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The introduction of the Africanised honey bee: A stinging menace or a blessing of the Americas?

- A comparison of the Brazilian and USA beekeeping experiences

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Abbreviations

AAPA	American Association of professional Apiculturists
AHB	Africanised Honey Bee
AIA	The Apiary Inspectors of America
APACAME	The São Paolo Association of Beekeepers, Breeders of European Bees
CBA	Brazilian Confederation of Beekeeping
EHB	European Honey Bee
EMBRAPA	The Brazilian Agricultural Research Corporation
FAO	Food and Agriculture Organisation
FARGS	Federation of Beekeeping Associations of Rio Grande do Sul
IBEG	Brazilian Institute of Statistics
NASDA	National Association of State Departments of Agriculture
USAD	U.S Agriculture Department
SEBRAE	Brazilian Service of Support for Micro and Small Enterprises

Abstract

In 1956, Brazilian scientist Warwick Estevam Kerr, introduced queens of the African honey bee (AHB) from South Africa to breed with European honey bees (EHB) in order to improve honey production in Brazil. Some of the AHB swarmed by accident out of the experimental apiary, located in Rio Claro-São Paulo State, and started to spread. Today, these have mixed with EHB and exist all over Brazil, the Neo tropic of South America, Central America, and South USA. This situation created drastic changes in the management of bees across the region.

This research explores and analyses the effects of the spreading of AHB in the social, economic, and policy-making levels in the apiculture sector in Brazil and USA. The study also contrasts and discusses the challenges faced by beekeepers in both countries and the resulting adaptation strategies to manage this new species.

One of the most important results in economic terms was the gradual increase in honey production years after the introduction of Africanised bees to Brazil; On the other hand, in the United States, the introduction did not cause any alteration in beekeeping in the already declining production of honey. In contrast, free market policies, inadequate handling of bees, diseases, inadequate use of pesticides among other factors have contributed to the fall in honey production and the number of boxes of bees for decades. Another result in the social field was the constitution of an interstate organisation of beekeepers allowing beekeepers to organise congresses and conferences with the purpose of discussing, analysing and proposing joint solutions to the emerging threat of Africanised bees as well as seeking new technologies for their management as well as government support to fund apiculture enterprises.

In general terms, the introduction of the Africanised in the medium and long term turned out to be a blessing instead of a threat to Brazilian apiculture and the rest of the Americas. However, in the United States, before and during colonisation, Africanised bees were seen as a threat to the beekeeping system, a vision that was dissipated as beekeepers became informed and found the best way to face the threat of Africanised bees, but with a problem still unsolved what will happen to the Africanised bees that for more than 20 years are already in the United States as swarms around the apicultural areas?

Keywords: Africanised honey bee, beekeeping Social field, Qualitative and Quantitative research methodology

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1. Introduction

1.1. Justification of the study

In 1956, Brazilian geneticist Warwick Estevam Kerr and his team travelled to Tanzania and South Africa and brought back to Brazil 56 queens of the aggressive African Honey Bee (*Apis mellifera scutellata*)[1] also known as AHB. Kerr's and his colleagues' intention was to crossbreed African Honey Bees (AHB) with European Honey Bees (EHB) in order to get less aggressive, more productive and more resistant bees. At that time, European bees in the Brazilian tropics were suffering from pests and diseases. Despite abundant flora and vast territories at hand, beekeeping in the North of Brazil had not had the same desired success as of those in temperate areas in Southern Brazil. Kerr and his colleagues were trying to solve those issues by crossing AHB and EHB. Unfortunately for Kerr, during the hybridisation phase, in a remote location of the periphery of Ribeirao Preto, while the African bees still were held in quarantine, 26 queens of AHB escaped. An unauthorised person took off by accident the grids that were placed at the entrance of the hives to prevent the bees from escaping. These bees mated with European bees and produced an offspring that spread all over Brazil and the tropics of the entire American continent.

In Brazil, as expected, critical voices were heard both from state officials as well as the general public, whenever the AHB were colonising new areas. One example of this is the letter from the responsible person of the beekeeping industry in Espirito Santo State, addressed to the Journal of beekeeping "A Colmeia" in 1972. In an annoyed tone he described his disagreement with the introduction of the Africanised bees, and his sadness of the destruction of the previous forms of beekeeping in Brazil and the whole continent. The same person recounts a disagreement he had with Kerr in a hotel room in his city where he stated that there was no need for these bees, which he called "the Greek gift" (A Colmeia, 1972) .

The incident with the AHB destroyed Kerr's reputation as a researcher. Even 20 years after the accident Kerr was still subject to bitter criticism wherever he went. Once a woman frowned saying to her little son that he was the man who had introduced the aggressive bees to Brazil (Coelho, 2005).

Up to this day, the spread of AHB all over the Americas represent one of the most controversial events in the history of the introduction of new biological species to the American continent. According to entomologist Mark Winston (1992:1) "*...countless insects, both beneficial and detrimental, have been introduced to locations throughout the world; but the Africanised honey bee [….] stands out because of the rapidly of its spread and the economic devastation it has brought*."

To make things worse, the media handled the discussion about AHB, and its effects, with sensationalism instead of facts in order to sell their headlines. Any kind of bee sting incident was reported as a major news event. It was the media in the United States that coined the term "the killer bees" to describe AHB. Mark Winston once said that "the Africanised "killer" bee was the popular insect of the twentieth century, media star of tabloids, B movies and television comedy (Winston, 1992: 2).

The socio-economic and political impacts of the crossbreed between AHB and EHB, and their subsequent spread, were noted at different times and levels in the beekeeping industry, both in Brazil and the USA. This was reflected mainly in the fall of honey production and the loss of hives with European bees. Therefore, government agencies sought to take measures to stop the invasion of the feral bees and mitigate its effects, both on beekeeping and the population in general. However, the measures undertaken by government agencies failed. They could not stop the advance of Africanised bees neither avoided the Africanisation of European bee hives.

In places where beekeeping was based on European bees the effects were devastating. By 1982, in Panama, the Africanised bees reached 338 beekeepers, the number of colonies declined by over 80%, overall production was down to 90%, and the number of beekeepers dropped by over 50% compared to the figures before the arrival of AHB (Caron, 2001: 86).

[1] ***Apis mellifera scutellata*** Lepelier (East African bees), were considered to be ***Apis mellifera adansonii*** during the early years of the introduction in Brazil, until Ruttner, in 1975, proposed that these bees were another species and could be called as *A. m. Scutellata* (Winston, 1991).

Despite an initial state of decline and devastation, some years later, beekeepers in some countries coped with the new situation by developing management techniques to work with the aggressive Africanised bees (Caron, 2001). In the case of the Peruvian Amazon and the Brazilian northeast beekeeping was born and developed with Africanised bees as an initiative of local people, often stimulated by international development agencies or by the government itself.

By 1990, AHB had reached the Southern part of the USA. However, a trained and well-informed legion of beekeepers faced the challenge with relative success. The control policies established by the United States Department of Agriculture were to prevent Africanisation of European bees. But now, 26 years after the invasion, those policies are questioned. Many beekeepers are wondering if it is worth continue fighting with or just adapt the management to Africanised bees, as many beekeepers in South America already did.

Nowadays, decades after the accidental swarm in Rio Claro, and the subsequent spread of AHB across the Americas, little research has been conducted about the effects of this event from the social sciences perspective, the beekeepers' coping strategies and the lesson that can be drawn from those processes.

1.2. Research problem

This research aims to explore how the beekeeping social field in Brazil and the US, at economic, social and policy-making levels, was impacted by the spread of AHB; how the beekeepers reacted to it and; what strategies were implemented to fight the invasion of the Africanised honey bee (AHB) in each of these countries. This study covers the period between 1957 -2012 in Brazil; and 1990 - 2012 in the case of USA. These time frames cover the moment of arrival to the moment Africanised bees were spread in both countries.

1.3. Objectives

1.3.1. Obtain an understanding of the change of apiculture after the introduction of the Africanised Honey Bee; both in the USA and Brazil.
1.3.2. Identify the main economic, social, cultural and political impacts on beekeeping in the USA and Brazil.
1.3.3. Analyse how the beekeepers in each country perceived and reacted to the gradual domination of the Africanised Honey Bee and identify the main strategies and actions they used.

1.4. Background and Context

African, Brazilian or Africanised honeybees?

According to Kent (1988) "*the hybrid honeybee that resulted from interbreeding between the dominant honey bee races in Brazil after 1957 is known by two different vernacular names. The Committee on the African Honey Bee refers to the hybrid as the Brazilian honeybee...Many other writers, led perhaps by Brazilians, had preferred to call the hybrids Africanised honeybees. Gonçalves (1974:145) outlines the rationale for the use of this term. He argues that the indigenous stingless bees of Brazil are called Brazilian bees and, hence, the hybrids cannot be called Brazilian honeybees, but should be called Africanised honeybees, because of their genetic mixing with the African queens initially introduced in Brazil. His reasoning is sound and in this study the hybrids will be referred to as Africanised honey bees*". Similarly, in this study the acronym AHB is used to refer to the hybrid or the Africanised honeybee.

Beekeepers: who were they?

Beekeepers in Brazil

Before the introduction of African bees (*Apis mellifera scutelata*) Brazilian beekeepers practiced a "hobbyist" beekeeping, i.e., beekeeping was not their main activity, but secondary. Their main purpose was to meet the consumption needs of their own families (EMBRAPA-Meio Norte, 2003). According to Michener (1975: 412) in the tropics, the interest in the honey bee was very little.

Most of the beekeepers were settled in the temperate southern regions of Brazil, in the states of Santa Catarina, Paraná and Rio Grande do Sul. They were mostly European immigrants, who mainly came from Germany. They did not only introduce their own bees, the European black bee (*Apis melliphera melliphera*), but also their own beekeeping knowledge and technologies. According to Cassidos dos Reis Pinheiro (nd), the rational Brazilian beekeeping started in southern Brazil.

During this period, most of the beekeepers had few beehives. Due to the low aggressiveness of the European bees, most of the hives were located close to houses and near other domestic animals such as pigs, chickens, horses, etc. (Embrapa Meio-Norte, 2003). Clearly, at that time, bees were not seen as a threat to domestic animals. Michener (1975: 412) adds that "before 1957 bees were often kept in or near settlements, especially in southern Brazil (…..). It was not difficult to obtain apiary sites."

Before the first swarm of AHB there was little information to share among Brazilian beekeepers. The only two bee magazines were written in German and were distributed among German-speaking beekeepers: *Brasilienische Bienenpflege* from 1897 and *Der Deutsche Imker* in Paraná from 1933 (Crane, 1999: 454). In 1951 the first Brazilian beekeeping magazine in Portuguese, called 'Brazil Beekeeping', was created by the beekeeper Edgar Vieira Cardoso from São Paulo state. Since then the Brazilian beekeepers have had a vehicle of national communication and knowledge exchange among them (Cassidos dos Reis Pinheiro, nd).

Beekeepers in the US

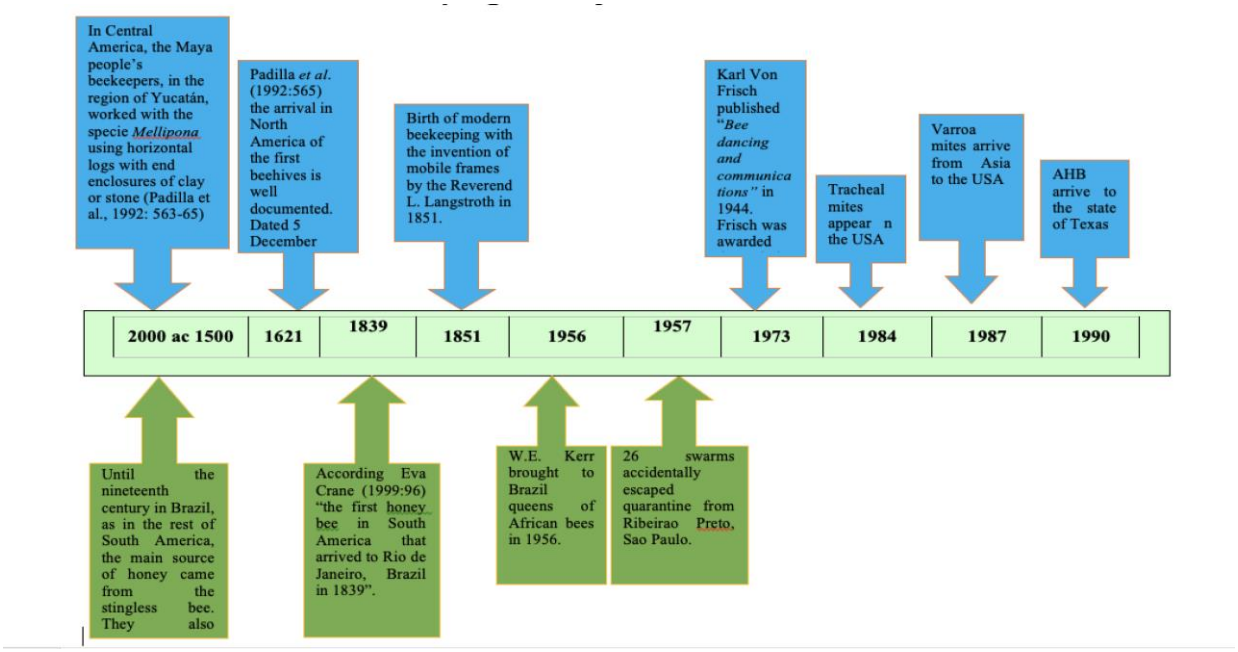
In the USA, beekeepers were classified as a hobby (fewer than 25 hives), part-time (25-299 hives), or full-time, commercial, producers (300 or more hives) (Hoff and Willet, 1994:2). By 1980, the USA was "keeping almost 5 million colonies of honey bees and produce 90 million to 113 million kilograms of honey annually" (Martin, E.C., 1980:1). There is a wide range of estimates regarding the actual number of beekeepers in the United States, however, since the Federal Government makes no official estimates. The International Trade Commission (ITC) reported in 1976 that the U.S. honey industry was comprised of 1,600 commercial beekeepers, 10,000 part-time beekeepers, and 200,000 hobbyists (Hoff and Willet, 1994:2).

The apiculture industry has a preponderance of small operators who keep honeybees as a hobby or for small-scale pollination of orchards and field crops. Most honey produced by hobbyists is consumed at home, given to friends and relatives, or distributed through local outlets. Many small producers do not operate honeybees primarily for profit nor are they necessarily concerned with production efficiency (Hoff and Willet, 1994:2). An estimated 90-95 percent of all beekeepers are hobbyists. Hobbyists and part-time beekeepers together account for about 99 percent of the beekeepers, half of the colonies, and 40 percent of the honey extracted (Ibid, 1994:2).

Part-time beekeepers were classified as owners of 25-299 colonies. Units of this size were usually not large enough to employ a beekeeper full time, and beekeeping generally did not serve as the principal source of income. However, since part-time beekeepers sold most of the honey they produced, they were more concerned with honey prices and production costs than the hobbyists were. There were an estimated 10,000 part-time beekeepers in the United States (Hoff and Willet, 1994:2).

Full-time or commercial beekeepers were estimated to be 1,600-2,000, owning 300 or more colonies. This group produced about 60 percent of the honey extracted. Full-time beekeepers could be divided into two groups: migratory and non-migratory. Most full-time beekeepers relocate their bee colonies several times during the year to provide pollination services, reach more abundant sources of nectar, or to escape damage from pesticides. Migration allows beekeepers to extend the production season by providing their bees with a supply of nectar for a longer period and move their colonies over significant distances. The non-migratory beekeepers normally leave their colonies in the same location, summer and winter (Hoff and Willet, 1994:2-3). There was a small group of full-time beekeepers that specialises in the production of queens and packaged bees. These beekeepers sold packages of bees to other beekeepers to replace colonies killed or severely damaged in the fall and winter in northern areas; to strengthen colonies weakened by overwintering, diseases, or pesticides and; to stock new colonies. The majority of packaged bees and queens are shipped between March and May to beekeepers throughout the United States (Ibid, 1994:3).

Figure1: *Brazilian and USA Beekeeping before the arrival of the AHB*



Source: Adapted from Crane, 1996; Padilla et al 1992 and Horn, 2006

The timeline shows the most important events occurred between the introduction of European bees to Brazil and the United States, until the introduction and arrival of Africanised bees to both countries. These events contributed, especially in the United States, to the transformation and modernisation of beekeeping in that country and in the world. As it is the case of the invention of the mobile frames and the investigation on dance of the bees that allowed to know the form as they communicate to collect the nectar of the flowers. The figure allows us to compare in what historical context Africanised bees were introduced in both countries. For example in this table we can notice that the introduction of European bees was earlier in the United States than in Brazil, we can also see that before the introduction of European bees, native bees were handled. It is important to note with the invention of mobile frames began modern beekeeping in the world. Finally, despite the European population settled in both countries, beekeeping has more historical and cultural roots in the United States than in Brazil.

The Africanisation process of European Honey Bees in the Americas

After 56 years in 22 countries in the Americas (Crane, 1999, Table 2 and 3), beekeeping has experienced a process of Africanisation, except in Chile and Canada, located at the southern and northern extremes of the continents. Chile is also protected by the "Andean Cordillera", which acts as a natural barrier. In the remaining 22 countries of the Americas (Crane, 1999) the Africanisation of beekeeping and the occupation of the territory by the swarms have been partial or total. In some countries like Argentina, the United States and Peru, the AHB came to inhabit warmer areas, but did not settle in cold areas (figure 1). In Argentina, AHB only mixed with EHB and reached the northern part of the country, while in the United States the bees only succeeded to settle in the southwest, parts of California and part of the Southeast including Florida (U.S Agriculture Department-USAD, 2012[2]); and in the Peruvian case AHB succeeded in occupying the Amazon and the northern semi-arid coast of the country, but not the high Andean territory, because it is a very cold area (Kent, 1989).

Table 1: Mainland North and Central America: dates of first records found for European hive bees (Apis)

Entries are made only for countries where dates were found; ( ) indicates an unsuccessful introduction.

Aml=A. m liguistica; other races are not specified here.
t*Am*=tropical African or Africanised *A. mellifera.*
Yes=probably present, from other records.

Country	European *A. mellifera* and where from	tAm
North America	1622, England	1960*
USA, east	1859, *Aml*Germany	(1980s)
		1990+
USA, west coast	1853, E USA	(1985)
	1859, *Aml* E USA	1994
Mexico	1500s-1700s	(1956?)
	1911, *Aml* USA	1986+
Central América		
Belize	1957, Mexico	1987+
Costa Rica	by 1830	1983+
El Salvador	by 1855	1985+
Guatemala	1830, Costa Rica	1985+
Honduras	1850s or 1860s	1985+
Nicaragua	1850-1900?	1984+
Panama	by 1960	1981+

***** *Semen received and used for rearing bees.*

\+ Arrived by natural swarming

Source: adapted from Table 36.2A: Mainland North and Central America: dates of first records found for exotic hive bees (Apis) and for *Varroa jacobsoni* (Eva Crane, 1999: 358).[3]

[2]The States invaded by the AHB in USA are: Texas (1990), Arizona (1993), California(1994), New Mexico (1994), Nevada (1998), Utah (1999), Oklahoma (2004), Arkansas (2005), Florida (2005), Louisiana (2005)(Livanis and Moss: 2010).

[3]The column concerning the arrival of the varroa jacobsoni from North and Central America was eliminated, and leaving the columns which relate to the time of introduction of Africanised honey bee and European honeybees.

Table 2: South America: dates of first records found for exotic hive bees (Apis)

Country	European *A. mellifera* and where from	*tAm*
Argentina	by 1839 1850, *Aml*	1965* or 1969*
Bolivia	By 1914/15, *Aml*	1967*
Brazil	1839, Portugal 1845, *Aml*(late 1950s, *A. cerana*, Hong Kong)	1956, S African and Tanzania 1956 A.m. capensis
Chile	1840, Germany 1844, *Aml* Italy	
Colombia	By c. 1855	1978* or 1979*
Ecuador	Date unknown	1981*
French Guiana	By 1902 1969, *Aml* Italy	1974*
Guyana	1920, *Aml*USA	1975* or 1976*
Paraguay	*c.* 1900, Chile	1965*
Peru	date unknown	1977*
Surinam	late 1800s	1975*
Uruguay	1839, Argentina	1971*
Venezuela	after 1866	1977*

*Arrived by natural swarming

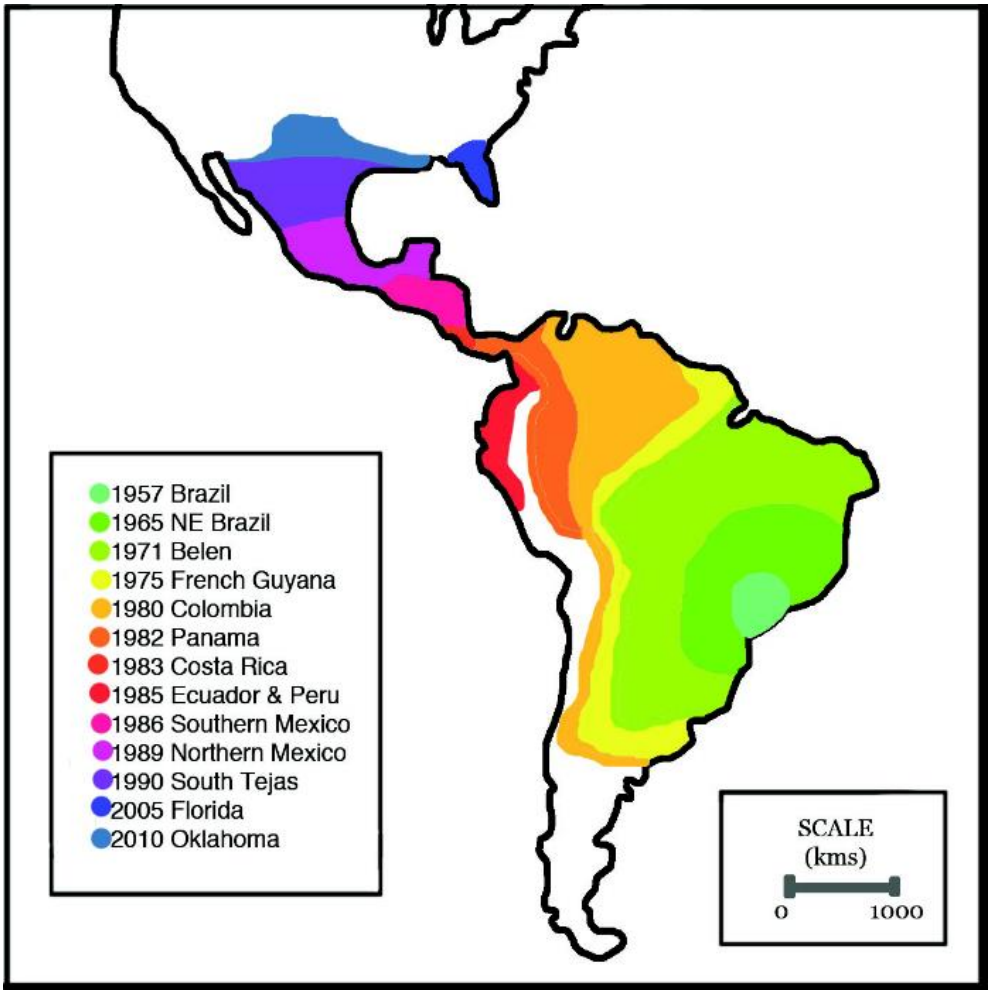
Source: adapted from Table 36.2D: South America: dates of first records found for exotic hive bees (*Apis*) and for *Varroa jacobsoni* (Crane, 1999: 364) [4]

Studies conducted by North American and Brazilian researchers indicate that levels of Africanisation of EHB vary from one country to another, even within the same country. For example, in some beekeeping areas where beekeepers historically used EHB to produce honey, the degree of Africanisation remained low. One of the reasons is that in these areas the re-queening with European queen bees was a common practice by the beekeepers to diminish the Africanisation and defensiveness of the beehives. Such is the case in countries like the United States and Mexico, to cite some examples, which have national plans to reduce the Africanisation of beekeeping. Nevertheless in countries like Peru, in the high Amazon region, and in the Northeast region of Brazil, like the state of Piaui,-according to my own experience, -there aren't beekeepers or governmental initiatives that may seek to reintroduce European queens in the beehives. On the contrary, it has been a process of natural selection among the hives of AHB for choosing the most calm and productive bees[5], discarding the most aggressive and unproductive ones. This is more or less what beekeepers do in most countries where AHB have arrived.

[4]The column concern the arrival of the varroa jacobsoni to South America was eliminated, and leaving the columns which relate to the time of introduction of Africanised honey bee and European honeybees.

[5]But also, the selection of bees goes according to the productive guidance of the beekeeper. These include: honey producing bees, pollen or specialised in the production of propolis.

Figure 2: Spread of the Africanised honeybee in the Americas.



Source: adapted from Figure 2: Actual and projected rate of spread of the Africanised honey bee in the Americas (Winston, 1992: 358)[6]

The most important characteristics of the AHB in relation to its European counterparts are:

- The AHB can swarm 4-6 times more than the EHB. When the population of a hive reaches its maximum size, the colony splits in a process called swarming. In feral AHB colonies, the original queen bee leaves with half the colony to create a new hive, leaving behind a new queen to control the remaining bees. Developing smaller hives at a higher rate of reproduction allows AHB to swarm five times more often than EHB.[7]

- AHB may sting 10 times more than EHB. They can chase their victims as far as 400 meters from their nest (Somervilla, 2008:13). In areas invaded by AHB the beekeepers overcome this new problem by appropriate protection gear and using abundant smoke at the time of entering the apiary to manage the beehives. Similar measures are not needed when working with the EHB.

- AHB also increase their population by taking over established colonies. When AHB infiltrate a colony in the wild, the takeover occurs without any resistance. Africanised swarms will enter an

[6] The adaptation of figure 2 was made by designer Alexia Pedal.

[7] Video production by the Florida department of agriculture

existing colony, kill the old queen and install their own, Africanised drones from the hive to mate with the new queens, and more colonies become Africanised.[8]

In economic terms there are no continental statistics indicating the number of EHB lost due the attack of AHB and the number of beekeepers who left the activity due to Africanisation. It is impossible to find information for each country. For instance, reports from Panama, southern Brazil, Argentina, Mexico, Venezuela, and the Dominican Republic tells us of a fall in the honey production and a decrease in the number of hives. However, studies according to Gonçalves, Stortand DeJong (1991) shows that after a long period of Africanisation the results have been positive in economic terms for Brazilian beekeepers. The same happened in Venezuela years after the Africanisation and in other countries that experienced the same process.

Finally, the process of Africanisation of beehives started over 56 years ago and it is still continuing in most countries that were affected by this phenomenon. Beekeepers in most countries try to adapt and cope in an intelligent way with the negative aspects of the bee. In most low income countries beekeepers have to make a natural selection, which means to keep the most calm bees and eliminate the more aggressive. The strategy in temperate zones, and more rich countries, is to buy European queen bees and introduce them to hives that have been Africanised.

[8] Video production by the Florida department of agriculture

2. Theoretical Perspectives

2.1. Making sense of past experiences

My keen interest in studying the AHB and its impact in the apiculture sector is drawn from my own experience as a beekeeper of AHB in North-Eastern Peru, my experience as a beekeeper of European honey bees (EHB) in Sweden, and the fieldwork I conducted with beekeepers in the Brazilian Northeast, in 2012.

My experience as a beekeeper managing AHB for 14 years taught me many lessons and considerations one should take into account when handling them. Later on, I had the opportunity to work in Sweden with the EHB together with a commercial beekeeper. Both experiences inspired this study and, at the same time, provided me with the empirical evidence to develop it. Besides, the experience in Sweden provided me with an indirect insight on how American beekeepers may also manage their docile European honeybees, i.e. using the most advanced technology in beekeeping and where state institutions and beekeeping organisations play an important role in beekeeping development. And of course, the visit to the beekeeping cooperative of Simplicio Mendes in the Brazilian semi-arid Northeast region made it possible to see, *in situ*, the economic, social, and policy-making impact of AHB in this remote area of Brazil.

2.2. Theoretical approaches and basic concepts

Policy-making and its unintended consequences

James Scott's (1998) book, "*Seeing like a State*" is a study of the unintended social consequences of overarching projects and policies, labeled 'master plans' twentieth century practice of imposition of structure upon diverse social elements. The book is a study of how the modern state has attempted to impose a structured order upon society, but how these policy orders create unintended consequences and disorder, which the state has not taken into consideration. A political and economic order is imposed by simplifying complex phenomena such as land ownership through processes like constructing highly regulated maps. Scott calls this process creating "legibility"(Eigenauer, 2004:2).

Centralisation and planning are two of the most important socio-political concepts of the twentieth century (Eigenauer, 2004:1). However, during the second part of the twentieth century, when the AHB colonised Brazil and USA, each of these had its own characteristics and levels of bureaucratic development; i.e. levels of centralisation and planning were different in both countries. In the 1990's the United States was an international superpower, economically and politically, while in the 50's the Brazilian state was a state that only partly controlled its own vast territory. The state's limited economic and political control made the weak Brazilian government unable to efficiently react and take policy measures to prevent the destruction of the country's small industry of local beekeeping, based on EHB that existed in southern Brazil.

According to Scott (1998: 2), the organisation of the natural world was not an exception. Agriculture is, after all, a radical reorganisation and simplification of flora to suit man´s goals. [……..], the design of the scientific forestry and agriculture and the layout of the plantation, [……..], all seemed calculated to make the terrain, its products and its workforce more legible- and hence manipulable- from above and from the centre.

In the introduction of 'Seeing like a state' Scott (1993: 2-3) made a homely analogy from beekeeping. He said that "In pre modern time the gathering of honey was a difficult affair. Even if bees were housed in straw hive, harvesting the honey usually meant driving off and often destroying the colony. The arrangement of brood chamber and honey cell followed complex patterns varied to hive to hive- pattern that did not allow for neat extraction. The modern beehive, in contrast, is designed to solve the beekeeper's problem.

Bourdieu's social fields and how actors experience and make sense of the world

On the other hand, Bourdieu's theoretical approach(Bourdieu and Waquant, 1992) helped me to interpret the reactions and perceptions of beekeepers generated by the arrival of EHB in both countries. Beekeepers in both countries created a body of knowledge and practices on the basis of EHB. The field of beekeeping has a number of mutually interacting actors, which have developed a series of social networks in the world; as well

as habits acquired through centuries of managing bees, governmental regulations and promotions of beekeeping, research and the economic and technological capital, which has been changing and becoming more sophisticated in recent years, especially since the discovery of the movable frame developed by Langstroth. All these assets have to do with the way of being and acting as a beekeeper.

Bourdieu (1987) tells us that it is of utmost importance to situate the logic of practice within the specific configuration of its particular economic, social and cultural configuration. These configurations often form specific social arenas of interpretation and practice, so called social fields. A field is made up of joint values, interests, etc. These fields constrain how its actors experience and make sense of their world. The actors(for the purpose of this study: the beekeepers, governmental agencies, market, etc.) are experts of their own fields; knowing "how to play the game", comprehending what values, ideas and practices that are most cherished , etc., but they seldom ask themselves why the game was constructed in the first place, why the rules are designed in a specific way, etc.

The various forms of ownership and social conditions of existence of the beekeepers vary between geographical locations, time periods, class positions and so forth and give rise to specific social and cultural frames of experiences, values, sentiments, illusions, and modes of thinking. The beekeeper's belonging to a distinct social field and their position within these will shape and constrain their actions and perceptions. It is not possible to account for their actions and perceptions in an unmediated way; we have to try to situate their experiences and perceptions within these fields. Is it possible to discern any overarching social and cultural patterns, for example, between how the bees were received by the broad public and the social position of the people? Which other major factors might have contributed to create and mold their perceptions and reactions?

Livelihoods and the different forms of capital.

Ellis (2000) defines *Livelihoods* as "the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household". The same author warns, though, that this definition, as any other of this kind, "fails to convey change over time and adaptation to evolving circumstances" and that the construction of a livelihood "has to be seen as an ongoing process, in which it cannot be assumed that the elements remain the same from one season, or from one year to the next" (Ellis, 2000).

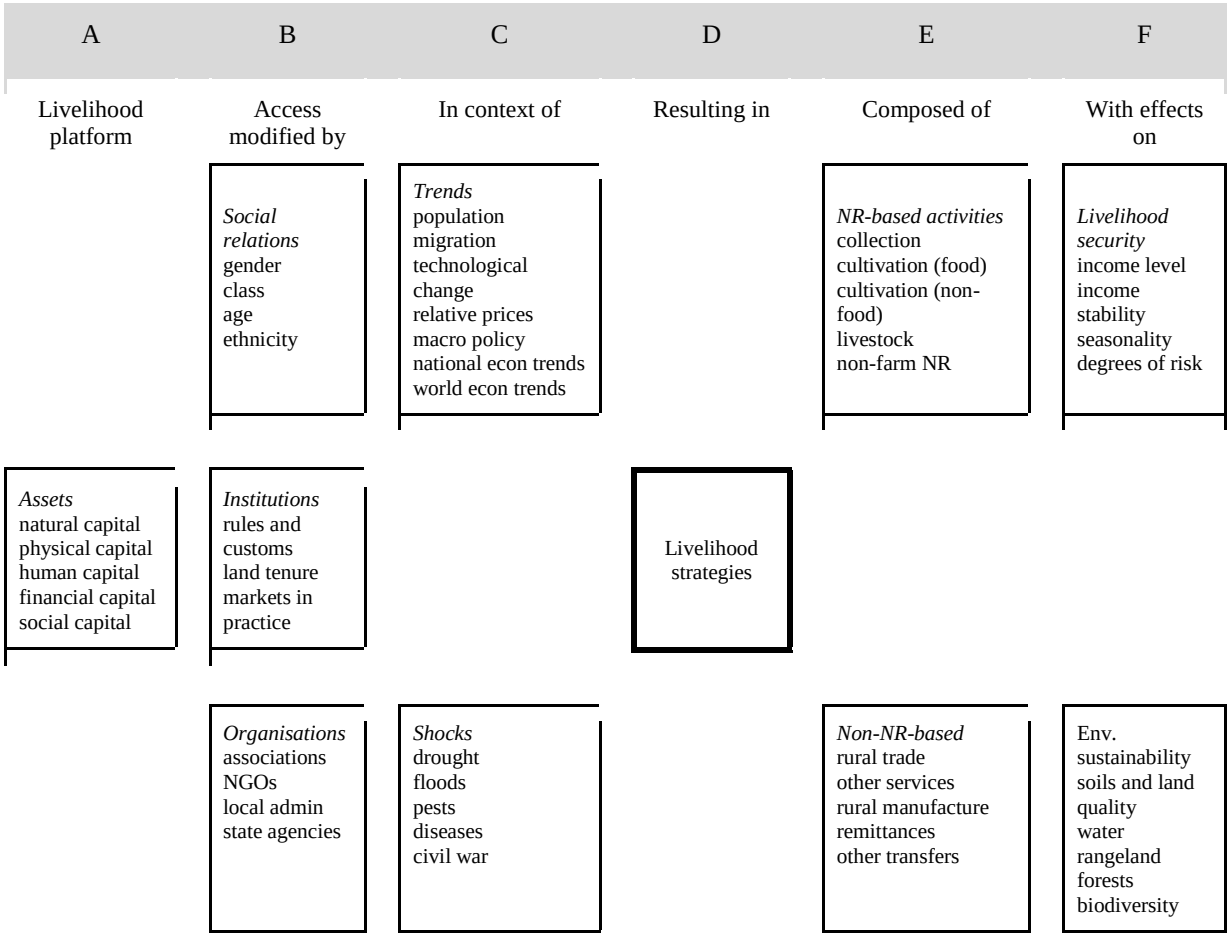


Table 3. A framework for micro policy analysis of rural livelihoods.
Source: Ellis (2000) adapted from Scoones (1998:4) and D. Carney (1998:5)

Coping strategies vs adaptation strategies

According to Ellis (2000) coping strategies are the sequence of survival responses to crisis or disaster. Meanwhile Carter (1997:62) argues that coping is the involuntary response to disaster of unanticipated failure in major source of survival. Coping, then comprises tactics for maintaining consumption when confronted by disaster, such as drawing down on savings, using up food stock, gift from relatives….[ ]and so on (Ellis, 2000).

Meanwhile adaptation has been defined as the continuous process of changes to livelihoods which either enhance existing security and wealth or try to reduce vulnerability and poverty (Davis & Hossain, 1997:5, in Ellis, 2000). According to Davies (1996) adaptation may be negative or positive: positive if it is by choice, reversible, and increases security; negative if it is of necessity, irreversible, and fails to increase security.

3. Methodology

This thesis is probably one of the few studies about the impact of AHB on beekeeping in the Americas, with an emphasis on social structures and practices surrounding the beekeeping and, civil society's reactions to the spread of the AHB. Most of the bee studies done so far are oriented towards the field of biology, production, physical and chemical analysis of honey, etc.

3.1. Scope and limitation of the study

This study focused on two countries: Brazil and the USA. These two countries were chosen because Brazil is the country where the AHB first were introduced and the US was the last country to be invaded by this bee. Another reason is that in both countries apiculture is a very important economic and cultural activity and involves many people, organisations and institutions.

3.2. Research methods and techniques

This research is basically a secondary research or desk research, since most findings are based on the review and analysis of secondary data. The preliminary results from the literature review have been contrasted and enriched with a fieldwork I conducted in the Brazilian state of Piauí, in 2012. The fieldwork was conducted at the Simplício Mendes cooperative, State of Piauí, Brazil, in coordination with the Brazilian researcher in bees Bruno Souza of the beekeeping unit of EMBRAPA Meio Norte Brazil and the managers of the aforementioned cooperative. The results and discussions are also enriched with my own experience working as a beekeeper both in the Peruvian Amazon and in central Sweden.

Table 4: Study Phases

Objectives	**Information source**	**Data collection**
Obtain an understanding of the change of apiculture after the introduction of the Africanized Honey Bee; both in the USA and Brazil.	1. Research literature, internet sources and policy documents. 2. Participant observation in Brazil	1. Document analysis 2. Field notes
Identify the main economic, social, and political impacts on the beekeeping both in the USA and Brazil.	1. Research literature, internet sources and policy documents. 2. Reflections over my own experience as a beekeeper	1. Document analysis 2. Notes from reflections
Analyze how the beekeepers in each country perceived and reacted to the gradual domination of the Africanized Honey Bee and identify the main strategies and actions used by them	1. Research literature, internet sources and policy documents. 2. Participant observation in Brazil	1. Document analysis 2. Field notes

3.2.1. Document analysis

"Document analysis is a systematic procedure for reviewing or evaluating documents—both printed and electronic (computer-based and Internet-transmitted) material. Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge" (Bowen, 2009).

As shown in the table 1, my main research resource consisted of secondary documents; scientific reports, books, newspaper clippings, published videos as well as discussions of beekeepers on specialised web platforms about the AHB topic. The objective of this research was to analyse the impacts experienced by the beekeepers both in the USA and Brazil and try to develop and answer the research question. For example, in order to understand the reactions and perceptions in relation to the AHB I had to investigate the case in specialised American websites addressing beekeeping and issues about AHB. Through The Commentaries On these websites, dating from the arrival of the Africanised bees, one can understand what it meant for beekeepers to be affected by the AHB and the problems were these bees were colonised. However, to find testimonies of Brazilian beekeepers was difficult due to the lack of records the time when AHB spread for overall Brazil between the 1950s and 1970s. But my visit to the Brazilian semiarid region helped me to observe *in situ* the impact generated by AHB in Brazilian beekeeping.

3.2.2. Participant observation

"Participant observation is the process enabling researchers to learn about the activities of the people under study in the natural setting through observing and participating in those activities. It provides the context for development of sampling guidelines and interview guides"(De Walt and De Walt, 2002., in Kawulich, 2005).

My fieldwork was composed of a varied and overloaded agenda scheduled by the directors of the cooperative Simplício Mendes in the three weeks that said activity lasted. For example: I attended the training workshops, visited the farms of the members, participated in the management and harvesting of honey, in liturgies organised by the cooperatives under the leadership of Father Gerardo, of German origin, founder of the cooperatives, I distributed honey to the educational institutions for the students' consumption, I accompanied in the fieldwork the researchers of the Federal University of Piauí who had research works with the aforementioned cooperative, and finally I participated in recreational activities with members of the cooperative.

During these three weeks I noticed the importance of beekeeping in all this semi-arid region, where I went I was with organisations linked to beekeeping activities. Much of the production of honey from the region, largely channeled largely through the cooperatives, went to the foreign market. Nevertheless, the local state also promoted honey consumption in local schools. It took part, in the delivery of honey sachets that the cooperative delivered to educational institutions in rural areas to be consumed as school breakfast. In my visits to the field I could perceive the fragility of the ecosystem due to the low rainfall that fell especially for agriculture, raising animals and in some way to beekeeping. On the other hand, I saw that the region had a huge natural capital; The dry forests of this area were a great attraction for bees when they migrated from Sao Paulo on their way to the north of the continent, finding in this region a lot of floristic resources to obtain nectar and pollen.

In the cooperative, the training sessions were aimed at developing business management skills amongst its members and their children. Partner NGOs provided the training courses. I also visited the farms of the partners, not only to know about their bees, but to see in situ the non-apicultural activities that they did, I was interested in knowing what they ate and what they thought in general terms. I could see that most of them raised goats, some cattle, sowed products such as corn, casava and beans, mainly for self-consumption. A recurring concern among the members was the lack of water. During those visits I could see that a fairly common activity among members and residents of the region was the capture of rainwater. This project was promoted by the cooperative but also by the local government. I also took part in the liturgical meetings that Father Gerardo founder, of the cooperative, carried out in partnership with local governments. It was a great concentration of young people in which he emphasised his discourse for environmental issues and the values of solidarity and cooperation among the poor. I also participated with the researchers of the Federal University in the research activities that were mainly oriented to find technologies seeking to mitigate the lack of water and increase the production of honey. The great migration of the previous years, that pushed thousands of northeasters to seek jobs in large cities such as Rio de Janeiro and São Paulo, was mentioned very often by the members of the cooperative.

Some findings during the field work:

- One of the most important findings that I found was that beekeeping was one of the most important activities of the members of the cooperative and of the region in general.
- The honey they produced went mainly to the international market, but there was a great interest in promoting self-consumption via the schools.
- The Brazilian semi-arid was a huge natural capital for beekeeping and offered the conditions for its development in one of the poorest areas of Brazil. The bees found an exceptional place where there was abundant pollen and nectar for their subsistence.
- The active participation of cooperatives in partnership with research centres, banks and local governments.

3.2.3. Autoethnography: using my own experience as a beekeeper

According to Ellis and Bochner (2000), "*Autoethnography is an autobiographical genre of writing and research that displays multiple layers of consciousness, connecting the personal to the cultural. Back and forth autoethnographers gaze, first through an ethnographic wide-angle lens, focusing outward on social and cultural aspects of their personal experience; then, they look inward, exposing a vulnerable self that is moved by and may move through, refract, and resist cultural interpretations*". The researcher's personal experience is at the centre of this kind of research as it "illuminates the culture under study" (Ellis & Bochner, 2000). According to the same authors "a greater or lesser extent, researchers incorporate their personal experiences and standpoints in their research by starting with a story about themselves, explaining their personal connection to the project, or by using personal knowledge to help them in the research process".

In the case of this study I, as a beekeeper, used my own experiences working with AHB (in Peru) and EHB (Sweden) to compare and analyse: 1) beekeeping practices; 2) my own perceptions of AHB before and after I started working with them and; 3) my own adaptation strategies, in contrast with those of beekeepers in Brazil and the USA.

4. Results

4.1. The effects of the spreading of AHB at the social, economic, and policy-making levels in the apiculture sector in Brazil and USA

4.1.1. The effects of the AHB spread on apiculture in Brazil

Social effects

AHB reshaping apiculture as a lifestyle in Southern Brazil

The accidental swarm of African honey bee queens and the subsequent africanisation of European honey bees in Brazil brought some changes in Brazilian apiculture as a lifestyle. In the Southern part of the country an important number of beekeepers, hobby beekeepers in particular, quit apiculture after the diffusion of AHB started. Almost three decades after, the number of beekeepers, beehives and, hence, honey production experienced a strong return that continues even today. In contrast, beekeeping in the Northeast was triggered by the arrival of AHB.

The exact amount of Brazilian beekeepers who abandoned the apiculture activity, and the amount of beehives lost during the first 20 years of Africanisation remain unknown. However, according to entomologist M. Winston (1992:89) over 90 percent of the beekeepers in Santa Catarina State, in the South, quit beekeeping. In a survey conducted by W.E. Kerr (1966/67 cited in Spivak, Fletcher and Breed, 1991:1) although he found a slight preference towards AHB amongst beekeepers, some of them reported quitting the business because of difficulties managing AHB. Michener (1975: 412) argues that "beekeeping as a hobby almost disappeared and beekeepers went out of business because they did not want to work with vicious bees or because they could not operate apiaries on farms along with livestock".

By the 1980s, the dramatic reduction in beekeepers and beehives experienced during the first decades of AHB diffusion, combined with the intensive and indiscriminate use of pesticides in the 10970s, bounced back. In Parana State, the Agricultural Census of 1995-96 carried out by the Brazilian Institute of Statistics (IBGE), 40 years after the introduction of the AHB to Brazil, reported the existence of 24,000 households with beekeeping, 273,000 beehives and a production of 2,680 tons of honey. The figures for the entire country were 172,488 households managing 1.6 million beehives and producing 18,450 tons of honey (Sommer, 2002). By 2002, it is estimated that the Brazilian apicultural sector had around 300 000 beekeepers, managing 2.5 million beehives and producing 30,000 to 40,000 tons of honey (ibid, 2002).

It is important to mention that beekeeping in Brazil and Paraná was and still is characterised primarily by being a small-scale activity, associated with owners, tenants and / or partners, which are structured around small agricultural units where labor is predominantly provided by family members and is mostly a secondary economic activity, parallel to their professional or other activities (Peixe and Silva, n.d.).

Bees nurturing humans in Northeastern Brazil

The social impact of AHB in the Northeastern part of Brazil was different from that of the South. In that region people became beekeepers after the arrival of the swarms of Africanised bees. Small-scale farmers became beekeepers with the support and technical assistance provided by NGOs in the beginning and, later on, by governmental agencies. They saw the potential of the abundant flora in the region and the fact that bees adapted very well to the Brazilian tropics. The governmental institutions and NGOs believed beekeeping could be developed and become a major contributor to household income and, thus, alleviate poverty among northeastern farmers, whose main household income was based on crop production and livestock. Before the arrival of honey bees many farmers settled in rural areas and supplemented their farm and livestock activities with the collection of honey from stingless bees (Vilela, 2000). In the state of Piauí, Northeastern Brazil, one of the beekeeping promoters recalls the first days of this experience:

"It was almost by accident. We did not have plans to make apiculture the flagship of the centre. We never thought beekeeping would become the one. We always thought it would be one of the projects we called alternative projects, such agri-silviculture and the like...then it turned almost fashionable, it was a novelty. Even the seed banks, the one we thought would turn out well didn't work, because it was not such a novelty to the farmers, and beekeeping was a novelty in one sense, in the way of working, since everyone already had some experience with the bees for extraction (stingless bees). From that moment things started to gain economic dimensions. Later, the financial actors themselves started to believe in this activity (beekeeping). With the entry of Banco do Nordeste the activity arose and grew with ease" (F.R.F.,Cefas agent in Floriano, cited in Vilela, 2000:116-117).

Nowadays in Brazil, according to the Brazilian Service of Support for Micro and Small Enterprises, (SEBRAE, 2006: 10-11) 350 000 people in Brazil are engaged in commercial beekeeping and AHB represents 90% of the bees available in the country.

Impact on beekeepers' organisations

Before the diffusion of AHB in Brazil the level of organisation among the beekeepers was incipient. The diffusion of AHB prompted the organisation process amongst Brazilian beekeepers, particularly of those in the South as it was the place where the first swarm started. The presence of AHB forced the creation of platforms for cooperation between beekeepers, researchers, and governmental agencies. It also prompted the creation of new communication channels among beekeepers.

Before the spread of AHB there was no intra-state organisation of beekeeping. Although there might be organisations that acted informally, the Brazilian Confederation of Beekeeping (CBA), *A Confederação Brasileira de Apicultura*– had no organisation registered prior to the arrival of Africanised bees. The first organisation of beekeepers appeared in 1967 - ten years after the bee escaped in Rio Claro, São Paulo. This organisation was founded in the south of Brazil in the state of Rio Grande do Sul and was called "Federation of Beekeeping Associations of Rio Grande do Sul" (*Federação das Associações de Apicultura do Rio Grande do Sul- FARGS*) (CBA, 2007).

The change in beekeeping since the arrival of AHB forced many beekeepers, especially the beekeepers that lived in the south of Brazil, to organise in order to face the new challenges caused by the arrival of AHB. They were aware that in this new scenario it was important to share the efforts with other beekeepers, scientists and governmental institutions. Beekeepers, researchers and governmental agencies gathered in several regional meetings, held in places such as Piracicaba, Rio Claro and Ribeirão Preto, in the state of São Paulo; Curitiba, in the state of Paraná; Florianopolis, in the state of Santa Catarina; and Taquari, in the state of Rio Grande do Sul (Gonçalves, Stort and De Jong, 1991: 361). As a result of these previous regional meetings and also because of the great interest and concern of Brazilian beekeepers to discuss issues related to the introduction of AHB bees and beekeeping impact on Brazil, in 1970, -13 years after the first swarm of AHB in Rio Claro - in Florianopolis, state of Santa Catarina, the first Brazilian Apiculture Congress was held (Brazilian Confederation of Beekeeping-CBA, 2007; Gonçalves, Stort and De Jong, 1991: 361). According to Gonçalves, Stort and De Jong (ibid, 1991: 361) the first congress had about 150 participants. The main issue discussed was how to find the best way to work with the defensive Africanised bees. It emphasised the need to use protective clothes, the development of new types of smokers, the distribution of the apiaries and other questions related to the management. Participating researchers also presented their research with respect to the biology of AHB, covering topics such as aggressive behaviour, swarming, reproduction and hybridisation with EHB (Gonçalves, Stort and De Jong, 1991: 362).

The first national congress had marked the new path of Brazilian beekeeping; thereafter several regional and national congresses have been organised to discuss the subject of Africanisation of bees and the new challenges of beekeeping in Brazil; there were also discussion about association issues and the establishment of strategies linked to the development of Brazilian beekeepers. It is important to point out the strong relationship that has existed between beekeeper organisations and researchers in Brazil, especially with researchers from the University of São Paulo, where W.E. Kerr was a dean. Currently there are more than 50 universities and research institutes engaged in bees and beekeeping (APACAME, 2013). In 2012, in the State of Rio Grande do Sul, the XIX Brazilian Congress of beekeeping and the V Meliponiculture Congress were held together. The last five Congresses reveal the enormous interest in AHB and stingless bee management and form a platform to share the same national forum to discuss, analyse, propose and agree on issues related to beekeeping, as well as meliponiculture[9].

Despite the success of Brazilian apiculture based on Africanised bees, not all Brazilians beekeepers have decided to work with them and encourage their use. On the 19th of October 1979 the São Paolo Association of Beekeepers, Breeders of European Bees, Associação *Paulista de Apicultores Criadores de Abelhas melíficas*

[9] The meliponiculture is the management of the stingless bees

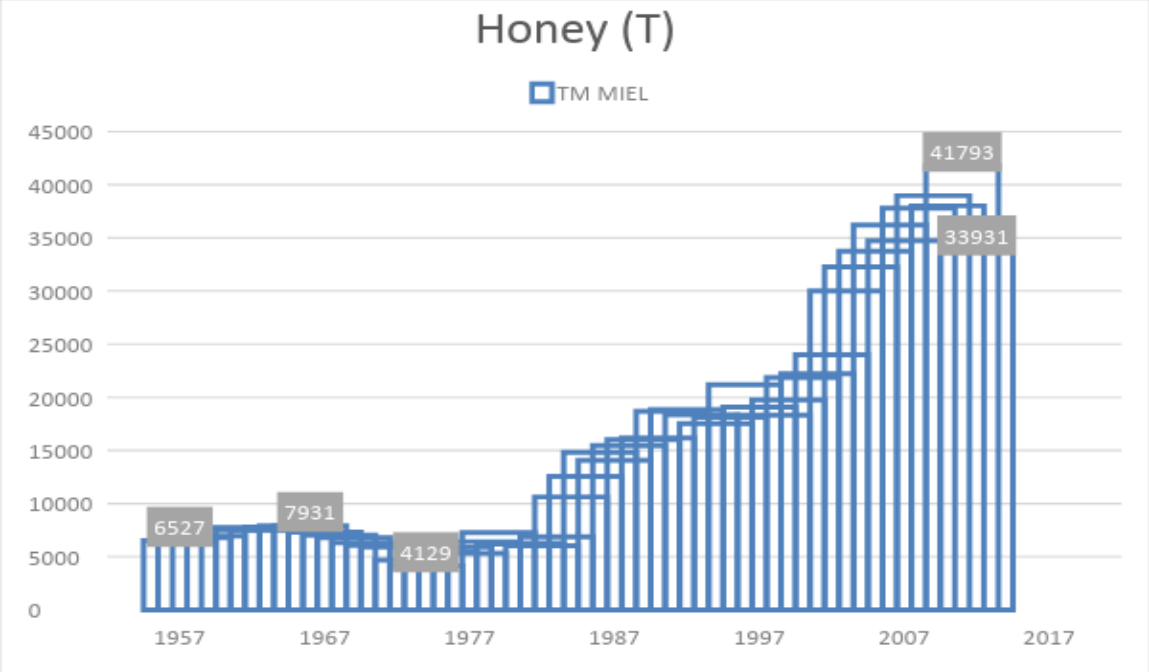
Européias- (APACAME) was founded with headquarters in the state of São Paulo. Members of the beekeepers association are known as *Europeistas* (Europeans). Although the objectives of the APACAME did not stipulate working exclusively with EHB or suggesting a "frontal struggle" against AHB; however there are associates to the beekeeping company "apiary Cosmos" with the founding leader Nikolaos Argyrios Mitsiotis, beekeeper from São Paulo, who openly declared his discontent with the introduction of African bees and considered them to be an alien species, which had caused the destruction of Brazilian "traditional beekeeping". However, to call one's own bees European can be a little contradictory in a country, where EHB have been entirely dominated by the African genes (Dinizet. al., 2003:50). During an interview conducted in Piauí, on the 11th of October 2012, Brazilian researcher on bees Bruno Souza, pointed at some concerning elements of such position: Why did the beekeepers from São Paulo label themselves as *'Europeistas'* in a country where the dominant gene in the honey bees come from the Africanised bee? How could the members of APACAME import European queens into Brazil when it was prohibited? Souza also mentioned that, despite the differences between the CBA and APACAME, they have a common objective: to promote meliponiculture among their members.

Currently, the main beekeeping federation in Brazil sphere is FARGS, which includes 73 beekeeper associations, 3 cooperatives and 43 affiliated companies. The federation's activities' include traceability, organic certification, dissemination of research through partner institutions and effective partnerships with the Governmental or NGOs (Lengle, Lago and Coronel, 2007). By 2012, 350,000 Brazilian beekeepers were organised into 27 state federations, 400 regional associations and cooperatives, and finally 210 companies (micro and small) registered at the Ministry of Agriculture, Livestock and Supply (CBA, 2011; Lengler et al., 2007; SEBRAE, 2006 cited in Pasin, Tereso and Barreto, 2012).

Economic effects

Impact of AHB on honey production

Figure 3: Brazilian Honey Produced, 1957-2012



Source: Adapted from FAO (2012) and Brazilian Institute of Statistic- IBEG and Brazilian Confederation of Apiculture-CBA (1989) Cited in Gonçalves, L., Stort, A. and De Jong, D. (1991).

The results shown by Brazilian and FAO statistics with respect to the impact on honey production caused by the introduction of Africanised bees to Brazil, in the first years of colonisation, point to a slight increase followed by a slight fall of honey production. On the other hand, Brazilian researchers in apiculture point out

that in the first years there was a fall in production; the same thing indicates a beekeeper, former manager of the Brazilian apiculture confederation. However, in the long term, Brazilian researchers, the Brazilian confederation of beekeeping and Brazilian statistics agree in pointing out sustainable increases in honey production, until becoming years later one of the great exporting and honey-producing powers in the world.

If we start to show the results (short, medium and long term) in a detailed way we can see that in figure 3 there is a historical record of 55 years of national production of honey in Brazil from the expansion of Africanised bees. The figure shows that from the year of 1957 to the year of 1966 there was a slight increase in the production of honey, followed, from 1967 to the year 1974, of a slight drop in production. But it is only since 1975, - 18 years after the introduction of Africanised bees, - when honey production began to take off and rise - with small declines, the most significant in 2012 - consistently over the next 37 years.

On the other hand, a Brazilian beekeeper and Brazilian researchers who recorded field information from the southernmost part of Brazil from the early period of colonisation by African Bees reflect a different point of view from the data shown by the Brazilian statistical institute with regard to the impact on the production of honey corresponding to the first decade of the expansion of the Africanised bees. According to the beekeeper Bruno Schirmer, who points out that before the arrival of AHB, the beekeeper Lenarth Schirmer (his brother), in Porto Alegre (Rio Grande do Sul State) harvested 43 tons of honey: "the year of the arrival of Africanised bee I have harvested 13 tons, the next year I have harvested 6 tons, and in 1971 I have harvested only 3 tons". His data is confirmed by studies made by Gonçalves, Stort and De Jong (1999: 367) on beekeeping in the state of Rio Grande do Sul; honey production had declined between 1968 and 1978; from 2,500 tons produced annually in this state, it fell to 800 tons, recovering to 1500 tons first in 1983.

The Northeast Region in the past decade produced less than 12% of the Brazilian honey production; today it is currently responsible for over 38% of honey production in Brazil (IBGE, 2011, cited in Pasin, Tereso and Barreto, 2012), disputing the leadership of the national honey production in the last five years with the traditional honey-producing states of the south as Santa Catarina and Rio Grande do Sul.

In 2012, the Brazilian honey production is one of the world's largest. According to the state institute of statistics IBGE, in 2008 the annual production was 37.791 metric tons. Pasin, Tereso and Barreto in a survey made in 2012 state that Brazil in that year occupied the 7th place among honey exporting countries, and 10th place among the largest producers in the world.

Improvement in household income

In 2000, 43 years after the introduction of Africanised bees to Brazil, Sergio Vilela (2000: 179) made his doctoral thesis on the impact of the Africanised bee in the state of Piauí, located in northeastern Brazil, he found in a study consisting of a total of 151 informants to determine the economic impact of beekeeping activities on families of beekeepers in the state of Piauí. He found that 55% claims to have beekeeping as a main source of income. The result indicates that in the state of Piauí beekeeping has generated a positive impact on household incomes as well as generating more employment. According to Vilela (2000: 185), based on the agricultural census of 1995/1996, there were 9,375 families working directly in beekeeping in Piauí. In 1988 there were approximately 18,000 families involved in beekeeping (Vilela, 2000).

According Vilela (2000: 206), in Piauí there were about 200 cooperatives and associations of beekeepers of which 184 received some funding from Northeast Bank (Banco do Nordeste). These cooperatives and associations of beekeepers consist of part-time beekeepers. The number of cooperatives and associations of beekeepers in Piauí are around 35, of which 17 are members of the Piauí Federation of Beekeeping, *Federação de entidades apícola de Piauí*, FEAPI member of the CBA (Brazilian Confederation of Beekeeping).

Effects on policy-making in Brazil

The presence of AHB in Brazil basically exposed a serious in the policy-making capacity of the Brazilian state. The very responsibility for the escape of the African Honeybee queens had never been cleared. Besides an active witch hunting against Kerr and his colleagues the Brazilian government never took responsibility for the incident.

The decision to send a mission to Africa led by Warwick Estevam Kerr to find productive bees with the intent to introduce them to Brazil and improve the production was a political event. Kerr made his trip to Africa commissioned by the Ministry of Agriculture, with the approval of the Brazilian beekeepers, motivated by the

poor performance of honey production by European bees introduced to Brazil during the last century. However, when the swarm incident occurred in Rio Claro and the subsequent Africanisation of the Brazilian beekeeping the Brazilian Agriculture Ministry made no report on this accident. There was never an official response, public defence or public information. Kerr and his colleagues had to face this issue and confront the problem of the Africanisation of beekeeping through their commitment as researchers of the department of genetics in Ribeirao Preto at the Sao Paulo University.

Also Kerr was perceived as a threat to the new dictatorship that had taken power in 1964, because of his critical standpoint against it. According to Morse (1991) the military dictatorship began to widely publicise any stinging incident, including those caused by wasps. Time Magazine in the USA, in its turn, recapitulated the military press release on the "killer bees". The name later was picked up and used by the tabloids to report incidents of Africanised bees on their migration to the northern hemisphere.

However, there is currently a strong push on the part of state, local governments and non-governmental organisations to promote beekeeping; especially in rural areas. Different mechanisms of financial support and equipment to make beekeeping a major source of income among rural farmers are promoted.

4.1.2. The effects of the AHB spread on apiculture in USA

Social effects

Impact on beekeepers' organisations

The American Beekeeping Federation has its origin in the American Bee Association founded in Cleveland, Ohio, in 1860. After several changes in name and reorganisation, the American Bee Association in 1949 finally was called the American Beekeeping Federation, Inc (Moffett, 1980: 175). In 1969, at the federation convention in Portland, a group of producers formed a second national organisation called the American Honey Producers. Both organisations are still active and hold annual conventions and represent their members´ interest in Washington (Ibid, 1980: 175). In 2012 the 10th congresses for both organisations were held.

There also exist various organisations and associations specialised in the need of the honey producers, such as The American Breeders Association and The apiary Inspection of America that congregate the inspectors that promote better beekeeping conditions through uniform and effective laws and methods to suppress bee diseases. The Bee Industry Association organise the supply and equipment manufacturers (Ibid, 1980: 175-177).

Impact on beekeeping as a lifestyle

A report written for MacDowell in 1984, commissioned by The U.S. Department of Agriculture, to investigate the probable impact of the AHB on the beekeeping industry concluded that many part-time and commercial beekeepers would have to leave the business and many hobby beekeepers would quit beekeeping. MacDowell (1984: 18) argued that 20 to 40% of the colonies operated by a hobby and part time beekeepers in the six affected states would disappear. In his turn, entomologist M.L. Winston, who was part of a team that investigated the AHB invasion in Guiana in 1975, added that the damage suffered by these beekeepers occurs because many of them keep bees in populated areas (1992: 119). He also predicted (1992: 119) a 50 to 80 percent reduction of colonies will occur because of zoning regulation, insurance problems and public pressure. Finally, MacDowell (1984: 23) argues that the invasion of the AHB also might affect public health, labor working with AHB, bee-disease management problems associated with large feral populations and other considerations.

In a report made by Hoff and Willet in 1994, bee culture was practiced throughout the United States in widely different types of geographical areas with different climates, flora, and farming systems (Hoff and Willet, 1994:2).

Some beekeepers move their colonies annually from several miles to several thousand miles to provide pollination services or increase honey production by providing their bees with abundant sources of nectar. Beekeepers frequently collect fees for the pollination services they provide to fruit, vegetable, tree nut, field,

and seed crops. In areas with abundant nectar producing plants, some beekeepers specialise in honey production and move their colonies only occasionally. Beekeepers in warmer climates, such as California and the Southern States, may specialise in producing packaged bees and queens for stocking hives (Ibid, 1994:2).

Peak labor needs for beekeepers usually occur when caring for the bees during the spring, when moving bees for pollination and for harvesting and extracting honey. Beekeeping is not dependent on land ownership; however, most beekeepers own a small acreage that serves as a base of operation (Ibid, 1994:2).

There are few entry barriers into beekeeping and honey processing. However, nearly all states employ county apiary inspectors who examine hives in the field to ensure that each apiary is free from diseases. State laws and regulations about honeybees and beekeeping are designed primarily to control bee diseases. Laws may regulate the movement of bee hives, the location of apiaries, require permits, certificates, inspections and impose quarantines and specify methods of treating diseased colonies (Ibid, 1994:2).

Economic effects

Impact on honey production

The concern at the level of the beekeeping field in the United States is remarkable, so much so that researchers and government agencies begin to predict and write reports years before the arrival of the AHB on the possible impact of Africanised bees on the production of honey and in the economy of the apicultural field in general; however, the facts show that the impact of Africanised bees entering the US territory did not happen as many researchers expected it to happen. Contrary to what is speculated, others are the causes of the decrease in honey production in the last 60 years.

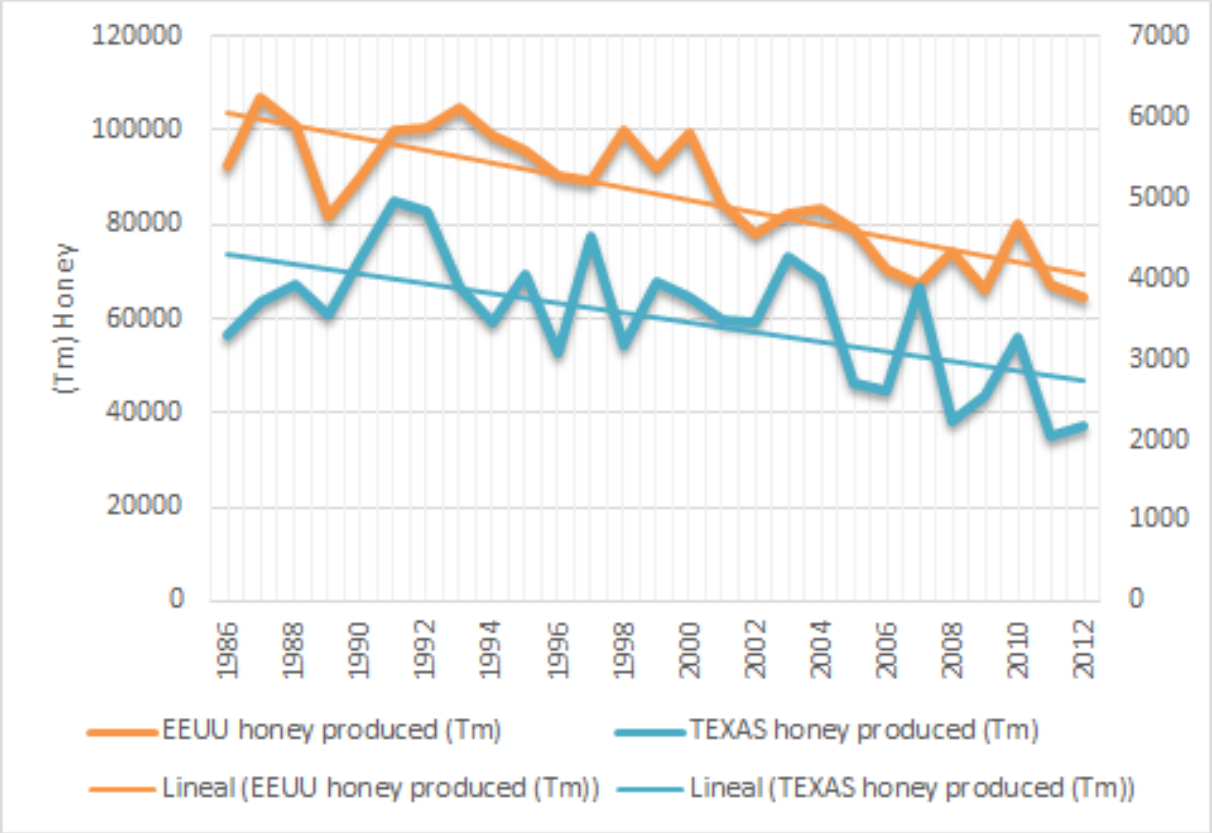
MacDowell (1984) concluded that the beekeeping industry, located mostly in the southern part of the United States, was seriously threatened by the infestation of AHB. He estimated the annual losses for the four scenarios[10] of an AHB infestation would be in the range of $ 58 to$ 26 million. However, he (1984:23) argues that such losses can be reduced if technical and scientific assistance is successfully used.

Meanwhile Winston (1992: 112-113) argues that the majority affected by the AHB would be those who depend on large-scale migratory beekeeping, because of the restriction on bee movement that was declared by the government. According to him by 1989 there were 3.3 million bee colonies in the United States. Around a third of them were moved long distances each season and the majority of the beehives spent at least part of the year in the extreme south of the United States.

Winston (1992:113) also refers to the impact of the restriction on bee movement on other activities, such as pollination as well as the sales and production of queens. For example, he states that 90 percent of the queens that are used to replace the old are produced in the south. He adds that in 1985, 1.2 million queens were produced to be sold to beekeepers, with a value of about US$ 7 millions.

[10] Annual losses: Scenario I (11 states): are $ 54-$58; Scenario II (11 states): $49-$52; Scenario III (6 states): $28- $31 and Scenario IV (6 states): $26-$28 million (MacDowell, 1986).

Figure 4: Honey Production before and after the arrival of Africanised Honey Bee to the United States and Texas, 1986-2012.



Source: NASS, USDA

On the other hand, the National Agricultural Statistics Service-NASS figure 4 shows a gradual decrease in honey production in both the United States and Texas[11]. The graphics show two parallel lines. The red line (USA) shows a gradual fall in honey production from 92 733.01 tons in 1986 to 64 544. 04 t in 2012. The blue line (Texas) also shows a decreasing production from 3 290.41 tons of honey to 2 169.98 tons in the same period. The data shown may suggest that the drop in honey production, both in Texas and in the entire USA, is connected to the arrival of Africanised bees, however, what has really been happening with the production of honey in the United States is a gradual decline since 1940[12].

A study of Livans and Moss (2010:901) on the impact of the production of honey, between 1980-2008, concluded that "the arrival of the Africanised honey bee has not significantly affected honey production in the United States". Schneider, De Grandi Hoffman and Smith (2004: 366) also mention the small economic impact of AHB on honey production in the United States, arguing that the impact was less severe than initially expected, due to the low average spread, reduced fitness in temperate climates, and the high level of preparedness based on the experiences of Latin America. They mention, though, that it is difficult to assess the impact of AHB because in some regions, [such as California], there are confusion because of the mite-induced losses of managed colonies and the importation of the large number of EHB for pollinating purposes.

[11] Historical data on honey production date back 4 years before and 12 years after the arrival of Africanised bees in the United States. The reason for including Texas in the box is because it is the first state to be invaded by Africanised bees. Currently, covers more than 60% of the territory of Texas.

[12] Since 1940, domestic honey production (the product of annual yield and the number of colonies) has trended downward, falling on average by about 0.7 million pounds per year (Burgett, Daberkow, Rucker and Thurman: 2009)

Dr. De Grandi Hoffman (Hayes: 2016), director of one of the most prestigious bee research centers, concludes that there are four challenges that North American beekeepers have to face. "*The first is Varroa followed by poor nutrition from lack of forage and then pesticides, whether self-inflicted from Varroa applications or from the environment. The fourth challenge that is not being included is climate change"* (p: 562). None of these challenges were created by AHB.

Effects on policy-making in USA

The impact of the political decisions, mainly taken by the Department of Agriculture became evident years before as well as during the arrival of AHB until present. This was reflected in the missions of researchers and beekeepers in affected areas, collecting information on the experiences of South American beekeepers. Other measures were more practical, like slowing the advance of AHB before and during their arrival. Political decisions were implemented at two levels: state and federal level, but also local governments began to implement their own measures when the AHB appeared in the area. Among The Most Important Political Decisions Taken Were: to send a research mission to Brazil, establishing a restricted zone in Mexico and policies at state and federal level.

About the mission sent to study Africanised bees in Brazil

In 1972 a work entitled: "*Final Report Committee of the African Honey Bee"* was published by a team of AHB entomologists in Brazil. The committee was composed of nine researchers seeking to learn directly from the Brazilian beekeepers about the problem of African bees (Cantell, 1974). According Cantell (1974) the committee operated under the Division of Biology and Agriculture of the National Research Council, National Academy of Sciences, Washington, DC.

However there are several critics about the final report. According to Gonçalves, Stort and De Jong, (1991), they argue that the US entomologists focused their attention on the negative effects of the problem, but not on solutions that the beekeepers and researchers had developed. The final report also served, adds Gonçalves, Stort and De Jong (1991), to legitimise the fire that had started in the tabloids in the United States about the AHB.

Moreover Sandfort (2006: 9) adds that despite the amount of scientific reports published before the publication of this document it was published as a final verdict of the problem. Actually he states, this was the first initial steps of a remarkable and controversial scientific investigation that continues to this day.

The agreement to establish a restricted bee zone between the United States and Mexico

In the mid 1980s an agreement was signed between the governments of the United States and Mexico (Winston, 1992:126-127). The agreement states that a Bee Regulated Zone should be established in Mexico with the aim to establish a biological barrier in the isthmus of Tehuantepeque to stop the spread and the advance of AHB towards the north. The resources proposed for such action included 39.000 bee colonies, 16.000 drone traps and 141.000 bait hives to catch swarms and establish them in an area 225 miles long and 170 miles wide. The proposal included also 1,150 employees and 220 vehicles. The budget shared between the two states was $ 8 million (Winston, 1992: 127). As Winston (1992) states, the program was formulated in military terms giving the impression that they were going to war against AHB, using the latest in technology.

Nevertheless, according Winston (1992: 130) the regulatory zone program generated a controversy between the supporters and those who were against. Unfortunately as expressed Winston (1992) bees continued their way north, as the discussion became more heated. The goals changed to the extent that the bees expanded further north. Finally, he argues that the bee regulated zone did not achieve stops or delays for the AHB. Sandfort (2006: 20-21) argues that despite the controversy that where the result in many areas; the bee regulated implementation provided the elements and experience for other future monitoring effort and served as a useful model for extension to assist beekeepers.

The State and Federal agreement when Africanised bees were in the United States.

According Sandfort (2006) the United States of America has benefited from the experiences of the countries of South and Central America in their struggle with AHB. It was therefore logical that the United States could develop a comprehensive program to help overcome the problems beekeepers faced.

Sandford (2006: 21) comments that many meetings about AHB occurred between the 80s and 90s. In

December 1984 in Texas, the entomologist society of America held its annual meeting to discuss matters relating to AHB. In March 1989 at Louisiana State University, Louisiana, an AHB initiative program was held (ibid, 2006: 21-22), and a conference was held in September 1990 in Tempe, Arizona, organised by the American Association of professional Apiculturalist (AAPA) and the Apiary Inspectors of America (AIA) (Ibid, 2006: 21-22).

Finally, the turning point came in a workshop organised in St. Louis, sponsored by USDA (United States Department of Agriculture) and NASDA (National Association of State Departments of Agriculture), whose objective was to develop a Honey Certification Program (Sandford, 2006). A program based on self-help and management practices rather than strict regulations. The conclusion from the workshop was a beekeeping model, developing a management plan that would require inputs from beekeepers, growers, researchers, extension educators and other; and that the management routine vary according to region, geography and climate. The pest management strategies should reflect these differences (Ibid, 2006: 23).

Nevertheless, during discussions on how to find consensus on what should be the responsibilities of the actors there was a lack of consensus. According to Winston (1992) the North American beekeepers community was permeated by a series of conflicts and likewise there was confusion about responsibilities between state and federal agencies (Ibid, 1992: 121-122). Sandford (2006: 21) means that the weakness of most of these meetings was the lack of input from the commercial beekeeping industry.

Despite the initial contradictions, in every state and municipality there were established regulations regarding beekeeping in populated areas before the arrival of AHB, especially in the southern states where places to set the apiaries had become increasingly difficult to find (Winston, 1992:118).

Weiss (1989: 389) describes the concern of beekeepers and researchers and the lack of a Texas policy to address the invasion of these bees. The concern is based on the fact that any attempt to halt the northward migration of the AHB had failed. Due the inaction of the USDA, scientists and beekeepers in Texas were coordinating actions. The lack of consensus and delineation of roles at the time of taking responsibility is reflected in the first state of the United States to be invaded by these bees. According to Winton (1992) the organ responsible for ensuring the pests control and diseases on a federal level announced to the state of Texas that it is negative to enact regulation, by delegating the responsibilities to Texas State to take first action to address the problem. The cost of such a measure was around $800,000 for the first year only (Ibid, 1992: 136). Also, the state of Texas took the first step to declare quarantine in the south east corner of Texas, because bees cannot be moved out of the nineteen counties in which they were found (Ibid, 1992: 133). Meanwhile, the ARS(Agricultural Research Service) scientist began to develop recommendations for beekeepers to minimise the problems that bees could create (Shimamiki, 1996).

4.2. The Perceptions of the AHB spreading amongst beekeepers in Brazil and USA

4.2.1. Perceptions amongst beekeepers in Brazil

The perceptions and reactions of beekeepers vary from one region to another in Brazil. While Southern Beekeepers perceived AHB as a threat, they were dependent on the EHB and thought that the Africanization of beekeeping would produce a great impact on beekeeping; socially, economically and culturally. On the other hand northern Beekeepers reacted and perceived the situation differently due to their different ethnic composition Their cultural background (European, Native and African) is very different from the southern beekeepers; for them beekeeping was not inherited from their European Ancestors; it was rather a new experience with much economic potential.

According Michener (1975: 412) “although in many areas beekeepers became unpopular, commercial beekeepers, especially in southern Brazil, mostly feel that the Brazilian bee [AHB] is superior to any species they had had before. Even in the north this attitude may be developing. Beekeepers value the large harvests of honey that the Brazilian bee [AHB] produces. In the area around the city of Recife in the North, beekeeping has shifted from native stingless bees to AHB”.

In an interview carried out by Da Silva (2004) with one of the oldest beekeepers of Joinville in the state of Santa Catarina about his perception of the arrival of the AHB to his apiary he said:

> *"... I lived in Campo Alegre when the African honey bee arrived....from 1959 and 1960 onwards appeared the first of the African swarms in Campo Alegre. The technicians in the beekeeping course and the beekeeping congress said that African bees arrived in Santa Catarina in 1963-1964(…….), I had(do not know where it goes) photos with these bees in apiaries and people trying to protect themselves.(.....) I'm familiar with the Africanized bees and the apiaries produced well(…….)is good to have around 20 beehives. More is bad, there is a lot of looting, (...) They work during rain,night and early morning, in the dark.*

> *(..) I had to change everything, and it took me years. They(the bees[AHB])were invading the hives and drove out the Europeans [European Honey Bee]...I saw a tiny swarm occupy the colony and, within one flowering season they grew to have seven boxes, but they are not as aggressive as in the beginning. They are quite different from the others, before we depended on having to buy the colonies (of European honey bees) but not any, in this case it´s much easier for the beekeeper, as everybody can capture swarms, and increase their apiary. And soon,we just install the hive on site. With good flowering, they develop as a family and already begin to produce" Mr. F (Joinville)*

Caldas-Filo, 1965-1966; Caldas-Filo, 1967; Caldas-Filo, da Silva, 1964 and Nogueira-Neto, 1964 cited in Michener, 1975:40 describe the beekeepers' strong reactions against the Brazilian bee (AHB) in the early years of their invasion by in the southern part of Brazil.

Below a beekeeper from the northeastern region discusses how he becomes a beekeeper and how he managed the AHB, but not as the beekeepers of southern Brazil had done. The interview was carried out by Vilela (2000: 117-118)

> *I entered 82 (1982), but I started working around 1984.... The importance of beekeeping, the thud It caused in the State of Piauí was something as an invasion of Africanised bees looking for space and the best conditions to live, the conditions were close to reality that she lived in the regions of Africa, so she found in Piauí almost like her natural habitat. They migrated from Sao Paulo. (.....). They arrived in 1962, the records that I have from people of the South region saw the first small bee swarms that it was a bee totally different ... (.....). They told some funny stories about it. They do not know sting bees (apis mellifera), so they knew the native bees as urucu, mandassaia and they harvested the honey without any protection. Then some of them began to observe that this new species of bees did not produce honey in pots , as they call it, they call the pots of native bees .. (....). So they did not know the bees doing this way, they called wasps, and they tell the stories.., they had un ritual, they came and struck the hollow stick and said, "Good morning African", then told a story and said: "Excuse to see their combs", then began working with the ax, if they did not this so that the bees would attack them, to Meleiro (honey hunter), to called Meleiro. But in reality they by doing this, they were anticipating the Sporades, because from the moment you pate in a hollow surface that gives vibration alert all the bees have an enemy, then in fact what they did was contrary to they were wanting (A.L.M beekeeper and president of Feapi).*

According Sandfort (2006), all countries invaded by the AHB have experienced more or less a similar history to that of Brazil. These are the words of Dr.Spivak, entomologist, (1991: 150) about his experience with the African bees.

> *""In all regions, there were beekeepers who were unwilling to modify their practices to adapt to new circumstances. They soon experienced extreme stinging responses and high incidences of swarming and absconding. Ultimately, these beekeepers abandoned their colonies. Based on these occurrences, the idea was erroneously perpetuated that the entire population displayed uniform characteristics and that all bees were both dangerous to the public and undesirable from a management standpoint.*
>
> *"When swarms and colonies from all areas were observed and assessed on an individual basis, however, they clearly displayed a wide range of behavioural characteristics. It was a minority of colonies which were consistently unmanageable and extremely defensive. Those beekeepers who were willing to requeen or kill such colonies and modify their management practices were able to work Africanised colonies profitably and with minimal danger to the beekeeper or public."*

4.2.2. Perceptions amongst beekeepers in USA

The perception of beekeepers about the arrival of AHB was to some extent influenced by the media who had labeled the AHB as the "killer bee", but also by the countless scientific reports published since the release of the first swarms in Brazil in 1957[13], where the aggressiveness stood out among other things. The bees were known for their enormous capacity to adapt to the environment where they colonised and for the destruction they caused to the economy for beekeepers.

[13] The exact numbers of scientific reports published from the first years of Africanisation are not known. However, most published reports come from the Brazilian and North American researchers focused on the biology and the adaption of the AHB in the neo tropics.

But at the same time it can be noted an enormous power of resilience by beekeepers after a long period of learning and adaptation. On the other hand there was the concern of the beekeeping honey industry and pollination service that by no means wanted to lose the status quo established on EHB. They called for more government intervention to prevent such change. All this created a climate of uncertainty and concern among beekeepers. Despite that the most concerned beekeepers were clearly small beekeepers, because they believed they could go out of business, experiencing a high level of prohibition and regulation that had to be implemented in order to operate their hives.

There are also beekeepers that have an unusual perception about AHB. They do not consider it as plague or threat. Such is the case of beekeepers in Arizona, one of the first southern states invaded in 1994 by AHB. Their explanation is based on the fact that Africanised bees were introduced, for research, years before the arrival of the AHB from Brazil and that these had been diluted over time with EHB. They also mean that these new bees from Brazil do not differ much from existing bees and therefore should not affect the beekeepers very much. They argue that the scandal created around the arrival of AHB was to get more funds from the state. This was for example the opinion of Carla McClain who wrote a report (1993) published on the website *The Bee Source*, titled "Some Beekeepers Believe Killer Bees are Fraud". On the website she collected the perceptions of the beekeepers from Arizona and Texas about the arrival of the AHB (Agricultural Research Service-ARS/USDA, 2009).

"Killer bees are nothing more than a hyped-up scam foisted on the public to milk federal research dollars", says a group of southern Arizona beekeepers. In response to the above authorities stated that federal dollars are not flowing to the USDA bee lab in Tucson. "It has not changed our budget by one dollar," said director Eric Erickson (McClain, 1993). These phrases create a polemical context. "There are so many distortions. This (Africanised) bee is nothing new in this country – it has been here for decades. It's what we already have," said Dee Lusby, president of the Southern Arizona Beekeepers Association and the state beekeepers group. Lusby claims she has federal documents proving that AHB were brought to the U.S. in 1935, and again in 1959, and dispersed into the breeding programs of professional beekeepers all over the country (McClain, 1993).

"Our domestic (bee) stocks already have Africanised genes in them," she said. "That's why you can't tell them (Africanised and European honeybees) apart. Despite all these scare tactics, you won't notice any difference when the so-called 'Africanised' bee gets here."As the killer bee continues to interbreed with the European bee, its defensive-aggressive temper mellows out, becoming basically the same as the European bees over time, she said. The Arizona beekeepers say they will not make any effort to keep the AHB out of their domestic hives after they arrive here later this year. They will instead allow them to interbreed freely with their domestic EHB (McClain, 1993).

Their controversial point of view is strongly disputed by beekeepers in Texas who are now living with the AHB, as well as bee scientists and researchers who have tracked this bee for decades. In Texas beekeepers are spending considerable money and manpower to keep their hives free from the aggressive AHB.

The idea that there is no real difference between the Africanised and the European honeybee is "unique to Arizona – to southern Arizona," said Henry Graham, president of the Texas Beekeepers Association. "It is unscientific and unprofessional for any bee expert to think that way," he said. "People in this business should know by now, for a fact, that there is a difference. "Beekeepers in southern Arizona tend to cling to old-fashioned beekeeping views and methods, he said. They believe modern breeding techniques have actually weakened the EHB in North America, making it vulnerable to domination by the AHB, he explained. "Now, we are faced with a constant influx of natural, wild Africanised bees that are not controlled at all, and are coming in major numbers. That is totally different. I think the Africanised bee is going to invade throughout the U.S. and we are going to have to deal with that."

"Our aim is to keep it as African-bee-free as possible," said Henry Graham, president of the Texas Beekeepers Association – the first state in the United States to face these bees.

"We want to do that because we have bred the (European) bees for 200 years – bred them for their productivity, their gentleness and their stability. Why would we want to lose these traits now, to something we don't know very much about yet?"

The general perceptions among beekeepers are that AHB are very aggressive. This is the dominating views on the beekeeping forums today. There is a concern from northern beekeepers to have found signs of Africanisation in their apiaries. Their concern is based on the fact that the experts predicted that colder areas

were to form a natural barrier for passage north, but the Africanisation, according to comments from beekeepers, is coming by migratory beekeeping and bee packages that are produced in the southern states, where AHB has established many years ago.

4.3. Coping and adaptation strategies taken by beekeepers in Brazil and the USA to adapt to the AHB spreading.

4.3.1. Coping and adaptation strategies taken by beekeepers in Brazil

According to my understanding beekeepers in Brazil had two strategies, developed in collaboration with researchers. They are as follows:
Reduce the AHBs' defensiveness by introducing new queen bees in the hives, but the results were failures. This work was started by Kerr in 1965 when he bought some European queens of the United States. From there they reproduced and were distributed among beekeepers in São Paulo(Coelho, 2005). With time the bees ended up diluted with AHB and the attempt to return to EHB had ended. The reason for the abandonment of the strategy was: The method was costly and beekeepers lacked necessary economic resources. The Brazilian government also did not have a policy of re-introduction and development of EHB.

The other strategy was to adapt to the AHB and that was the strategy that worked and consisted in (Soares, 1996 cited in Sandfort, 2006):

-Manipulating colonies with great care.
-Locating hives correctly.
-Using adequate equipment and protective clothing.
-Manipulating the beehives only when climatic conditions are favourable.
-Selecting less-defensive bees and using EHB when necessary.
-Taking advantage of mutations such as the split sting.

4.3.2. Coping and adaptation strategies taken by beekeepers in USA

The strategy by the beekeepers in the southern region seeks to avoid the Africanisation of American beekeeping managed by European bees and avoid conflicts with the neighbourhoods due to bites. The actions taken were:

> Move apiaries located in urban and suburban areas to more remote areas so that they cannot cause accidents with people who live nearby. In areas that already have been identified as areas invaded by AHB, quarantine is declared in the area. However this is controversial. In quarantined areas the beekeepers have to declare the entrance and exit to the area and they have to certify that their bees have European lineage.
>
> In areas declared under quarantine it is recommended to beekeepers to at least change queens every six months. There is also controversy among the beekeepers, because this strategy is very expensive; especially for small beekeepers. It is very laborious for large beekeepers and often useless work, because sooner or later their end up mixed with the AHB.

Some beekeepers in areas declared under quarantine give a pat on the back of the beehive to see if the bees behave violently. Presumably that could be a sign to kill the queen and then divide the hive into three cores and put an EHB queen there. However, there are areas like Arizona where the quarantine has not been established and the traffic is free.

Entomologist Winton (1992) said that beekeeping is mainly a family marginal occupation. One or two bad years can lead to bankruptcy easily. The bee industry is very susceptible to the slightest economic disruption and losses could be incalculable. Nevertheless, there are other authors who had more positive views about the arrival of AHB, as described by Morse(1991,9)in which he mentions that once AHB cross the border a well-trained community of beekeepers, quickly will know how to adapt to new situation. He also notes that many of the beekeepers have visited countries where AHB already exist and have learned from their experiences. He also comments that many semi-commercial and hobby beekeepers may need the assistance of extension agents, trained in beekeeping.

Despite the fatalistic predictions of the impact of AHB on beekeeping in the United States, in the southwest part of the country beekeepers have kept their EHB hives in areas surrounded by AHB. According to Kaplans (2004) the Agriculture Research Service-ARS recommended beekeepers to regularly introduce European queens of known lineages, mated with EHB drones, in order to keep out African bee traits in their apiaries. And despite not having a statistic about the number of beekeepers who stopped with this activity, looking at table 5,I presume that few beekeepers were affected by the invasion.

According to Sanford (2006,8), citing an interview with Texan beekeeper Bill Venderput, who talked about the impact of AHB on his apiaries; "25 percent more stings, 25 percent more work and 25 percent more sweat". The same Texan beekeeper cited by Kaplan in his article in 1996 six years after the arrival of the bees in Texas said: "I wear gloves all the time". Apparently the impact on the beekeeping was small, but also, you can see the rapid knowledge acquired by the beekeepers as AHB were invading the territory.

5. General Discussion

5.1. The effects of the AHB spreading on the apiculture sector

5.1.1. Social effects

The social impact caused by the arrival of Africanised bees both in the US and Brazil differ in a great sense due to the historical moment in which the introduction and arrival of bees occurred. In the case of Brazilian apiculture, there was no interstate organisation to bring together the few and scattered apiculture organisations in Brazil (Gonçalves, Stort and De Jong, 1991) to deal with the problem. On the other hand, in the old and deep-rooted United States, the organisation closely followed the process of advancement of Africanised bees from the South to the North of the Americas; It also served to discuss among its members the measures they should take in order that Africanised bees do not end up destroying beekeeping on the basis of European ones.

The Brazilian confederation of apiculture was founded 13 years after the arrival of Africanised bees that brought about the destruction of beekeeping on the basis of European bees; while in the United States both the association and the federation of beekeepers were founded a century ago. Those that undoubtedly allowed them to defend themselves better and take preventive measures and information about Africanised bees. Bourdieu(1987) says that social capital is an important element in a society to be able to face and adapt to problems, the stronger a better organisation can deal with problems, the social capital allow to developed a series of social networks.

Up to 2012, in Brazil, 26 federations, associations and companies were established that give a lot of support to the growing development of Brazilian beekeeping. To get an idea of how active the beekeepers were since the formation of the CBA, in 2012 the XX Congress of Beekeepers and V of Meliponiculturists was held. What shows in Brazil a solid interest for beekeeping and also for meliponiculture, an activity of old roots in Brazil, but with little attachment in the national context.

The arrival of Africanised bees drastically changed the way of beekeeping in Brazil, especially in the southern area where the largest European migration in Brazil is based. As we mentioned before bees were considered as pets, they could be raised close to their homes together with the other animals. With the irruption of Africanised beekeepers had to change all equipment and materials due to the demands of Africanised bees. However, in Brazil there is an association based in Sao Paulo that calls itself Europeanist and proposes a work with European bees. One of the leaders of the group considers that the arrival of Africanised bees has caused a severe economic and environmental impact in Brazil, however the scope of action of the mentioned organisation is limited and the majority feeling is to continue working with Africanised bees .

In the United States, beekeeping is part of its national identity. It arrived with the first European inhabitants to the Americas and settled well in North America for environmental (temperate climates conducive to breeding European bees) and cultural issues. A body of knowledge that has much cultural roots has been built on it. With the arrival of African bees, it was initially thought that bees would change the old paradigm to make way for a new paradigm. But that did not happen. According to Bourdieu cultural capital is very important in the development of the peoples, beekeeping in Brazil is not a great economic activity as it happens for example with the arms business or the soybean agro-industry. However, it enjoys global approval because it considers a business closely linked to nature. Cultural capital is a very important element in the culture of the people, the entrenched traditions often do not allow us to take the next step, due to those strong roots that are

tied to the past. Because European migrants from Brazil and European migrants from the USA did not change their paradigms quickly.

5.1.2. Economic effects

Honey Production

The results suggest that the introduction of Africanised bees ended up being a blessing in the medium and long term for the field of Brazilian beekeeping, especially for the production of honey. For example: in 1957, when the Africanised bees began to colonise the Brazilian territory, the production of honey in Brazil was around 5000 tons, and 55 years later, in 2012, the production amounted to 45000 tons, in other words the production went up 9 times since then. This result could sound contradictory with the arguments raised by James Scott when he states that the great plans elaborated and implemented by the states ended up impacting and altering the entire economic, social, environmental and cultural system (social field). Indeed the introduction of Africanised bees especially in the early period of colonisation turned out to be destructive for Brazilian beekeeping installed in the south of the country on the basis of European bees, causing the abandonment of many beekeepers of their activity due to aggressiveness that showed the bees making their management impossible. But Scott (Jesus: 2013) himself in his speech at Yale University also says that after a state of crisis people (including the group of researchers led by Kerr) sought informal solutions [or formal as the Brazilian scientists] adopting creative ways (thicker clothes that avoid stings, larger smokers, etc.), this type of formal and informal outings not only happened in Brazil but in the largest number of countries colonised by bees, found the right means for its management and as a result of them the increase in honey production to make Brazilian beekeeping one of the most important in the world.

In the North American case, the arrival of Africanised bees to the North American territory ended up being a threat to the beekeeping system, but very little for the production of honey. However, the drop in honey production shown in the figure 4 is due to a decreasing trend that comes from many years ago that dates back to the 40s on which there is a set of reasons put forward by North American researchers (Burgett, Daberkow, Rucker and Thurman: 2009). It is important to note that the production of honey as well as the other services and products of beekeeping come from gentle European bees introduced in the early period of colonisation. The question I ask myself is why a master plan such as the introduction of Africanised bees may have caused different responses in two countries. The reason is in the configuration and strength of the state. In the Brazilian case the state when it was introduced was a weak state in the North American case the state was a strong state; an economic, political, technological superpower, etc. For this reason he had the necessary means to avoid the transformation of his beekeeping. This postulate could be in the Scoot line where only failed projects affect weak states.

I also want to take this opportunity to discuss a controversy that arose between the data shown by the agency in charge of Brazilian statistics and the data shown by a beekeeper and Brazilian researchers on the initial impact on honey production. The first states that in the first years there was a slight rise in production followed by a slight fall, data that contradict, the latter, when they state that the fall in honey production was severe and took in some cases more than a decade in recovering. This discrepancy is understandable considering that Brazil was a relatively weak state with institutions that had limited capacity to collect data on honey production. But on the other hand how to give credit to the words of the beekeeper Bruno Shrimer if he was a fervent opponent to the introduction of Africanised bees and from his magaine called "the hive" developed a fervent critique of the introduction and the consequences caused by bees Africanised, of course there could be doubts, but in the case of Brazilian researchers, disciples of Kerr subjected the same pressure by people and the average as Kerr; why they would have to say through their inquiries that the impact was brutal, if such a conclusion could put them between the rope as Kerr and be white criticism especially of beekeepers and people in general affected by the introduction. Consequently, it is important to consider that the data of the beekeeper and the researchers are the ones that are most adjusted in terms of the impact suffered by southern beekeepers.

One of the limitations in the study is not having found sufficient data from Brazilian researchers and beekeepers to be able to contrast and discuss with the data shown by the Brazilian statistical institute on the impact on honey production in the first years of the Africanisation of the Brazilian beekeeping, which could have better clarified the impact on honey production especially in the first years of colonisation.

5.1.3. Effects on Policy-making

The decision to send Kerr to Africa to bring Africanised bees with him was a political mandate from the Brazilian state with the aim of improving honey production and expanding beekeeping to regions where beekeeping had not been developed, which in turn were the poorest in the country. The area where beekeeping had traditionally developed was southern Brazil, but on the basis of European bees, and where the largest colony of European immigrants from Brazil was based. On the other hand, in the rest of the country beekeeping was very incipient and had not been successful because European bees do not adapt well to the tropics. The aforementioned project of introduction can be considered as part of an ambitious project of modernisation and economic development of the Brazilian state in the field of agriculture, industry and the strengthening and decentralisation of the state, as mentioned by Scott in his book seeing like states. The great modernising plan was implemented under the government of Juscelino Kubitschek between 1956 and 1961 (Scott, 1998). The departure of Kerr to Africa to bring African bees, as well as the construction of the capital Brasilia, coincidentally had the same starting point: 1956. The main actors of these two controversial projects Warwick Estevam Kerr, Oscar Niemeyer and Lucio Costas correspond to the same profile of people: leftists, positivists, humanists and with strong social commitment. Unfortunately, the aforementioned projects, both Kerr and Niemeyer and Costas began to have their problems; on the side of the new capital Brasilia, the new inhabitants, as Scott said, suffered from the brasilia syndrome, which consisted of having claustrophobia and lack of community life because of the extensive and oversized streets; In the case of Africanised bees, beekeeping also began to abandon the activity due to the fierceness of the bees due to their handling difficulties. In the case of Africanised bees, it was not possible to foresee the consequences, contingency measures also failed due to the weak state that failed to respond to the conditions imposed by the arrival of African bees. Both the institutions and the state were very weak. However, all those megaprojects that failed at the time could be redirected and adapted, as Scott himself tells (Jesus, 2013). In the case of Brazilian bees with the commitment of beekeepers, Kerr and his colleagues managed to find ways to adapt to new circumstances. Later, with the support of the government and non-governmental institutions, beekeeping in Brazil became an activity of global importance.

On the other hand, in the United States, a powerful state with strong institutions and supranational thinking, the institutions and agencies knew how to react in time with a series of measures that sought to first investigate the impact of Africanised bees in other countries and then a series of measures that sought to delay arrival north or dilute the aggressiveness of bees. Finally, avoid the Africanisation of European bees and the paradigm shift of American beekeeping in general. The arrival was inevitable. Unfortunately all the actions failed, because many times you can not go against nature, much less against an unpredictable insect and that have semi wild characteristics. Today the states affected by the arrival of Africanised bees are implementing measures to keep Africanised bees in line in order to avoid crossing with European bees. In the case of Texas, the first state to be invaded by the Africanised quarantine measures were already raised that means that beekeepers can move from one place to another, from areas colonised by African bees to non-colonised areas and vice versa, one of them it's because really such a measure was really useless. The question they ask themselves is how to transport millions of Africanised bees from Florida to California aggressive bees and then place them in large areas of plantations to act as pollinators without affecting the people who work in these large plantations. However, the state of the United States faces new problems, many more serious than the African bees, is the fall in the number of boxes and the production of honey in the last 60 years.

5.2. The beekeepers' perceptions of the AHB spreading

The reactions and perceptions of the Brazilian beekeepers were amazed and worried to see how the Africanised bees took their colonies and it was soon impossible to handle them. In the North American case it was of concern for what could happen in the near future. In the Brazilian case years later the beekeepers realised that these bees could be handled under certain conditions and began to see that it could not be considered a threat but an opportunity. In the USA bees continue to be considered as a threat, a series of measures have been developed to avoid their mixing with European bees.

5.3. Coping and adaptation strategies taken by beekeepers

In Brazil Brazilian beekeepers with the support of researchers develop a series of strategies such as:

Locate the apiaries away from the roads, from the animal people. The Africanised bees can pursuit their victim up to 200 meters, it is possible that they are altered when they pass by making noise animal, people,

who can be attacked immediately. To avoid it is suggested to locate the apiary far from the roads. the breeding of animals, urban centres, etc.
Use abundant smoke. Smoke is what stuns and soothes bees. It is necessary beforehand during handling to use abundant smoke on the bees. Enough smoke without these end up irritating the bees. Without smoke one could not check the boxes of bees. Smokers also have to be large enough, more than double the traditional ones due to the abundant smoke that is used during the revision of the colonies.
Use appropriate relatively thick and white coloured jackets to avoid irritating bees.
Thick gloves The Africanised bees have to bite more times when one is made to the hives to avoid stinging on the hands Brazilian beekeepers had to use thick gloves made many times of animal leather material sufficiently resistant to stings. Without a glove, it could be difficult, not impossible, to manage the paintings and check the hives.
Select the most tame and productive by the aggressive and unproductive. It is a strategy that Brazilian beekeepers with the support of Brazilian researchers have been doing. not all bees are totally aggressive,

On the other hand, in the United States, they developed a strategy to combat Africanised bees.

-Move the apiaries away from human settlements if they were colonized or taken by the Africanised bees.
-Communication campaign.
-Reintroduce European queens into hives with symptoms of Africanisation.
-Quarantine in area colonised by Africanised.

6. Conclusions

Like European bees, Africanised bees were also introduced to the Americas, with the following differences: AHB are more rustic and better adapted to the tropics than EHB and they did not require the assistance of humans to spread throughout the Americas. Due to their enormous capacity of reproduction and aggressive behaviour they soon came into conflict with the interests of beekeepers and the bee industry. The beekeeping and beekeeping industry that entered a crisis in the Americas is a social field “the apiculture field”- where a number of actors and agencies with different forms of assets and abilities interact. Various actors within the social field of apiculture have invested in the maintenance of the EHB, thus making the resistance to AHB more fierce. Bees that are "eligible" or acceptable by beekeepers and beekeeping industry should have certain criteria or characteristics that the beekeeper and institutions has been shaping by centuries of management and interaction with EHB. The most notable advance occurred 140 years ago with the invention of movable frames by Reverend Langstroth in the United States. Since then, beekeeping stopped being a family cottage industry and became a profitable industry.

Despite the huge impact by AHB caused in the Americas beekeeping based on EHB, in the United States, a well developed beekeeping industry -with high knowledge, capital and technology-, the social, economic and cultural impact was small. But with an issue still unresolved: How to avoid the Africanisation of the North American beekeeping on a long term? However, in Brazil, the impact was very hard during the first 20 years and many left beekeeping, especially in the southern regions where beekeeping established on EHB had developed by the European immigrants; However, years after, the Brazilian beekeepers managed to adapt to the new circumstances that the Africanised bee imposed. They were also part of a process of partnership between the organisations of beekeepers and Brazilian researchers led by WE Kerr and his Brazilian colleagues, who worked on finding better ways to manage AHB. Also, with the arrival of Africanised bees in areas with little or no beekeeping tradition as in the North East of Brazil in the semi-arid, inputs were given to the development of a thriving beekeeping industry. Agencies and actors were interacting with each other and in recent years they have become one of the most powerful beekeeping regions in the country. Getting closer to change the leadership of honey production from the southern areas to the northeast region. Today in Brazil there are around 350,000 beekeepers organised in 27 state Federations, 400 associations and cooperatives and 210 micro and small enterprises.

At the political level the reactions of the state were almost absolute silence although the trip of Kerr and his group to Africa to import African queens was mandated by the Brazilian government. What we can see in this thesis is the personification of the problem because of Kerr, i.e. the weight of the problem and the consequences caused by the introduction of these bees was under Kerr's shoulders. One wonders why? The answer is in the weakness of the Brazilian state in failing to address the problem to its own responsibility.

There were several actions implemented by US Government before and after the invasions of AHB to USA.After the invasion, new regulations were implemented to combat the AHB. Other measures were to slow and/ or stop the entry of AHB to USA. The measures were also taken at federal, state and local level once AHB had entered U.S. territory, who resided mainly in establishing quarantine zones where they had detected swarms of Africanised bees, the capture and destruction of swarms was one among others measures.

The economic impact. There are an unknown number of lost hives during this period as well as decreased honey production in Brazil. However, since the year 1978 the increase in production of honey and the amount of beehives was evident as indicated by the statistics of the period, and thereafter the activity and the production of honey has been growing steadily until today. Today Brazilian beekeeping involves more than 350,000 people which have developed a honey production chain involving cooperatives, associations, small and medium enterprises. Brazil is today ranked as number 4 in the world ranking of the production and export of honey in the world. Meanwhile in the United States there are no statistics showing the number of beekeepers who were driven out of business during the first 10 years of the invasion of the AHB. But the reports by the Ministry of Agriculture point out that there was not a significant decrease in honey production or in number of hives, indicating that the impact was not severe.

In terms of reaction and perception, the southern beekeepers watched with great concern how the AHB where competing with the European bee hives. While in the north and centre it was perceived differently because they were not managing European bees. However, some beekeepers, beekeepers especially organised around Apacame, thought that the introduction of the African bee would be negative and result in a decline of the EHB. Meanwhile, in USA, AHB where considered very aggressive and low in honey production comparing with the EHB. The overall perception by the majority of beekeepers where that the AHB are aggressive, even in areas not colonised by AHB. This perception today when one reads the forums about beekeeping shows a concern from northern beekeepers to have found signs of Africanisation in their apiaries. Their concern is based on the fact that the experts predicted that cold areas form a natural barrier for AHB to passage to north of USA; however according to comments from them, the Africanisation is coming by action of migratory beekeeping and bee packages that are produced in the southern states where Africanised bees has been established for years. There is also a tendency on the part of beekeepers to correlate any incident of aggression of their bees with AHB. Unaware European bees also have to react in special cases as they are threatened of AHB.

The first strategies used by the Brazilian beekeepers 1964 was to introduce European bee queens to Brazil to reduce the Africanisation of the hives, it became a failure; because the European genetic materials that were introduced for that purpose was so small for the vast area occupied by AHB and the Africanised bees are also much more dominant than EHB. Adaption became the successful strategy and this is the approach used until today. The beekeepers had to establish a series of measures in order to manage their apiaries and take advantage of the new bees. Meanwhile in the USA beekeepers set up a comprehensive strategy of communication that gave a basic understanding about Africanised bees for the public and among beekeepers. Much of this information can be found on the websites of beekeepers and institutions linked to beekeeping. Another strategy was the introduction of European queens to bee hives that had been invaded by AHB. These two strategies are the two most important up until today. However, you can hear voices among beekeepers wondering if its worth all the effort made to combat Africanisation of beekeeping or if it would be better to adapt and manage the Africanised bees?

Finally, Africanised bees continue their way to the far north and south of the American continent, climatic conditions which served as natural barriers in the start of colonisation have been exceeded, today it is known that AHB are adapting well to the temperate zones. In Latin America in rural families with low incomes, beekeeping with AHB is a chance for extra income; in the USA there is still resistance in the system to include AHB, the Africanised bee is not "eligible" because they are not adapted to the given conditions. A new way of beekeeping would mean profound changes in politics, culture, economy as in the beekeeping industry and the Department of Agriculture in the United States. How long the US beekeeping industry can rely on the gentle EHB, only time will tell.

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