

# **Current Human Impacts on The Ohlone Tiger Beetle (*Cicindela Ohlone*) Populations in Santa Cruz County**

**ENVS 100W – Section 1**

**Environmental Research and Writing**

By

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October 23rd, 2022

## **INTRODUCTION**

In the state of California, Santa Cruz County is home to a variety of endemic and important species that cannot be found anywhere else on the planet (Ebbin et al. 2021). Among some of the endemic species of Santa Cruz County is the Ohlone Tiger Beetle (*Cicindela Ohlone*), which has been affected by many

human impacts currently that include agriculture, recreational activities, and unnatural disturbances such as human-caused fires, urbanization, as well as invasive species preying upon the insect (Arnold and Knisley 2018). This insect was officially recognized in 1993 when they were first collected by Russell Morgan and colleagues who collected them in west central Santa Cruz from 1987 to 1992. In 2001, they became listed as an endangered species due to their low numbers (Ebbin et al. 2021). The Ohlone Tiger Beetle used to have 17 populations throughout the county of Santa Cruz, but today there are only 5 to 6 populations, and half of them are found in the city of Santa Cruz (Cornelisse et al. 2013). Tiger beetles are the largest group of beetles in the world, outnumbering all other insect, invertebrate, and vertebrate species found today. They are also the most universally known group of insects in the world and they all require specific conditions in their ecosystems (Knisley and Gwiazdowski 2020). Below is a figure that represents not only the habitat distribution of Ohlone Tiger Beetles currently located in Santa Cruz, but the regions that it once occupied before the human population grew alongside urbanization.

Figure 1. Habitat Distribution of the Ohlone Tiger Beetles and areas where the beetles are no longer active.

*Source:* Data from Arnold and Knisley 2018.

The Ohlone Tiger Beetle is not only an endemic species to Santa Cruz County but a bioindicator species that helps therapists and biologists understand how they can modify their natural habitats to make them more suitable for the insect (Gerlach et al. 2013). This species has been around since the dawn of prehistoric mammals and modern-day herbivores that once dominated the state of California but have now been declared extinct or locally extinct. California has been one of the most diverse places on the planet with the greatest number of endemic species of plants and animals (Tershy et al. 2016).

Unfortunately, California has also become one of the most populated states in the country and wildlife has been affected greatly by the continuation of growing human populations and land development. In addition to the growing human population throughout Santa Cruz County, many other impacts affecting the beetles have included the introduction of invasive species, climate change, and unnatural disturbances that are influenced by human activity. However, there has been studies found that if we are able to properly manage the wildlife to the species' specific needs, then they are able to make a recovery from dwindling declines (Knisley and Arnold 2013). Below is a figure that shows that Ohlone Tiger Beetles

benefit from our help when we modify their natural habitats and when we find that the species is indicating that the environment is not suitable enough (Gruas et al. 2013). Regulating a habitat can not only benefit the species that require suitable changes but allows us to gain more knowledge to helping other endangered species that require the same assistance.

Figure 2. Bar graph that depicts wildlife management and conservation methods that not only work but benefit the beetles greatly.

*Source:* Data from Knisley and Arnold 2013.

### **Bioindicator**

When a species is listed as a bioindicator, this will alert biologists about the changes being made in the ecosystem that that species calls homes (Gerlach et al. 2013). Ohlone Tiger Beetles are a vital species not just for grassland ecosystems, but to researchers who find that they require certain modifications when there are too many negative impacts affecting their ecology and populations (Gerlach et al. 2013). Another major factor that has affected them in their environment and population is precipitation. The amount of rain will influence their numbers and many studies found that when there is little to no rain, the Ohlone Tiger Beetle Population will skyrocket, but when it rains more, their populations begin to dwindle (Cornelisse et al. 2013). Climate change has changed the annual rainfall, and this has resulted in the beetles being less active during wetter seasons while being most active during the dryer years. The Ohlone Tiger beetle prefers to live in dry coastal prairies and grassland ecosystems throughout Santa Cruz County. They are also found in agricultural environments in Watsonville due to the amount of open space created for farmlands (Knisley and Arnold 2013). With less vegetation and human disturbance, the beetles can repopulate and build burrows for their larvae. Many researchers have found that the Ohlone tiger beetles were at their highest numbers in 2014 and 2015 when it became some of the driest years in history (Knisley and Arnold 2013). They then found that when the rains finally arrived in the winter of 2016 and the first 2 months of 2017, their numbers began to shrink again (Cornelisse et al. 2013). Below is a figure that represents this explanation with more clear and concise details.

Figure 3. Chart representing the population growth of Ohlone Tiger Beetles during dryer seasons and population declines from wetter seasons.

*Source:* Data from Cornelisse et al. 2013.

## **Agriculture**

Agriculture has caused many unnatural disturbances in the Ohlone Tiger Beetle's Ecology and has also caused high mortality when it comes to farming crops and livestock that invade the beetle's environment (Cornelisse et al. 2013). Many invasive species such as wild turkeys can prey upon the beetles which have caused them to disappear from their coastal prairie homes that were turned into farmlands. However, some large grazing herbivores such as cows can create more bare grounds for the beetles and allow them to build more burrows, hunt for prey, and make it easier to find a mate (Arnold and Knisley 2018). Their numbers have shown the importance of having cattle roaming around the coastal prairies and many researchers have even tried using more active herbivores such as horses but did not get the same outcome as the cattle (Knisley and Gwiazdowski 2020). Because of agriculture, there are mixed feelings on how we can manage to protect the Ohlone Tiger Beetle since they require grasslands, open prairies, and any open field environment to roam around. They also require less vegetation growth to have less dense patches to dig burrows to lay their eggs and seek refuge underground (Knisley and Arnold 2013). Therefore, agriculture comes into play as it destroys the larger vegetation that the Ohlone Tiger Beetles do not find suitable and helps build more space for their burrows, hunting grounds, and bare grounds made by larger animals. Below is a figure of Ohlone Tiger Beetle Burrows dug up by the adults and are not only used to seek refuge, but to allow their larvae to hunt before they develop into adult beetles.

Figure 4. Image displays different burrow sizes that the Ohlone Tiger Beetle digs up for refuge, breeding, as well as letting the larvae to hunt and develop from underground before turning into adults.

*Source:* Data from Knisley and Arnold 2013.

## **Recreational Activities (Human Unawareness)**

Most people who enjoy recreational activities have shown that they lack awareness of the wildlife around them (Gruas et al. 2020). This is a problem for many species that can become killed by certain outdoor

activities if the people performing them do not consider the wildlife. When people have little to no awareness of the wildlife around them, this results in high mortality rates in both recreational activities and road accidents. The Ohlone Tiger Beetle has faced many recreational activities such as mountain biking and large group hikes (Arnold and Knisley 2018). Having fewer people in the grasslands and coastal prairies puts less stress on the Ohlone Tiger Beetle and reduces the mortality rates on dirt trails. Many researchers have advised wildlife management to encourage mountain cyclists to slow down and travel at speeds of up to 5 mph when entering Ohlone Tiger Beetle Habitat (Cornelisse et al. 2013). Another method needed is to have fewer people hike around the beetle's territory and go in small groups (Arnold and Knisley 2018). UC Santa Cruz has made countless attempts to try to raise more awareness when placing signs with the Ohlone Tiger Beetle's presence and encouraging people to be aware of their surroundings when entering their natural habitat. They have provided images of the insect and images of their burrows where the females lay their eggs and hatch into carnivorous larvae (Knisley and Arnold 2013). Unfortunately, tactics like these are not enough as there will be some individuals who may refuse to look at the signs or ignore the instructions on how to be active without harming the local wildlife around them (Gerlach et al. 2013). If we can find ways to raise more care and awareness in people, there will be better outcomes in the long run for both humans and the Ohlone Tiger Beetle. Below is an image that depicts the many results collected from people who perform recreational activities and are asked about their perception on the wildlife around them when doing outdoor activities.

Figure 5. This figure is a representation of the perceptions of people who perform recreational activities and the percentage of people who fall into the different categories concerning wildlife.

*Source:* Data from Gruas et al. 2020.

### **Unnatural Disturbances**

Humans have been the cause of many unnatural disturbances throughout the world, and it has affected multiple species to the point of no return. As previously mentioned, Ohlone Tiger Beetles are a prime example of a bioindicator when it comes to severe changes in their natural habitat (Gerlach et al. 2013).

They have shown that severe changes such as urbanization and the introduction of invasive species can greatly impact their population and are unable to cope with the drastic changes around their environment (Ebbin et al. 2021). There have been attempts, however, to see if tiger beetles can adapt to new hotspots in their natural habitats in new environments (Pearson and Wiesner 2022). Many additional disturbances that the beetles do not find natural are human-caused fires, pipeline irrigation, construction, and road development (Ebbin et al. 2021).

Since California is home to some of the most biologically diverse species that cannot be found anywhere else on the planet, it concerns researchers who are trying to come up with solutions that will prevent local extinctions and less stress on the ecosystems that are affected by human development (Tershy et al. 2016). Climate change has also played a role in the stress of species throughout the state and some species will benefit from the long droughts while others will be affected severely (Gerlach et al. 2013). The Ohlone Tiger Beetles are a species that prefer dryer grasslands and coastal prairies because the heavy rains force them out of their burrows and drown them (Cornelisse et al. 2013). Other unnatural disturbances are invasive species that affect endemic and native wildlife because they not only out-compete the local wildlife but also prevent some endangered species to recover from the impacts made by their ecological damage (Gerlach et al. 2013). Even some native species can become invasive by growing to a concerningly large numbers and outcompete the other native species within the same ecosystem.

## **CONCLUSION**

The Ohlone Tiger Beetle has been significantly affected by human impacts currently to the point where we must be less invasive and more conservative of its ecological status. As of now, their numbers are getting lower and lower than expected (Ebbin et al. 2021). To fully understand the ecology of this beetle, researchers have recommended the study of both adult beetles and their larvae to collect all the data necessary for the insect's ecological status (Arnold and Knisley 2018). Other studies suggest finding additional methods for slowing down vegetation growth in the coastal prairies where Ohlone tiger Beetles are more likely to build burrows (Knisley and Arnold 2013). Additional studies even suggest the use of cattle in agriculture as they are more helpful with creating barer grounds for the beetles and avoid using more active grazers such as horses (Cornelisse et al. 2013). The city of Santa Cruz has created multiple methods to develop more effective conservation plans for the Ohlone Tiger Beetle and with the help of proper wildlife management, we can prevent the extinction of an insect that has been longer than humans have existed. It is worrying that the Ohlone Tiger Beetle is few throughout the county of Santa Cruz, but

we can make a difference for them if we continue to contribute to helping them with the many beneficial tactics of disturbing them less with our presence, having larger herbivores graze on dense grass patches, as well as placing them in dryer grasslands and coastal prairies with less vegetation (Knisley and Arnold 2013; Arnold and Knisley 2018). Researchers also suggest the use of monitoring the beetles when relocated into new habitat hotspots and modifying the changes to prevent any more mortalities (Gerlach et al. 2013). Once these actions take place, the Ohlone Tiger Beetle can continue to thrive in Santa Cruz for many more generations. Being able to protect an endemic species can provide hope and knowledge for the future of the natural sciences.

## **TABLES AND FIGURES**

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