

Are Insect Populations Really Decreasing?

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Background

In the Citizens' Environmental Commission minutes of October, 2019, it was reported that insect populations are declining. While this may very well be true, I must admit that the statement caught me somewhat by surprise. I was aware that certain types of insects were on the decline, such as Monarch butterflies, honeybees, and lightning bugs, but I didn't realize that the apparent decline might also apply to all insects in general. Based on my personal experience over the last few years, I had thought that perhaps mosquito and ant populations were actually increasing. I don't seem to ever recall seeing and being attacked by so many mosquitoes early in the day when performing outdoor yard work. Undoubtedly, the abundant rains this year have been a factor, but I have noticed more mosquitoes over the last several years than any other time I can remember. Also, I don't believe I have ever seen so many ant colonies around my property, even in grassy areas. Of course, these observations are purely anecdotal and might easily be explained by the frequent "boom and bust" cycles many insect species undergo due to changing environmental conditions.

Nevertheless, I thought it might be worthwhile to investigate what the scientific literature has to say about the current status of insect populations. Insects are an important component of our ecology, and they perform many beneficial functions, such as plant pollination, soil aeration, maintenance of soil structure and fertility, and assistance in decomposing waste products. They are also a ready source of food for birds, bats, spiders, and other insect consumers. It, therefore, makes sense to be concerned about the fate of insects in our environment.

The following analysis is based on my cursory review of the literature regarding the current status of insect populations. It is my hope that this information will be of interest to Commission members, City staff, and local residents concerned with the quality of our environment.

There are two recent, often-cited studies of insect declines that have been referred to by some as groundbreaking. The findings of these studies have led to much speculation about the future of insects and often to dire predictions about the fate of our ecosystems. These two studies are briefly summarized below.

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1. Hallmann, C.A., Sorg, M., Jongejans, et al. (2017). More Than 75 Percent Decline Over 27 Years in Total Flying Insect Biomass in Protected Areas. *PLoS ONE* 12 (10): e0185809. <https://doi.org/10.1371/journal.pone.0185809>.

This investigation was an historical study of data on trapped flying insects conducted in a region of Germany. The authors used a standardized protocol to assess total insect biomass and estimated "a seasonal decline of 76% and mid-summer decline of 82% in flying insect biomass" over a period of 27 years. The authors of the study concluded that the significant declines could not be explained by weather, land use, or habitat characteristics.

2. Sanchez-Bayo, F. and Wyckhuys, K.A.G. (2019). Worldwide Decline of the Entomofauna: A Review of Its Drivers. *Biological Conservation* 212: 8-27.

This study was a large-scale review of 73 historical reports from around the world concerning insect declines. The authors assessed the findings and attempted to evaluate systematically the drivers of these events. Their findings revealed "dramatic rates of decline," and the authors postulated that such declines could lead to "the extinction of 40% of the world's insect species over the next few decades." They concluded that the likely drivers of the declines in insect species were: (a) habitat loss due to intensive agriculture and urbanization; (b) pollution from synthetic pesticides and fertilizers; (c) biological factors, such as increased pathogens and invasive species; and (d) climate change. Habitat loss was considered the primary driver.

Several other recent studies have also intimated apparent insect declines. For example, the authors of one study [Lister, B.C. and Garcia, A. (2018). Climate-driven Declines in Arthropod Abundance Restructure a Rainforest Food Web. *PNAS* 44: E10397-E10406. <https://doi.org/10.1073/pnas.1722477115>.] reported that arthropod biomass, including that of insects with external skeletons, had decreased by "10 to 60 times" between 1976 and 2012 in Puerto Rico's Luquillo rain forest. They deduced that "climate warming" was "the major driver of the reductions in arthropod abundance" that resulted in a collapse of the rain forest's food web.

In contrast to the above studies, some reports have shown apparent increases in populations of certain types of insects, most notably mosquitoes. Because of their proclivity to spread potentially serious diseases, such as malaria, dengue fever, and the West Nile and Zika viruses, these findings are of particular public health significance. One study noted that populations of mosquitoes "have increased as much as tenfold" over the last 50 years or so in areas such as New York, New Jersey, and California. The authors also noted that the "number of mosquito species in these areas increased two- to four-fold in the same period." [Rochlin, I., Faraji, A., Ninivaggi, D. et al. (2016). Anthropogenic Impacts on Mosquito Populations in North America Over the Past Century. *Nature Communications*: 7 (13604) doi:10.1038/ncomms13604. <https://doi.org/10.1038/ncomms13604>.]

Comments

The original question raised in the title of this short paper was "Are Insect Populations Really Decreasing?" While several news reports and other media sources have inferred that an "Insect Apocalypse" or "Insect Armageddon" is on the horizon, based largely on the two "groundbreaking" studies cited in the previous section, the answer to the question is not as clear cut or as simple as some have been led to believe.

Helpful in understanding the various issues involved are two excellent articles in 2019 issues of *The Atlantic* and *Discover Magazine*, respectively (see retrieval information at the end of this paper). I encourage all to read these for a balanced view of the controversies. The authors, in my opinion, do a very good job of putting things in perspective. Basically, we should be concerned about potential insect declines in diversity as well as overall numbers. Insects are vitally important to our environment and our overall livelihood as well. However, we should not succumb to hyperbolic pronouncements of imminent doom or take all claims of insect declines as proven facts. As informed individuals, we should be aware of significant limitations in the current research methodologies for investigating insect populations and promote, where we can, better, more well controlled studies. In particular, valid background data are critical to drawing definitive conclusions about insect declines. Adequate background data, unfortunately, are not yet readily available. Nevertheless, there is cumulating evidence that suggests that insect declines are real and should not be ignored.

As good citizens, we should therefore foster sound conservation measures and environmental practices wherever we can. Seeking to understand more thoroughly the determinants and consequences of actions that can threaten insect populations and the wildlife that depend on them are also vitally important. Habit loss (e.g., due to deforestation), increased pesticide use, increased environmental pollution, introduction of invasive species, climate change, and other factors may all contribute to insect declines and therefore should be attended to in a timely manner. There are many ways the average person can promote environmental conservation. Examples include citizen advocacy and support for better environmental measures. Maintaining our environment is a duty that belongs to all of us.

For copies of the articles in *The Atlantic* and *Discovery Magazine*, check the following urls:

<https://www.theatlantic.com/science/archive/2019/02/insect-apocalypse-really-upon-us/583018/>

<https://www.discovermagazine.com/environment/are-insects-going-extinct-the-debate-obscares-the-real-dangers-they-face>

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