

A COMMENTARY ON THE ECONOMIC ASPECTS OF THE TRADE AND TRAFFIC OF WILD ANIMALS AND THEIR CORRELATES TO THE DEMAND CURVE

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Abstract - All animals subject to legal and illegal trade are to be considered from an economical point of view as real economic goods. This preliminary study shows how the economic correlates of the wild trade may influence the elasticity of the demand curve. The elasticity of the demand curve should become a driver in the conservation policy focused to protect the biodiversity of the species. The prices trends are an important key to fully study the elasticity of demand. Understanding the response of consumers and hunters to perceived rarity is vital for predicting the impact of intervention strategies that seek to minimize extinction risk (Hall 2008). The trade in animals is directed towards markets with a higher level of income. In the global market, as the goods increase in price, they will always find their demand. For conservation reasons it is extremely important to understand which are, for each species, the reactions of the demand curve respect to the price changes.

INTRODUCTION

Human use of species is sustainable if it can be continued indefinitely without adverse effects on population survival (Ross 1998). Much of the use of reptiles is clearly unsustainable. Commercial impacts of reptiles have been more pervasive and severe than on amphibians (William 1999). The severity of turtle crisis on a global scale was emphasized by Rhodin (1999), who reported that of the approximately 293 taxa (mainly species, but including some subspecies) of freshwater turtles, tortoises, and sea turtles known to be extant over the last few centuries, 3% (9 taxa) are already extinct in the wild. The commercial trade in freshwater turtles exceeds any possible sustainable levels, and extinction of some species in the wild can be expected within the next decade (Gibbons et al. 2018). In this scenario we would supply an economic view of wild trade starting from some basic considerations.

There are significant differences between economic goods and free goods; a free good provides its usefulness and it is accessible to all, and unlike the economic good it is not scarce and is present in abundance, in a quantity greater than that demanded. The free good cannot have a price because it can be easily obtained by anyone. The value of the good is determined by its abundance and relative scarcity. Without any doubt a

good that is traded, and it is exchanged for a price is defined as economic good. For this reason, even wild animals traded meet the same principle and they are to be considered to all effects as economic goods. As for every economic good, the animals traded also differ for their intrinsic characteristics that determine its demand. One of the main characteristics that distinguish the good is the scarcity. The scarcity is the driver to determine the economic value of the good. We postulate that because rarity makes living species attractive, their (over)-exploitation can remain profitable, rendering such species even rarer, and driving them to extinction (Courchamp et al. 2006). Each economic good is composed by the following characteristics: (i) Scarceness; quantity in which the good is available with respect to the needs. The scarcity of the good determines the exchange ratio on the market through a price. (ii) Utility; utility is the ability of a good to satisfy a specific need. The irrepressible need to collect a specific animal species, the need to eat, the scientific need to obtain data for a research etc. (iii) Price; marginal rate of substitution (MRS) is the rate at which a consumer can give up some amount of money in exchange for a good while maintaining the same level of utility. (iv) Accessibility; the possibility of more or less easily finding a good determines its own value. Hardly

accessible goods could be particularly desired and have a high value. (v) Information; information is an essential requirement of the economic good. This feature collects information on the ability of an economic good to satisfy a specific need. This feature provides all the information related to the good. Imagine scientific articles that provide all the information necessary to find a specific species.

There are several kinds of goods, but the most relevant in the wild trade, where we can find important characteristics of economic differentiations are: (i) Perfect substitutes - Two goods are considered perfect substitutes if the consumer is willing to replace one good with another at a constant rate. (ii) Perfect complements - The perfect complementary goods are

goods that are consumed together in fixed proportions. (iv) Staple goods - They are economic goods that satisfy the primary needs of man as food, clothes, security. (v) Luxury or collectible subject - Luxury goods are strictly connected to the historical and social environment in which human populations do live and the average standard of living. An example is reported by the turtle trade; turtles are not all the same. Each species of turtle is consumed with different purpose. There are turtles purchased as collectible subject, turtles that are considered food as well, turtles that are purchased for reproduction purpose and turtles that are easily to substitute with others because are considered very common species (Figure 1)

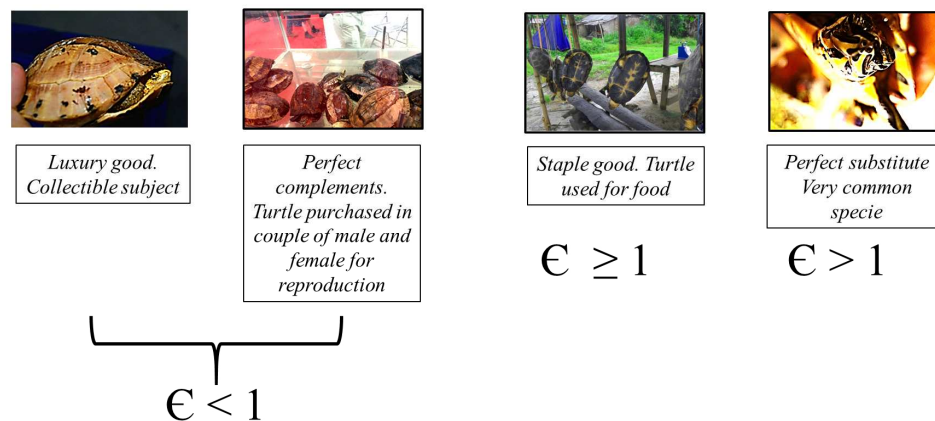


Figure 1 Turtles of different species may be used for different aims and hence are subjected to different elasticity demand curve (ϵ)

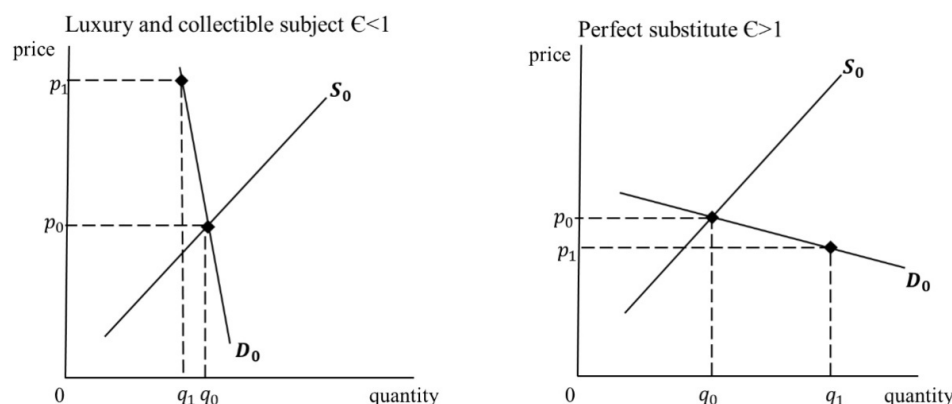


Figure 2 Effect of the elasticity on the demand curve D_0 for two different types of goods

METHODOLOGY

In a Cartesian axis system (figure 2), we represent on the X axis the traded quantities of a generic good X; on the Y axis the prices of the goods sold. We represent the demand curve as a straight line that has a negative slope. The demand curve is negatively sloping because for a generic good x, the higher is the price, lower will be the quantity demanded, while as the price goes down, the quantities demanded increase.

While the supply curve is positively slope because the supplier will be willing to sell further quantities only at ever-increasing prices. In a market system there will be 2 forces: (i) a force that regulates the demand D_0 ; where consumers tend to win increasing quantities at ever lower prices; (ii) a force that regulates the offer S_0 ; where suppliers tend to sell smaller quantities at ever higher prices. The result of these 2 contrasting forces is the achievement of a balance point E_0 , where at the price p_0 the seller is willing to sell the quantity q_0 and the consumer is willing to pay the price p_0 to buy the quantity q_0 . Additional quantities can only be traded through an increasing of price, thus achieving a new market equilibrium point E_1 . We found that severely declining species have a significantly different price-volume signal than stable/increasing species; the former are characterized by increasing market prices and declining volumes (Berton Harris et al. 2015).

The position of D_0 depends on the characteristics of the good. The intrinsic characteristics of the good determine the reaction of the quantity demanded to price changes. This reaction is called elasticity

$$\epsilon = \frac{\Delta y/y}{\Delta x/x}$$

Where x are the quantities traded, y the prices and the range of the elasticity $0 \leq \epsilon \leq \infty$. The elasticity determines the slope of the demand curve. In other words, the elasticity of the demand curve in relation to the price varies for types of goods. For example, if we take the case of luxury or collectible subject and we consider the forces that directly affect the price we can observe that normally these are highly desirable goods for which people are willing to bear sacrifices and waivers to ensure their use. The information for this type of good is circumscribed to a selected target of consumers and it is not available for everybody. While in term of the utility, it evaluates the capacity of the good to satisfy a specific need of

the collector that gives a subjective utility based on human perception. Normally collectible subjects are very difficult to reach, and they have a very low accessibility. Scarceness play an important role because this type of goods is very rare.

Optimal public expenditures on apprehension and conviction of illegal suppliers obviously depend on the extent of the difference between the social and private value of consumption of illegal goods, but they also depend crucially on the elasticity of demand for these goods (Becker et al. 2004). In the left part of figure 2 is depicted a generally vertical demand curve represented by a vertical “rigid demand curve”. Large price changes are transformed into small variations in the quantity demanded. In the left part of the figure 2 is depicted. a generally flat demand curve is defined as “elastic demand curve”. Small variations in prices determine large variations in the quantity demanded.

CITES TRADE Database has been used to collect the quantity trade between 1980 and 2015 by the United States and Europe for *Kinixys belliana*, *Kinixys erosa*, *Kinixys homeana*. The analysis was performed with Past statistical software. Furthermore, it has been analysed the export of *Reptilia* from Vietnam and Togo. While from China has been analysed the quantity demanded of *Testudinidae*.

In this study, I made two simulations on the economic relations between the official market and the black market, with the aim to identify economic variables that are involved in animal trafficking. In order to make a state of the art on all the economic information available on the phenomenon, two typical scenarios are analysed.

The variables are defined as follow:

- p_w = Price in the official market
- p_b = Price in the black market
- D_L^C = Legal Demand of certified goods
- D_N^U = Demand of uncertified goods by non-law-abiding consumers
- S_L^C = Legal Supply of certified goods
- S_N^U = Supply of uncertified goods by non-law-abiding producers
- q_L^C = Consumption of certified product by law-abiding consumers
- q_N^U = Consumption of uncertified product by non-law-abiding consumers

FIRST SCENARIO $p_w > p_b$

It is not possible to talk about the economy of a good subject to wild trade without considering the correlations that this good has with the different types of markets. The official market and the black market are symmetrical and can give rise to different scenarios. “The black market in illegal wildlife is now the second largest in the world—ranking only behind the trade in illegal drugs” (Schneider 2008). Therefore, the illegal trade, according to Cook et al. (2002), not only threatens survival and conservation of endangered species but also offers high rewards and low risks to those involved.

Here it is depicted the scenario where the price p_w that balances demand and supply in the official market is greater than the price p_b that balances demand and supply in the black market (figure 3).

This situation is represented by the black part of the two graphs. When the price on the official market is higher than the price on the black market, the traded quantity of the non-certified good on the black market is higher than the quantity traded on the official market.

$$t_0 \rightarrow q_N^U > q_L^C$$

There is a delta of variation between the black-market price and the official market price.

$$t_0 \rightarrow p_w^0 > p_b^0$$

On the black market they will tend to sell larger quantities at a lower price than the official market. Therefore, at moment zero $q_N^U > q_L^C$.

$$p_w - p_b = \Delta_{t_0}$$

Assuming an increase in the price on the official market what happens on the black market? What are the forces that regulate the market?

Who offers a good pursues the tendency to sell as much as possible lower quantities at a higher price?

Consumers tend to buy as much quantity as possible at ever lower price.

Therefore, the supply curve in the official market tend to switch on the left. But at the higher price the consumers reduce their demand, so the demand curve tends to switch on the left. The market finds a new equilibrium point in E_1^C , where at price p_w^1 are traded the quantity q_L^C .

The black market moves accordingly and tends to settle itself with a new equilibrium point E_1^U .

At moment one, the quantities traded in the black market are higher that the quantities trade in the official market of certified product:

$$t_1 \rightarrow q_N^U > q_L^C$$

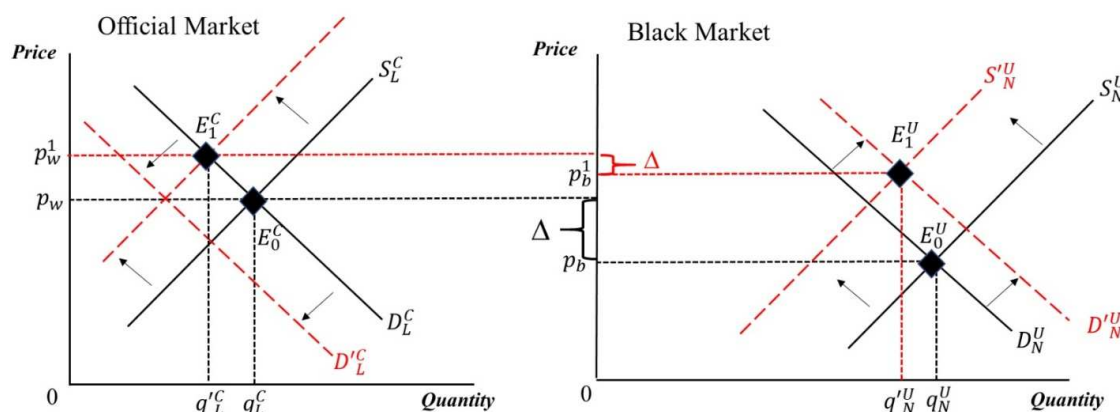


Figure 3 scenario $p_w > p_b$

The black market with the aim of maximizing profits raises prices thus reducing the prices gap between the official and the black market.

$$\Delta_{t_0} > \Delta_{t_1}$$

$$\Delta_{t_0} - \Delta_{t_1} > 0$$

SECOND SCENARIO $p_b > p_w$ FIX QUOTA OR TRADE BAN

In a condition of equilibrium on the official market the goods are not present in unlimited quantities, but the quantities traded are planned, so the quantities are fixed (figure 4). This means that additional quantities of the good cannot be found on the official market.

The additional quantities requested do not find a corresponding offer. So, to find additional quantities it is necessary to resort to the black market.

In the graphical representation figure 4 the double effect has been decomposed:

- An effect on the demand side D_L^C move to D_N^U ;
- An effect on the supply side S_L^C move to S_N^U ;

The consumers, that need further quantities respect those available in the official market, go on the black market. This effect produces an increasing of uncertified good demanded. The demand curve switch from D_L^C to D_N^U .

Suppliers on the black market will be willing to sell additional quantities only at a higher price so that will increase the marginal trading rate on the black market and the slope of the supply curve will be more vertical. The supply curve switch from S_L^C to S_N^U . The slope of the supply curve passes to S_N^U on the black market, where it is possible to commercialize additional quantities with respect to the quantity q_L^C of the official market.

The projections of the D_N^U and S_N^U on the Black Market meet each other's in a specific equilibrium point, the new equilibrium point will only take place at a higher price level. The projections of the demand and supply curves on the black-market led to a new point of equilibrium E_b .

In a new quadrant, we can see that the projections of supply and demand curves on the black-market lead to the achievement of a new equilibrium level. This equilibrium point is reached at a higher price than the official market of goods. In E_b the new scenario shows that $p_b > p_w$ and the quantities q_N^U

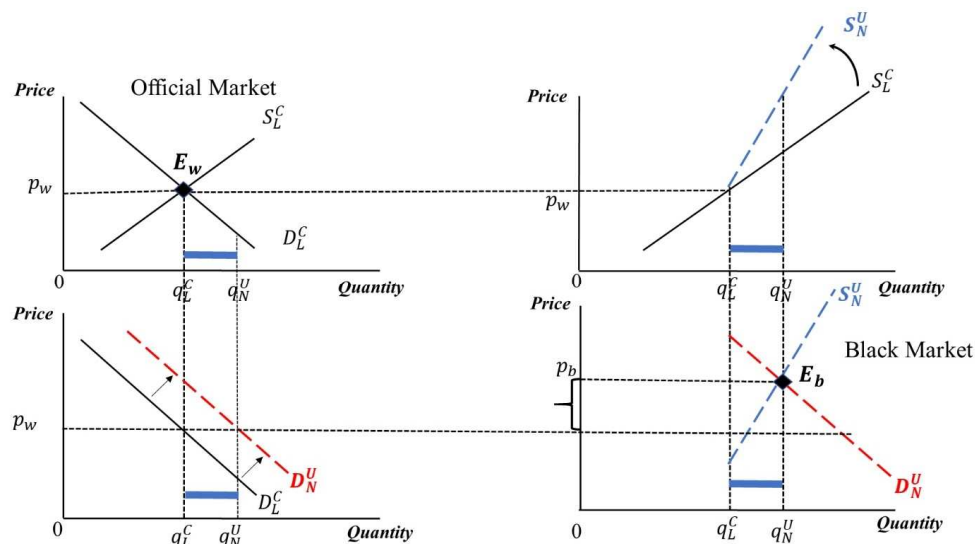


Figure 4 scenario $p_b > p_w$

RESULTS AND DISCUSSION

Legal and illegal trade of wild animals is subject to the complex implications of global market. The globalization produces effects on the global demand because provide a greater diversification of consumers. This network gives greater information and increase the number of markets where wild animal can be traded (Arawatari et al. 2015). The effects of globalization on local economies can be contrasting by promoting or depressing local productions. It produces a more stable presence of the good on the market due to a reduction in

the effects of seasonality. Furthermore, the globalization renders greater accessibility of the good.

However, from a conservationism point of view the quantities traded in the legal and illegal market are unsustainable for the survival of the species. The trade in fresh water turtles and tortoises in Asia is so huge that it threatens the survival of many species (Nijman et al. 2007)

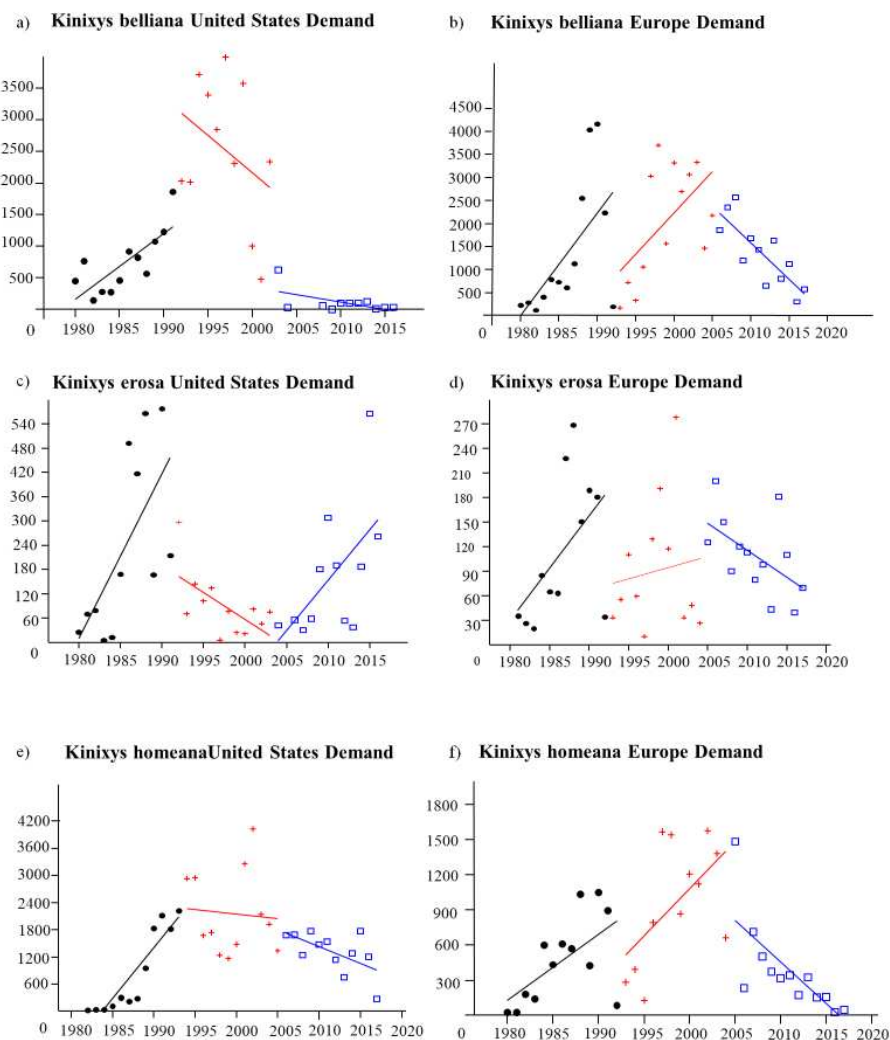


Figure 5 Demand of *Kinixys* in the market of United States and in Europe

On the other hand, there are countries that are net importers (figure 5). A statistical analysis has been performed with one-way -ancova of the data downloaded by CITES Trade Database. The analysis was focused to identify a significance in the trends. We report here the result for each analysis:

Figure 5:

part a) Demand of *Kinixys belliana* from 1980 to 2015 by the United State ($P = 0.042$, $F = 5.553$);

part b) Demand of *Kinixys belliana* from 1980 to 2015 by Europe ($P = 0.0075$, $F = 7.254$);

part c) Demand of *Kinixys erosa* from 1980 to 2015 by the United State ($P = 0.0050$, $F = 6.35$);

part d) Demand of *Kinixys erosa* from 1980 to 2015 by Europe ($P = 0.055$, $F = 3.174$);

part e) Demand of *Kinixys homeana* from 1980 to 2015 by the United State ($P = 0.0007$, $F = 9.13$);

part f) Demand of *Kinixys homeana* from 1980 to 2015 by Europe ($P = 0.0005$, $F = 9.6$)

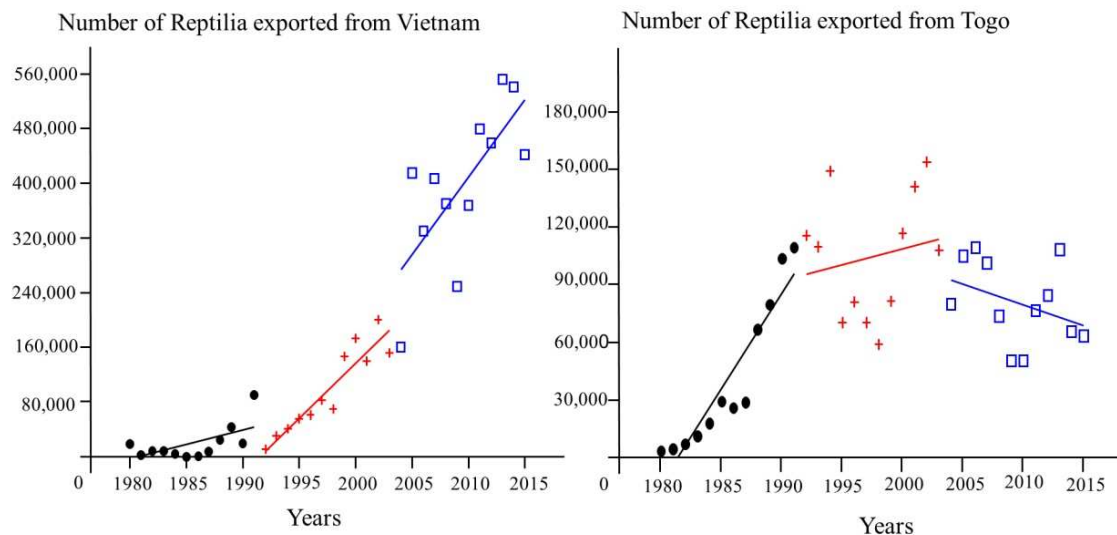


Figure 6 Vietnam and Togo net exporters of Reptilia

For each *Kinixys* analyzed imported either by United States or by Europe it is possible to identify levels of P value very significant and for each of them it is possible to underline a trend.

Even though *Kinixys* are usually a luxury and collectible subject, it is very interesting to highlight that the intrinsic characteristics of the same good impact differently in the two markets. There is a different role played by scarcity, price, accessibility, information.

There are countries that are characterized as net exporters of animals (figure 6). The theoretical underpinning of sustainable use as a conservation tool should be based largely on the creation of incentives that make the conservation of wildlife populations and their habitat in the best interest of those who benefit from the harvest (Thorbjarnarson 1999). Meanwhile the import of Reptiles by USA (figure 7 a) analyzed with past software show 3 significant trends and a general decreasing trend from 1980 to 2017 ($P = 0.00059$, $F = 9.444$).

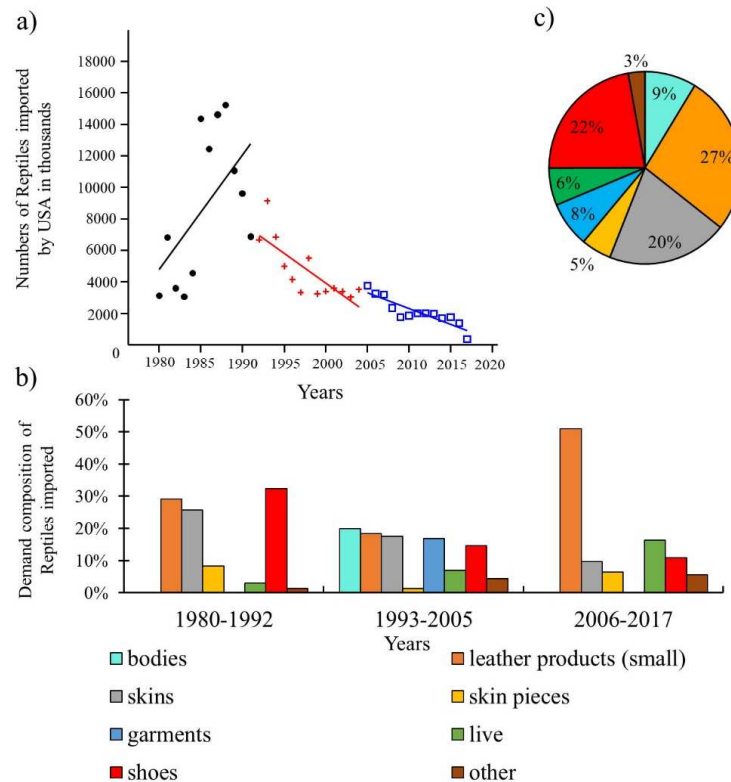


Figure 7 a) Trend of Reptiles import by the USA; b) Demand composition of Reptiles import by the USA from 1980 -2017; c) Average composition of import demand 1980-2017

But if we look at the composition of the import per purpose (fire 7 b) there is an increasing in the import of live animal, there is an increasing in the import of reptiles for leather products and a decreasing in the import for shoes production. It is very interesting observe that the 91% of import of reptiles

is composed by purpose as raw material in production processes (shoes, leather products, skins, garments, bodies). Only 6 % of the total import are live animal and they are considered collectible subject.

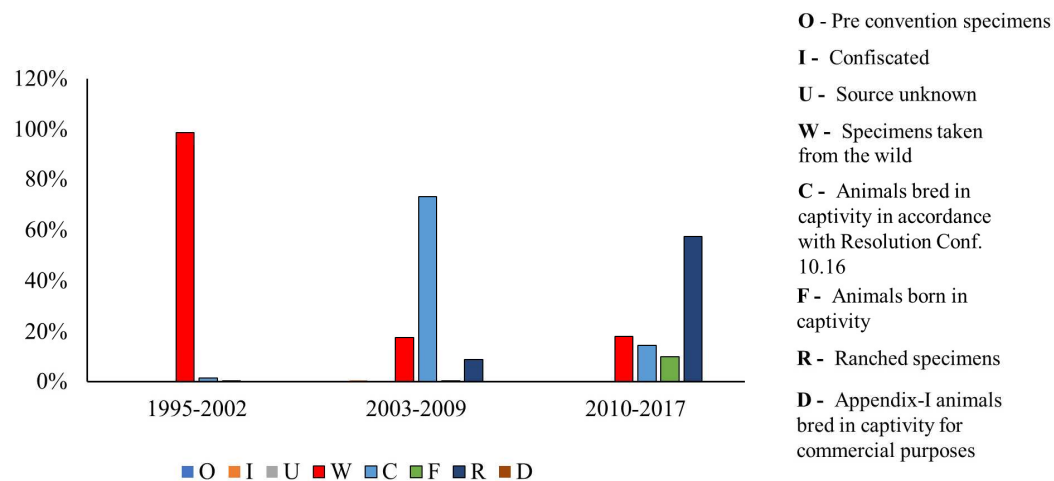


Figure 8 Testudinidae imported by China per source from 1995 to 2017

A fascinating example of market changes is represented by the import of Testudinidae by China (figure 8). We are witness to the changes of the good's characteristics during the years from 1995 to 2017. The market of Testudinidae is changed because during this period there was a reduction of specimens taken from the wild in favor of an increment of ranched specimens and animal bred in captivity.

CONCLUSIONS

The aims of the wild trade are: (i) food purpose, (ii) as raw material for production processes, (iii) as a raw material to produce medicines in traditional and non-traditional medicine or simple consumption, (iv) collecting purpose, (v) scientific purpose. But the main driver to study the paths of the import is the income level. The EU is an important destination and transit market of trade in wildlife. While according to Engler and Parry-Jones (2007) the EU ranks as top importer by value of wildlife, Europol indicates that the EU is simultaneously one of the most important markets of illegal trade in endangered species. Large European airports (e.g. Schiphol, Frankfurt, Heathrow) and major harbours (e.g. Antwerp, Hamburg, Rotterdam) appear to play an important role as main entry points to enter the EU for the demand market or in transit (Daan van Uhm 2018).

Based on limited data available dealers and their regional counterpart earn for bonobo and gorilla much more respect of the poachers, that earn is a very small amount compared to the final price paid by long-distance buyers and are paid (Clough., 2018)

The interconnections of the markets in a global system increase the value of the global demand. In a global market the higher will be the income levels, the higher will be the aggregate demand for a given aggregate offer. The trade in animals is directed towards markets with a higher level of income. In the global market, as the goods increase in price, they will always find their demand.

For conservation reasons it is extremely important to understand which are, for each species, the reactions of the demand curve respect to the price changes.

There are economic variables governing the market and influencing the quantities traded; to date, however, these variables have not been sufficiently investigated and require more in-depth studies. It is necessary to reconstruct the trend of the market demand in all the wild traded species to study the reactions of the demand to the price variation. This would allow the application of corrective economic interventions aimed at regulating the quantities traded in order to allow the

application of biodiversity conservation policies through economic corrective mechanisms.

What we should investigate is, to what extent do the supply and demand curves vary in relation to price changes because when the demand elasticity is perfectly inelastic an increase in price leaves the quantity demanded unaltered. In this case the elasticity is $= 0$ and the demand curve is vertical. If we found an inelastic demand has a level of elasticity < 1 it means that a $\Delta\%$ price increase causes a reduction in the quantity demanded of less than $\Delta\%$. If the elasticity of the unit demand is characterized by having a level of elasticity equal to 1, which means that an increase in the price turns into a reduction in the quantity demanded of the same percentage. In case that the demand is elastic, it means that is characterized by having a level of elasticity >1 , which means to have a decrease in quantity demanded that is more than proportional to the price increasing. Understanding the response of consumers and hunters to perceived rarity is vital for predicting the impact of intervention strategies that seek to minimize extinction risk (Hall et al. 2008).

The analysis of the demand curve allows us to understand what response should have with the implementation of corrective policies aimed to the conservation of animal species.

A new and important element to be included in the battle to preserve biodiversity is the introduction of price trends in order to fully study the elasticity of demand.

Towards policies addressed to regulate the quantity trade on the market it is possible to have positive effects on the preservation of the biodiversity. With the application of the duty as a quantitative and regulatory mechanism. According to Stolper-Samuelson's theorem (Deardorf et al. 1994), the imposition of a tariff favours (in the sense that it increases the real unit remuneration) the factor most intensively used in the sector that produces the import good.

The country, that imposes a duty, increases its welfare. The other countries pay the expenses of this increase. Thus, the Pareto optimality is confirmed in the free trade.

The duty becomes an instrument for the transfer of wealth. In this way, importing countries can promote biodiversity protection programs in exporting countries.

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REFERENCES

- Arawatari, R. (2015), Political Economy of Trade Openness and Government Size. *Econ Polit*, 27: 28-52.
doi:10.1111/ecpo.12049 <https://doi.org/10.1111/ecpo.12049>
- Becker, G.S., Murphy, K.M., Grossman, M. (2004). The economic theory of illegal goods: the case of drugs.
<http://www.nber.org/papers/w10976> JEL No. D00, D11, D60, I11, I18
- Berton Harris, J. C., Green, J.M.H., Prawiradilaga, D. M., Giam, X., Giyanto, Hikmatullah, D., Putra, C. A., Wilcove, D. S. (2015). Using market data and expert opinion to identify overexploited species in the wild bird trade. *Biological Conservation* 187 (2015) 51–60.
- Clough, C., (2018). Illicit Financial Flows and the Illegal Trade in Great Apes. Report by Global Financial Integrity October 2018 <http://creativecommons.org>.
- Cook, D., Roberts, M., & Lowther, J. (2002). The international wildlife trade and organised crime: A review of the evidence and the role of the UK. Wolverhampton, UK: WWF-UK.

- Courchamp F, Angulo E, Rivalan P, Hall RJ, Signoret L, et al. (2006) Rarity value and species extinction: The anthropogenic Allee effect. *PLoS Biol* 4(12): e415. DOI: 10.1371/journal.pbio.0040415
- Daan van Uhm. (2018) Illegal Wildlife Trade to the EU and Harms to the World. <https://www.researchgate.net/publication/305441741>
- Deardorff, A.V., Stern, R. M., Sundari R. B. (1994) The Stolper-Samuelson Theorem: A Golden Jubilee The University of Michigan Press ISBN 0-472-10533-7
- Engler, M. and Parry-Jones, R. (2007). Opportunity or Threat: The Role of the European Union in Global Wildlife Trade. Brussels: Traffic Europe.
- Fischer, C. (2004) The complex interactions of markets for endangered species products. Elsevier *Journal of Environmental Economics and Management* 48 (2004) 926–953 doi:10.1016/j.jeem.2003.12.003
- Gibbons, J. W., Scott, D. E., Ryan, T. J., Bulhmann, K. A., Tuberville, T. D., Metts, B. S., Greene, J. L, Mills, T., Leiden, Y., Poppy S., Winne, C.T. (2018) The Global Decline of Reptiles, Déjà Vu Amphibians. August 2000 / Vol. 50 No. 8, BioScience.
- Hall, R. J., Milner-Gulland, E. J, Courchamp F. (2008). Endangering the endangered: The effects of perceived rarity on species exploitation. <https://doi.org/10.1111/j.1755-263X.2008.00013.x>
- Nijman, V., Shepherd C. R (2007). Trade in non-native, CITES-listed, wildlife in Asia, as exemplified by the trade in freshwater turtles and tortoises (Chelonidae) in Thailand. *Contributions to Zoology*, 76 (3) 207-212 (2007).
- Rhodin A. (1999). Celebrate the turtle: Perception and preservation. Paper presented at Powderm i ll 1999, 4th Occasional Fresh water Turtle Conference; 13–16 Aug 1999; Laughlin, N V.
- Ross JP, ed .1 9 9 8. Crocodiles: Status Survey and Conservation Action Plan. 2nd ed. < www.flmnh.ufl.edu/natsci/herpetology/act-plan/plan1998a.htm> (6 Jul 1998).
- Schneider J. (2008). Reducing the Illicit Trade in Endangered Wildlife: The Market Reduction Approach. *Journal of Contemporary Criminal Justice* 2008; 24; 274 originally published online on May 22, 2008. DOI: 10.1177/1043986208318226
- Thorbjarnarson, J.(1999). Crocodile Tears and Skins: International Trade, Economic Constraints, and Limits to the Sustainable Use of Crocodilians. *Conservation Biology*, Pages 465–470 Volume 13, No. 3, June 1999
- Williams T. (1999). The terrible turtle trade. *Au du bon Magazine* 101: 4 4 – 5 1