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A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them

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ABSTRACT

Honey bees are a highly valued resource around the world. They are prized for their honey and wax production and depended upon for pollination of many important crops. While globally honey bee populations have been increasing, the rate of increase is not keeping pace with demand. Further, honey bee populations have not been increasing in all parts of the world, and have declined in many nations in Europe and in North America. Managed honey bee populations are influenced by many factors including diseases, parasites, pesticides, the environment, and socio-economic factors. These factors can act alone or in combination with each other. This review highlights the present day value of honey bees, followed by a detailed description of some of the historical and present day factors that influence honey bee populations, with particular emphasis on colony populations in Europe and the United States.

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1. Introduction – the value of honey bees

The European honey bee, *Apis mellifera* L., is the most commonly managed bee in the world. A highly adaptable species, it has a native range that stretched from the southern parts of Scandinavia to Central Asia and throughout Africa (Seeley, 1985; Ruttner, 1988; Sheppard and Meixner, 2003). Since the 1600s, however, *A. mellifera*'s range has expanded to nearly all habitable corners of the globe. Most of the European honey bee's range expansion has been the result of deliberate human transport (Crane, 1999). "Like the dog, the honeybee (*sic*) had accompanied man on most of his major migrations, and some of the early settlers in each part of the New World took hives of bees with them" (Crane, 1975). Unlike dogs however, honey bees were imported by settlers for their ability to make honey and bees wax. Honey was the only sweetener available to early African, Middle Eastern and European civilizations, and demand for the product no doubt led to the domestication of bees by the Ancient Egyptians sometime before 2600 BCE. The practice of keeping bees was passed to the ancient Greeks by 650 BCE, who in turn passed the art to the Romans (by 150 BCE) who spread the art throughout what would become medieval Europe. It was the descendants of medieval European beekeepers who eventually spread both the practice of beekeeping and the bees themselves around the world (Ransome, 1937).

1.1. Honey

Honey was the only readily available sweetener to the peoples of Europe until methods were developed for refinement of sugar from sugar beets and sugar cane (Voorhies et al., 1933). Honey remains an important international commodity with global production estimated at 1.07 million metric ton in 2007, a 58% increase in production since 1961 (FAO, 2009). Using the average 2006 US price for honey, \$1168 metric ton, the global value of honey production in 2007 had an estimated worth of US\$1.25 billion.

1.2. Pollination

By far the most important contribution honey bees make to modern agriculture is the pollination services that they provide. Fifty-two of the 115 leading global food commodities depend on honey bee pollination for either fruit or seed set (Klein et al., 2007). Some (five) honey bee-dependant commodities would have $\geq 90\%$ yield reduction without honey bees (Klein et al., 2007). In addition, yields in terms of fruit size, quality, or quantity would be greatly reduced (90–40%) in 16 commodities, modestly reduced (10–40%) in a further 19 commodities, and slightly reduced (<10%) in a further 13 commodities (Klein et al., 2007). In total, 22.6% of all agricultural production in the developing world, and 14.7% of agricultural production in the developed world is directly reliant on animal pollination to some extent (Aizen et al., 2008). However, when foods that indirectly benefit from pollination are included, 35% of the human diet is thought to benefit from pollination (Klein et al., 2007). Globally, the value of insect pollination has been esti-

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