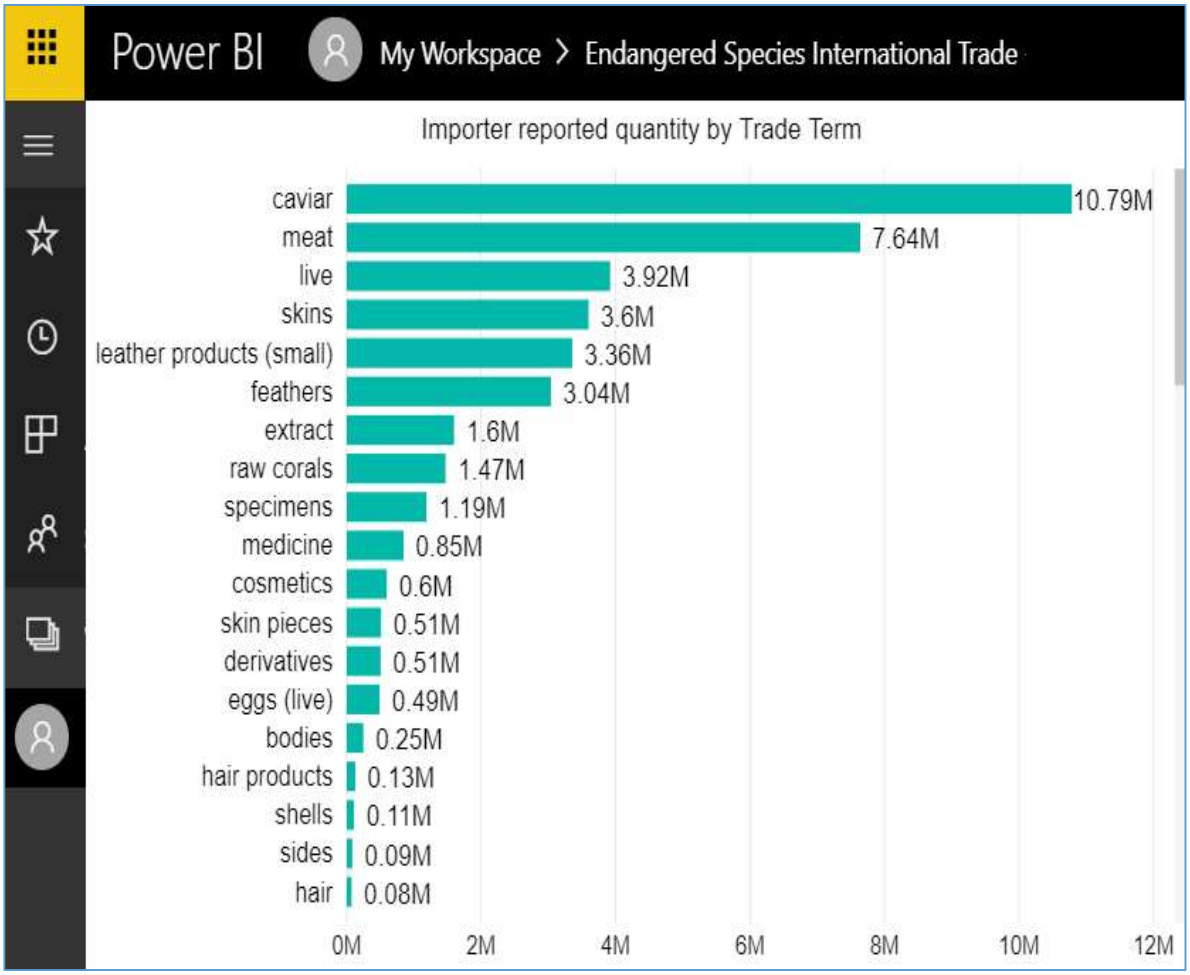


Class	Family	Importer reported quantity	Exporter reported quantity
Mammalia	Cercopithecidae	786,778.22	1,193,296.82
Mammalia	Balaenopteridae	5,485.85	201,523.10
Mammalia	Bovidae	184,300.02	172,135.80
Mammalia	Mustelidae	226,013.50	84,432.23
Mammalia	Otariidae	7,358.25	67,116.44
Mammalia	Tayassuidae	46,007.21	52,880.50
Mammalia	Camelidae	41,232.98	47,069.90
Mammalia	Felidae	48,590.16	37,447.93
Mammalia	Moschidae	6,323.12	31,119.44
Mammalia	Canidae	8,297.00	27,396.00
Mammalia	Elephantidae	19,308.97	27,010.88
Mammalia	Ursidae	32,353.70	21,492.35
Mammalia	Odobenidae	5,707.72	13,671.33
Mammalia	Hominidae	2,069.80	7,926.15
Mammalia	Hippopotamidae	5,994.62	6,154.00
Mammalia	Delphinidae	4,247.40	5,741.10
Mammalia	Manidae	11,722.00	4,142.00
Mammalia	Equidae	2,164.00	3,289.00
Mammalia	Balaenidae	561.33	2,767.00
Mammalia	Rhinocerotidae	782.00	2,018.10
Mammalia	Viverridae	6,805.30	1,965.99
Mammalia	Cebidae	2,999.72	1,626.90
Total		**1,455,102.86**	**2,012,222.97**

Quantities of Endangered Species Specimens Imported

Figure 4 shows the 'clustered bar chart' representation by the Term (description of specimens traded) revealing cavier (internal ovary eggs from wild sturgeon in the Caspian Sea and Black Sea (Davidson & Jane, 2006)) as the maximum imported quantity (10.79 million) followed by meat as the second largest imported quantity (7.64 million).

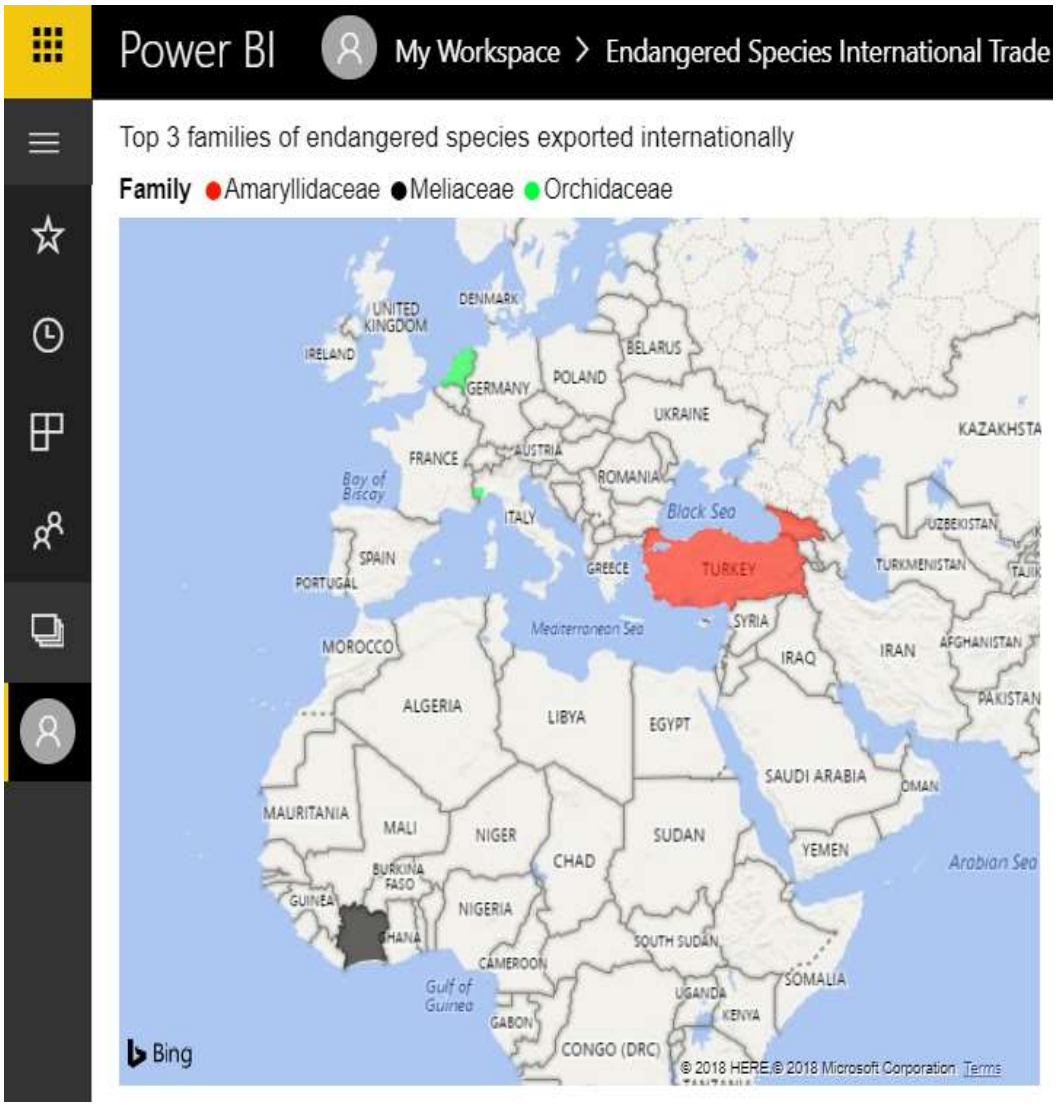
FIGURE 4
VISUALIZATION REVEALING 'CAVIER'S THE MAXIMUM IMPORTED QUANTITY (IN MILLIONS)



Top 3 Maximum Exported Endangered Species Family

The 'filled map' visualization in Figure 5 reveals the top 3 maximum exported endangered species to be from the family of Amaryllidaceae (perennial flowering plants), Meliaceae (mahogany family flowering plant) and Orchidaceae (Orchids). Further upon hovering over the visualization it displayed the export quantity of approx. 26 million of Amaryllidaceae family plants being exported from Turkey. The second largest were approx. 9 million Orchids exported from Netherlands and third largest were approx. 8 million of mahogany family plants exported from Cote D'Ivoire (West African country). The revelation of the top 3 maximum exported families of species being from the family of flowering plants indicated regulation in the trade of animal species.

FIGURE 5
VISUALIZATIONS REVEALING THE TOP 3 MAXIMUM EXPORTED SPECIES FAMILIES AND THEIR EXPORTER COUNTRIES



Top 5 Maximum Exported Endangered Species Class

Figure 6(a) shows the countries exporting the top 5 maximum exported species by class. United States was seen to be the largest exporter of Actinopteri (fish) with export quantity of 64,994 and almost all of India was seen to be exporter of 19,424 reptiles.

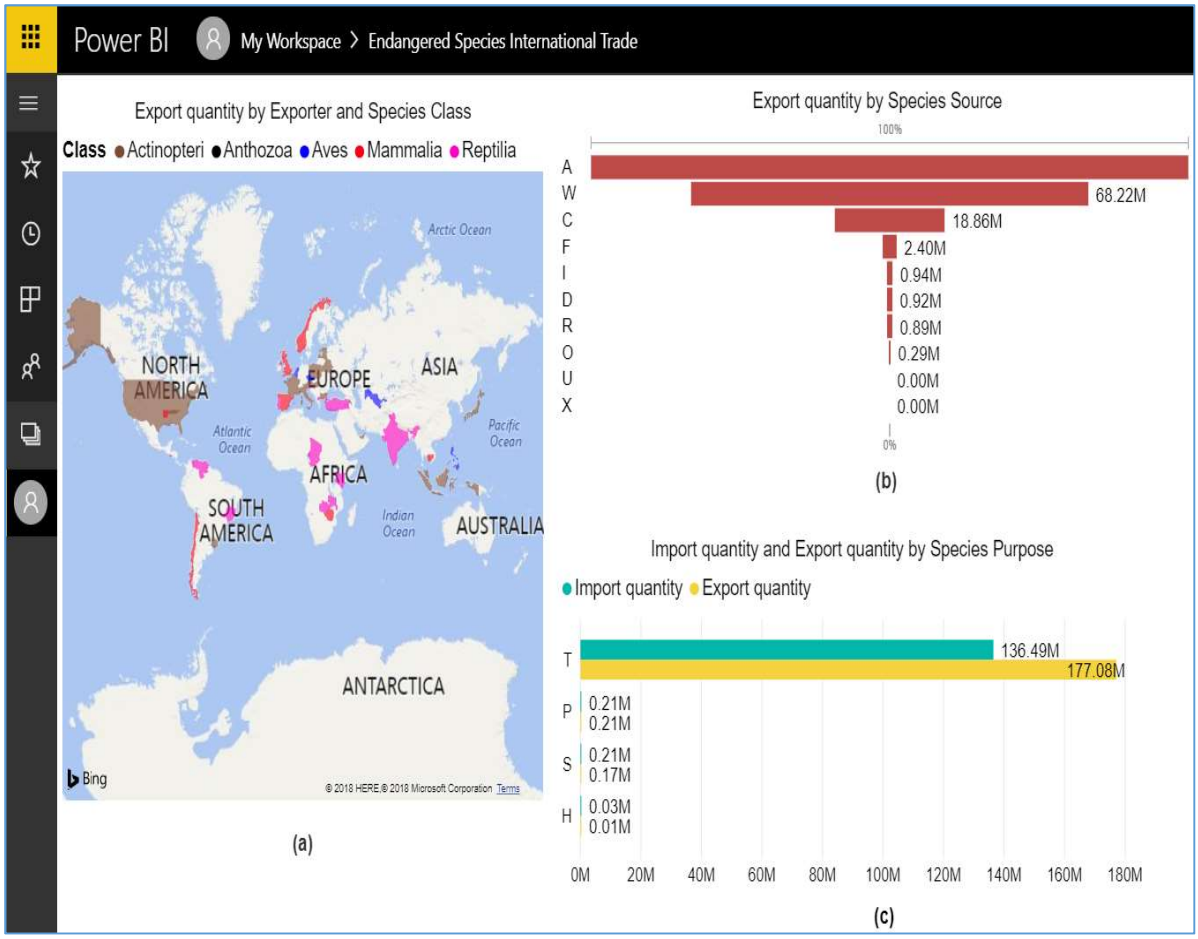
Source of the Maximum Species Exported

Figure 6(b) reveals that approximately 102 million species exported were from the source code A that refers to the plants that are artificially propagated followed by 68.22 million species for source code W referring to taken from the wild. It also reveals that export of animals bred and born in captivity source code C and F respectively are much less than the ones from the wild.

Purpose for the Maximum Species Imported and Exported

Figure 6(c) displays the commercial use (code T) as the purpose for maximum trade occurred. It also shows that number of exported species (177.08 million) were more than imported species (136.49 million) used for commercial purpose. The remaining purposes such as code P (personal), S (Scientific), H (Hunting) had much less trade quantities confirming trade regulation and restriction on the trade purposes.

FIGURE 6
DASHBOARD REVEALING THE EXPORT QUANTITY



CONCLUSION

The method of descriptive analytics using Power BI visualizations provided instant exploration of the endangered species data and revealed meaningful insights on the international trade that occurred in 2016. It can be concluded that use of analytical tools such as Power BI can be very powerful and faster in analyzing the voluminous data from the endangered species international trade database such as CITES. Visualizations created can reveal meaningful insights and thereby benefit the trade restriction monitoring and import/export volume assessment process.

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