Pollinator declines, impact, causes and solutions: can South Africa prevent them?

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An extremely large proportion of plants require some sort of animal pollinator in order to reproduce. This is in the region of three-quarters of all flowering plants on earth (van Engelsdorp *et al.,* 2008) and two-thirds of all agricultural crops (European Commission, 2012; Pensoft Publishers, 2012), namely fruits, vegetables, seeds and nuts. These make up about one third of all food consumed by people worldwide (Van Engelsdorp *et al*., 2008) and are the main natural sources of vitamins and minerals. It is therefore very worrying that pollinators are currently in decline worldwide (European Commission, 2010). This essay will be discussing the extent, causes, effects and solutions to pollinator decline.

Most of the pollinator declines have occurred in Europe, North America and Asia. (The Science of Pollinators, 2011) However, only managed honey bee populations have been recorded accurately. It is therefore necessary to look at decline of managed honey bees and wild pollinators separately.

In the USA, according to results from the National Agricultural Statistics Service, managed honey bee populations in the USA declined 40% from 1947-2005. (Berenbaum, 2007) This while demand for pollination services was increasing. The rate of decline in both regions showed an increase in the 1980s after the introduction of two parasitic mites, namely varroa and acarina mites, into populations of honey bees. Then in 2006 honey bee colonies began to disappear without a clear reason. (Van Engelsdorp *et al*., 2008) Normally bees will only abandon a hive if they have a shortage of food, no queen or if all the larvae have hatched, however, these hives had sufficient food, a queen and larvae. This phenomenon became known as colony collapse disorder (CCD) and has had an extremely serious impact on bee populations in recent years. It will be discussed further later in the essay.

With regards to pollinators other than managed honey bees, there is no accurate evidence on their populations. However, most localised surveys point to a decline in their numbers in the area the survey was conducted. (Berenbaum, 2007) Therefore it can be concluded that wild pollinators as a whole are decreasing. Wild pollinators are extremely important in food production. A study by the University of Calgary (University of Calgary, 2013) has shown the wild pollinators are more effective in pollinating crops than managed bees and that while higher numbers of managed bees do not significantly increase yields, higher numbers of natural pollinators do, irrespective of managed bee numbers. Therefore, a decline in wild pollinators results in a decline in food production. Wild pollinators are also important to spread the task of pollinating between many different pollinators and so minimize the impact of a decline in a specific pollinator such as managed honey bees. This is something wild pollinators have not been able to do as they are simply not numerous enough. As a result, in 2005, the USA had to import honey bees for the first time since 1922, to meet pollination demand. (Eilperin, 2006) It is therefore extremely important to have healthy populations of wild pollinators.

The decline in pollinators can be attributed to a variety of causes and is most likely the result of a combination of most factors. They vary only slightly between managed bees and wild pollinators.

Managed bees have declined due to parasites and diseases spread by transportation of bees around a country to pollinate different areas. The problem is exacerbated by stresses associated with moving hives, pesticide use, monoculture and herbicide use, which reduce the variety of plants available to bees as a food source. A combination of these factors weakens bee's immune systems, making them more susceptible to parasites and diseases.

The two main parasites attacking bees are varroa and acarina mites. (Berenbaum, 2007) These mites suck the blood of their host bees and breed inside the capped brood. (bee larvae inside of a covered cell) The main diseases are European Foulbrood, American Foulbrood and Nosema

disease. (Blackiston, 2013; South African National Biodiversity Institute, 2012) These diseases kill the bee larvae. A combination of these parasites and diseases can kill an entire hive.

Natural pollinators decline for much the same reasons as managed bees, except that wild pollinators are not moved around the county, but are affected by habitat loss (AgriLand Project, 2012). In farmland, pollinators nest in hedges, unploughed edges of fields, small woods, and fallow land. Farmers, in an attempt to increase yields, plant these areas and so remove habitats for wild pollinators. This is a major factor in wild pollinator decline. Wild bees are also more susceptible to malnutrition because they are not fed syrups by beekeepers and are not moved around to pollinate different crops. A wild bee colony will generally have an overabundance of one food source for a short time in the year and then have very little food for the rest of the year, because of the shortage of natural habitat and the loss of weeds killed by herbicides. This malnutrition will weaken a hive to the point where if a parasite or disease is introduced (probably from a travelling managed beehive), the hive will probably succumb and die. Another reason wild pollinators are threatened is due to the fact that they are viewed as pests. A bee's nest is considered a pretty dangerous thing to have around and gardeners generally try to kill caterpillars which would produce pollinating butterflies if given the chance. Therefore, many pollinators are actively attacked by humans. This is the main reason for the low number of pollinators in urban areas. Air pollution is another factor that contributes to pollinator decline. Ozone, hydroxyl, and nitrate radicals bond with the scents of flowers, reducing the distance they travel, thereby interfering with bees finding food sources. (Fuentes, 2008)

There is great potential for vicious cycles of pollinator loss to form. For example, as bees declined, beekeepers probably moved their bees around more to allow fewer bees to pollinate more crops. This would intensify bee decline which would encourage beekeepers to increase movement more and so the cycle continues. I hypothesize that it is the development of cycles such as these that have resulted in CCD. Bees have become gradually more and more overworked until it reached a point in 2006 when colonies were collapsing for no apparent reason. Wild pollinator decline would also have the effect of reduced yields and higher hive

rental prices. In response, farmers probably ploughed more of their land and used more pesticides and herbicides in an attempt to keep yields high. This would reduce pollinator populations even further, leading to yet more declines due to even greater habitat loss. Unless something is done to interrupt the cycles, it will continue until bee populations are decimated.

All these pollinator losses have had a number of effects. The loss of natural pollinators have caused increased reliance on managed honey bees and shortages of managed honey bees have caused increases in the price of renting hives for pollination. These two trends create a large expense for farmers in the form of pollinator rent. This translates into higher food prices. In addition, General pollinator shortages, especially shortages of wild pollinators, reduce agricultural yields, so according to the laws of supply and demand, food prices increase further. Due to the fact that it is fruit, vegetable, seed and nut crops that require pollinators (University of Calgary, 2013; Berenbaum, 2007), it is these crops that will increase in price. Therefore there will be a trend for people to eat less of these crops due to price concerns. As these crops supply the bulk of vitamins and minerals consumed by people, a drop in consumption of these crops will have a detrimental effect upon human health. Health care costs associated with a degradation of health will combine with a loss of income from insect pollinated crops to damage the economy.

Aside from consequences for humans, the environment will also suffer. A higher proportion of wild plants require pollination compared to agricultural crops (Eilperin, 2006; Berenbaum, 2007), making wild plants under even more threat than agricultural crops. Therefore many plant species already under threat from loss of habitat are faced with the further threat of loss of pollination. This will trickle down into the rest of the ecosystem, as it relies on the plants pollinated by pollinators that are too few to do a proper job. Plant losses will also cause problems for efforts to re-establish pollinators as the reduced numbers and varieties of wild plants will not be able to support a larger pollinator population.

It is therefore clear that pollinator decline must be stopped and reversed where it is already occurring, and prevented where it is not, or where it is not yet serious. South Africa is lucky in that we fall under the second group and therefore have an opportunity to prevent this problem before it becomes serious. The probable reason for the low rate of pollinator decline in South Africa is the way agriculture is conducted in this country. Overall we have rather poor soils and low rainfall, not all areas of a farm are suitable for planting and many farm dams are built to store water. These unplanted areas and areas around farm dams are fairly natural habitats that can support large numbers of wild pollinators. In addition, we have many game farms, hiking trails and wilderness areas that are essentially natural habitats which contribute further to supporting healthy populations of pollinators.

However, our bees are still under threat from the other factors found in Europe and North America, like parasites, diseases, stress from moving around and pesticides. In addition to preserving habitat, we must move quickly to combat the threats to our bees and prevent their decline. The sooner this is done, the better. This could be achieved in the following ways: Adjusting bee management so that hives are moved less frequently and over shorter distances, further increasing populations of wild pollinators would also reduce the distance and frequency managed hives must be moved, reducing pesticide use and banning those pesticides toxic to bees, adjusting the feeding of bees by introducing a greater number and variety of flowering plants planted in fringe areas of farms to provide both managed bees and wild pollinators with a varied food source in order to bolster their immune systems so that they are less susceptible to diseases and parasites If these steps are taken, severe pollinator decline in this country may be avoided.

As for areas which are already experiencing pollinator decline, essentially the same steps must be taken, only intensified as decline must not only be prevented, but reversed. What is also required, is some sort of national effort to breed large numbers of disease and parasite free bees to replace ailing colonies and to release into the wild to rebuild wild pollinator populations. The breeding program would involve breeding bees under controlled conditions,

such as inside greenhouses, with an abundance of food to encourage rapid colony growth. The large colonies can then be subdivided. As wintertime hive losses are very large (Van Engelsdorp *et al*., 2008), the breeding should be done in warm areas, like Texas or southern Europe, this will reduce winter losses and further increase colony growth. If it is found that colonies are collapsing shortly after being released due to lack of resistance to parasites and diseases, weakened forms of the pathogens could be introduced as a form of vaccination. Where pollinators have already declined significantly, it is not enough to simply create the conditions for growth; growth must be actively driven to make up the losses. A breeding program will accomplish this.

In conclusion, pollinators, particularly bees, are incredibly important for human food supply and for natural ecosystems. Their decline is having far reaching detrimental effects that will only get worse at faster rates due to the cyclical nature of the causes of pollinator decline. Therefore, in places experiencing pollinator decline, rapid and decisive action must be taken to halt and reverse it. Where pollinator decline has not yet become a problem, decisive action must be taken to prevent it. If action is taken, the world can look forward to a healthy environment and healthy people.

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