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Imperceptible Changes: The Effects of Land Use and Climate Change on the Lives of Insects in the Puget Sound

Executive Summary:

This article describes the impact of land use and climate change on the lives of insects in the Puget Sound. Butterflies are studied by field researchers because their presence is a good indication of a healthy ecosystem for arthropods and surrounding flora. For the purposes of this paper butterflies will be the main example of environmental damage due to land use and climate change. The article will show butterflies in rural and urban regions of the Puget Sound have decreased in numbers. The decrease in butterflies corresponds to the decline in health of the surrounding environment. Climate change in the sub alpine region of Mount Rainier National Park will be used as an example of the negative impact on insects. The land development of Thurston County will be used as an example of the negative impact on insects.

The combined effects of land use and climate change will be outlined with a suggested response to the issues.

Introduction:

Puget Sound; green terrain cut with numerous rivers, endless forests and prairies covered in wild flowers and butterflies. It's a beautiful place where one can easily find themselves appreciating nature. It's no surprise the human population continues to grow here. As the population booms the land usage grows to accommodate us humans. Unfortunately, the land has not always been used in a manner that benefits every living thing in the area. Humans have been utilizing nature to their benefit since the dawn of mankind. We haven't always thought about our actions where they concern other living creatures. However, we have been pretty keen to see the potential benefit to ourselves in everything. If it can benefit humans we can exploit it.

The Puget Sound region had much to offer the indigenous people and the new ones when they first settled in the territory. There was much timber to be harvested for homes and business. All kinds of fish were waiting to be plucked from the water and the land was host to a great variety of wild game. It's all been quickly picked over. You can still hear crickets and frogs during the twilight hours, but you don't hear them arranged in the symphony of night like they performed 30 years ago. During the summer days of the 80's and 90's one could observe as many grasshoppers, crickets, lizards and whatever else a person could get their hands on.

Western Washington had a myriad of organisms to offer up for studying. However, it seems there aren't as many bugs and critters to play with as there were 20-30 years ago. You don't see or hear them as much. It's not because we stopped listening. The reason being there

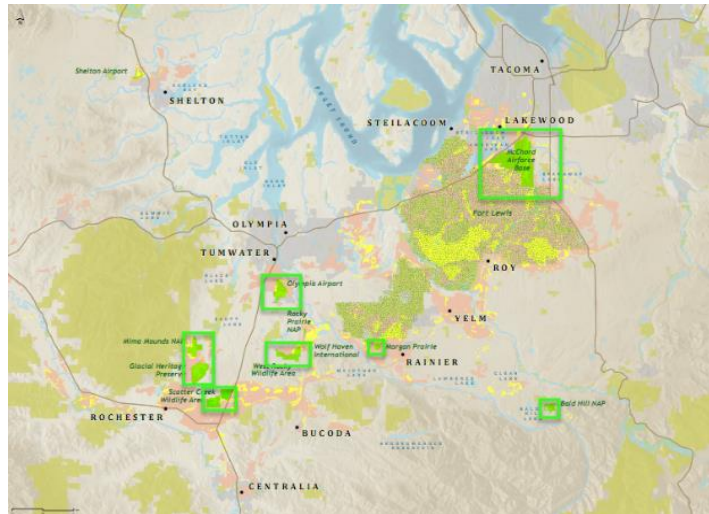
aren't as many insects and small animals around urban developed areas anymore. Small creatures would need an untouched path of land or corridor through the woods to get away to a safe place. Such considerations have been largely ignored. Should enough insects escape there is little hope elsewhere. As the land is developed the insects are killed because they cannot adapt to a new ecosystem (Hugh et. al. 1999). This article will demonstrate how this has happened and how it is continuing to happen in Washington State and the Pacific Northwest.

After the Treaty of Medicine Creek was signed on December 26th, 1854 (HistoryLink.org), the Natives and their respect for the land were chased away. The white settlers began a campaign of using the land in whatever way they saw fit. There was so much natural beauty and resources they never dreamt they could come close to using it all. After one century salmon populations in the Puget Sound are beginning to run out. The waters have been overfished. The logging industry has thinned the forests and polluted the mountain air.

One can observe the practice of slash and burn in areas like the Mt. Rainier National Park land. While burning may ultimately be good for the forest it leaves nothing for many insect species and animals to live on. In addition to the damage in mountain regions the lowland prairie insects are becoming endangered as the land is mismanaged (Krotzer 1999). The insects can do nothing to stop the destruction of their habitats. That is a fact we often overlook as humans. We disregard the lives of insects not realizing we depend on them for agriculture and many other important things. As we alter the land to suit our needs we often create a lot of pollution like greenhouse gases. The gases we create impact climate change, which has a dramatic effect on insect habitats (Department of Ecology 2006).

Land Use in the Puget Sound

The prairies of Thurston County have been developed to support the growing need for new homes and agriculture. As these prairies become developed, the animals and insect habitats are destroyed or left fragmented. One example is the local military Joint Base Fort Lewis-McChord. Reports estimate that 90% of the total prairie land remaining in the region is home to the Joint Base Fort Lewis-McChord, also known as JBLM (Krotzer 2013). JBLM is researching strategies for conserving the prairie land the joint base is built on, and taking steps to protect the endangered species on that land (Krotzer 2013). Increasing land use has destroyed the natural habitat of the Taylor's Checkerspot Butterfly, making it an endangered and protected species (Krotzer 1999). The butterfly is very important to the ecosystem. The destruction of habitats and loss of indigenous insect species creates open niches in the ecosystem. This is a big concern for many reasons.



As a pollinator the Taylor's Checkerspot Butterfly is important to the land. Unfortunately, due to land use issues it is in rapid decline. The butterfly needs to make it around to the different flowering plants to spread pollen. In this way the butterfly is useful much like the honey bee that is also declining in population. The butterfly is so important to the planet that groups have been popping up to protect and conserve them. Butterfly Conservation

is a group working to support moths and butterflies (and their natural environments) in Britain. The conservation group formed in 1968 in response to the decreasing numbers of butterflies in the UK. According to the Butterfly Conservation Group, butterflies are very important to their ecosystem. Butterflies are a sign that there is a thriving invertebrate population and that said population is healthy (butterfly-conservation.org). The absence of the butterfly would indicate a decline in the environment, or a “butterfly effect.” Prairie butterflies contribute up to 90% of the pollination within their habitat (butterfly-conservation.org). Like all insects, butterflies have their place in the food web. They support parasites and aid their survival (butterfly-conservation.org). Birds and fish and many other animals feed on the butterflies.

More recently the Institute for Applied Ecology did a study called, “Dispersal behavior and habitat variation of Taylor’s checkerspot butterfly (Ross et. al. 2011). The study showed that the butterflies often live on the boundaries of forests and roads (Ross et. al. 2011). Most of those locations were shown to be covered in invasive plant species or other vegetation making the area unsuitable for the butterflies (Ross et. al. 2011). There were many areas that the Taylor’s Checkerspot Butterfly has become extinct because they couldn’t find the proper vegetation to lay their eggs (Ross et. al. 2011). The research showed the importance of corridors (picture to the left) for the animals and insects to stay connected with each other and the land (Ross et. al. 2011). It cannot be stressed



enough how important it is to develop the land in more efficient ways that allow the butterflies and other living creature to thrive.

During the study the Taylor's checkerspot butterfly were observed trying to leave their habitat (Ross et. al. 2011). The butterflies have some success crossing man made boundaries like roads (Ross et. al. 2011). However, the study also showed that most of the butterflies became lost after this, leaving their fate unknown (Ross et. al. 2011). With the future of the butterflies being uncertain it is obvious that we humans need to evaluate our impact on the environment. It is humans that changed the land and the ability of the butterflies to access their habitats. Steps must be taken to prevent the extinction of creatures through land modification.

The first step is to have a plan to build with the environment in mind. Thurston County is taking the steps to conserve places like prairies by preserving them and protecting the endangered species living within them. According to the Thurston County website the new program will be known as Thurston County's Prairie Habitat Conservation Plan, or HCP (co.thurston.wa.us). This is what the HCP intends to do:

- Design regulations for the land and its usage.
- Deal with whatever damage has been done or will potentially be done to the environment as urban development occurs.
- Find solutions to habitat fragmentation.
- Observe and handle degradation and predation of endangered species.
- Conserve the remaining prairie land(s) (co.thurston.wa.us).

Climate Change

Improving land use practices will not solve the problem alone. It must be combined with improvements in other destructive practices and control of climate change. The human way of life has been greatly impacting the land, water and the air; all things life depends on. Not just human life, but all life, depends on these elements for their continued survival. As humans we are the only beings creating garbage and pollution. The consequences have become reality. We have mismanaged our resources and if left unchecked, climate change will hurt the Earth further. It is imperative that we act now because the flora and fauna can do nothing to clean up our mess.

As the climate changes it effects the life cycles or phenology of pollinating insects and the flowers they pollinate. Each insect is specially adapted to the timing of its habitat (Loxdale 1999). For instance, if the frost season changes to become shorter, many ground plants and trees will bloom out of sync with the pollinating insects life cycle (kingcounty.gov). This will cause food and habitat shortages for the insects (Loxdale 1999). The flowers will not be pollinated by the insects if they do not have a habitat to reproduce in (kingcounty.gov). Studies show that insects are tied to their habitat through their genotype, which can only adapt over very long periods of time (Loxdale 1999). The effects of climate change do not afford the insects a suitable habitat for a duration sufficient for adaptation (Loxdale 1999).

Climate change has the potential to damage all ecosystems in Washington; endangering the butterflies and many other species of insects. In light of this many environmental interest groups have joined together to tackle the issue. The group is collectively known as the North Cascadian Adaptation Program, or NCAP. NCAP finds butterflies highly valuable in the research

of climate change, habitat loss and fragmentation; they are an all-around important creature (adaptationpartners.org). Because of this the Taylor's checkerspot butterfly is used to monitor climate change in the sub alpine regions of national parks, such as Mt. Rainier National Park (adaptationpartners.org). They have already been reported as having gone extinct in many of their former habitats, indicating problems for the invertebrates in that region (adaptationpartners.org).

Thurston, King, Pierce and many other Washington Counties are reporting negative changes in their insect populations (kingcounty.gov). King County reports local mollusks are beginning to suffer from the increase in temperature (kingcounty.gov). Across the Pacific Northwest problems associated with climate change are occurring. It extends from the lowlands of the prairies to the sub alpine regions of the Cascadian range. NCAP reports that climate change in higher elevations will drive the mountain pine beetle up in elevation and other invasive beetles will take their place at lower elevations (adaptationpartners.org). As the different invasive beetles eat their way through the damaged trees they reduce the amount of livable habitat for the rest of the forest ecosystem (adaptationpartners.org). The effects can be catastrophic. Invasive species will move into the empty niches left by insects leaving to find a suitable habitat or a tolerable climate (DOE 2009).

When Douglas Fir trees become less sustainable the Mountain Pine Beetle can move in (DOE 2009). The beetles will rapidly kill off trees and they will proliferate quickly. The DOE has reported the effects of the Mountain Pine Beetle in British Columbia, Canada, as killing more trees than logging or wildfires (DOE 2009). The invasive insects we call pests will prosper. The DOE reported reproduction rates in agricultural pests will increase because of the warmer

winters (DOE 2009). Because of the warmer winters fewer insects will die during the cold season, allowing them to maintain maximum numbers (DOE 2009). In addition, an earlier onset of Spring allows them to have a longer breeding season (DOE 2009).

With everything being so intricately connected we can't afford to cause climate change and yet it's happening. The summer season has become observably warmer and longer in the Cascadian range (adaptationpartners.org). NCAP states that the warming will not only hurt the plants but it will undoubtedly cause droughts (NCAP 2009). With all the dry trees and dry roots exposed to increased temperatures there will be more wild fires. Unless the insects can escape they will be caught up in the forest fires. Should they survive they may be left without a food source or a corridor to find resources. Once again this poses the threat of insects moving to find food and leaving open niches in the ecosystem.

The higher temperatures in the alpine regions have been making the glaciers melt away. The extra melt water could flood the forests surrounding the glaciers (NCAP 2009). The forest floods could wash away insects that provide valuable food sources for fish and other animals. Increased moisture in the soil will also cause landslides that upset the ecosystem. Between the forest fires, droughts, loss of life, invasion of species and floods there could be a complete breakdown of nature. With reduced emissions we may not be able to stop the butterfly effect, but we might be able to slow it down. If we combine our efforts like NCAP has we can slow the progress of climate change and ultimately we can begin to make things right.

How Could We Help the Insects?

NCAP is educating everyone concerned with the care of our environment here in the Pacific Northwest (NCAP 2009). They are teaching people about the diverse effects of climate change and the causes of climate change (NCAP 2009). It would be wise to read their reports and follow their advice when you're in the wilderness. Research what you can do to lower your impact on the environment where you live. If you live in an urban area remember to shop for locally grown produce. Use a local butcher who only uses locally acquired meats. Use recyclable bags when you shop. Try to remember that Americans have a tendency to eat larger serving sizes than the body needs and take the time to research your own dietary needs. Make the decision to get out of your house or car and walk to where you need to go. If we drive less we can cut down on automobile emissions which can cut down on greenhouse gases.

When you take the time to follow the suggestions you can help the local ecosystem. If you don't use more than you need you create less waste. Everyone loves the idea of a large house, but they aren't practical if you don't have a large family. Consider how your home was or is going to be built and how that can affect the environment. If you have a farm or grow produce think about how your operation can affect the surrounding ecosystem. If you're going to grow crops be sure to leave a forest corridor for the insects to be able to safely travel within a suitable habitat. Think economical. Be mindful. Be humble.

Conclusion

Everything living will suffer if we don't change the way we treat the Earth. Climate changes will start small, but the chain reaction will grow until we can barely stay on top of the issues. Climate change may be largely unseen now but there are observable changes occurring. The evidence comes in the form of seasonal shifts, changes to insect phenology, displaced insects, starvation and extinction. The lack of insect noises is a clear indication something has changed and the insects have been affected.



References:

Animals, plants and habitat. (n.d.). Retrieved January 20, 2016, from

<http://www.kingcounty.gov/environment/animalsAndPlants/biodiversity/threats/ClimateChange.aspx>

Forest ecosystems, disturbance, and climatic change in Washington State. (n.d.). Retrieved

January 20, 2016, from <http://link.springer.com/article/10.1007/s10584-010-9858-x>

North Cascadia Adaptation Partnership Preparing for climate change through science-management collaboration. (n.d.). Retrieved March 3, 2016, from

<http://adaptationpartners.org/ncap/events.php>

Pictures retrieved March 2, 2016, from www.google.com

Slaves of the environment: the movement of herbivorous insects in relation to their ecology and genotype (Loxdale 1999). Retrieved

March 2, 2016, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1692655/>

Thurston County's Prairie Habitat Conservation Plan (2016). Retrieved

March 2, 2016, from <http://www.co.thurston.wa.us/planning/hcp/hcp-home.htm>

Warmer Temperatures. (n.d.). Retrieved January 20, 2016, from

http://www.ecy.wa.gov/climatechange/warming_more.htm#species