# Project Graphics

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```
birds <- read.csv('https://docs.google.com/spreadsheets/d/e/2PACX-1vQwR56LrrsuT8BMSLbN6bmu8CPLIFhX5LauA
```

```
birds <- birds %>% mutate(
  Year = factor(Year),
  Property = factor(Property),
  UTM_E = UTM_E / 1000000,
  UTM_N = UTM_N / 1000000
)

birds %>% distinct(Property)
```

```
##               Property
## 1          Vista Point
## 2             Hamilton
## 3          Kent Butler
## 4         Forest Ridge
## 5           Double J&T
## 6            Bike Park
## 7  Emma Long Expansion
## 8            Emma Long
## 9        Reicher Ranch
## 10      Vireo Preserve
## 11          Wild Basin
## 12        Barton Creek
```

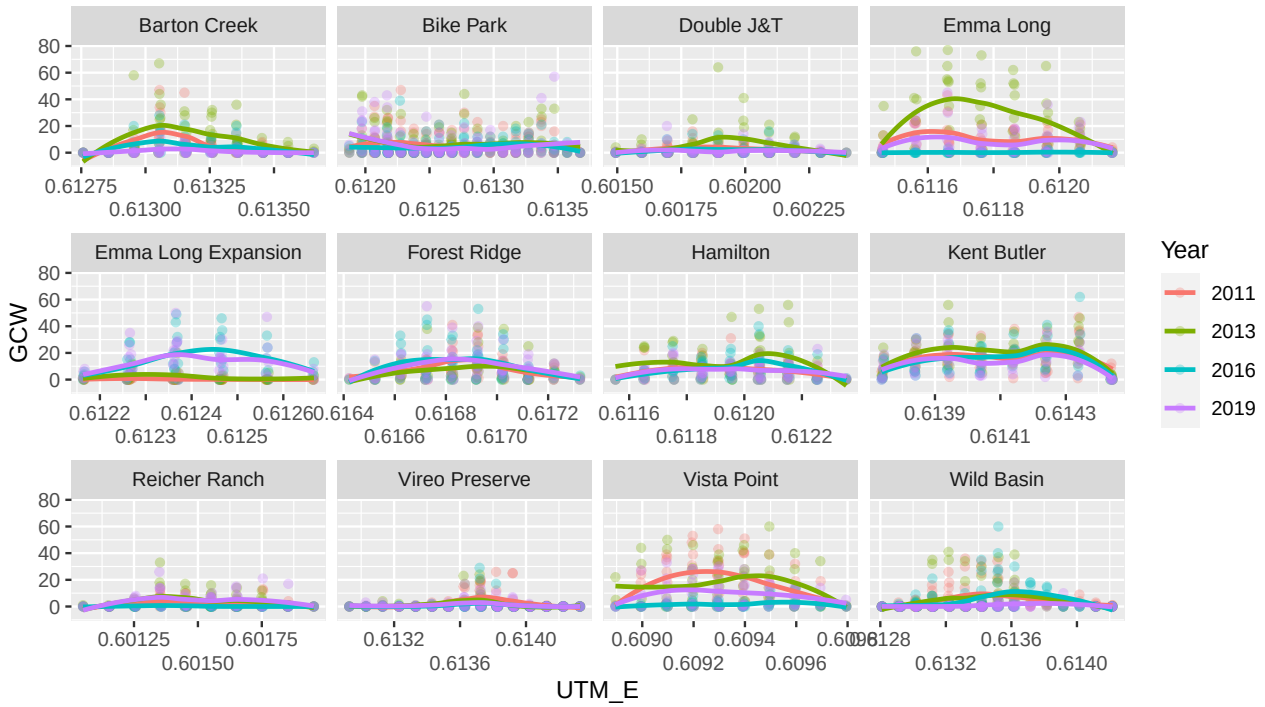
```
birds %>% summarize(max = max(GCW), min = min(GCW))
```

```
##   max min
## 1  77   0
```

**Scatterplots of GCW ~ Coordinates and MeanImp Variables**

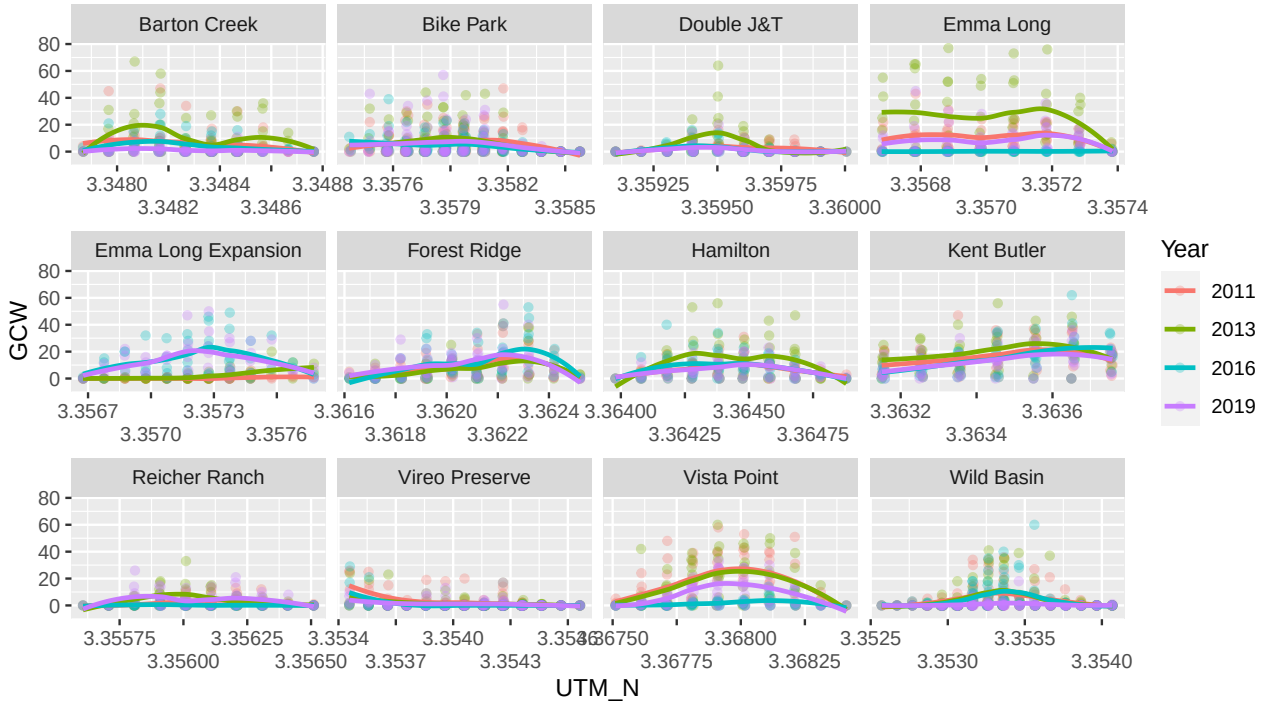
```
birds %>% ggplot(aes(y = GCW, x = UTM_E, color = Year))+
  geom_point(alpha = .3) + geom_smooth(se = FALSE) + facet_wrap(vars(Property), scales = "free_x") +
  guides(x = guide_axis(n.dodge=2))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

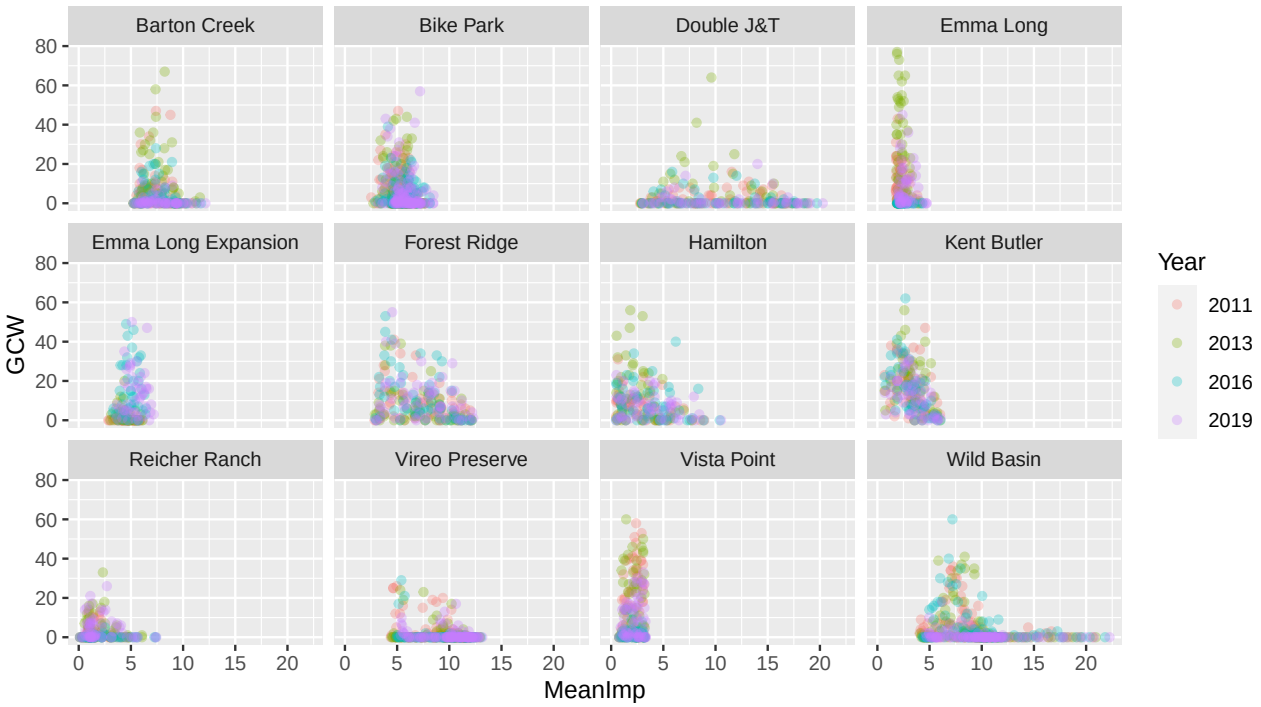



```
birds %>% ggplot(aes(y = GCW, x = UTM_N, color = Year))+
  geom_point(alpha = .3) + geom_smooth(se = FALSE) + facet_wrap(vars(Property), scales = "free_x") +
  guides(x = guide_axis(n.dodge = 2))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
birds %>% ggplot(aes(y = GCW, x = MeanImp, color = Year)) +
  geom_point(alpha = .3) + facet_wrap(vars(Property))
```



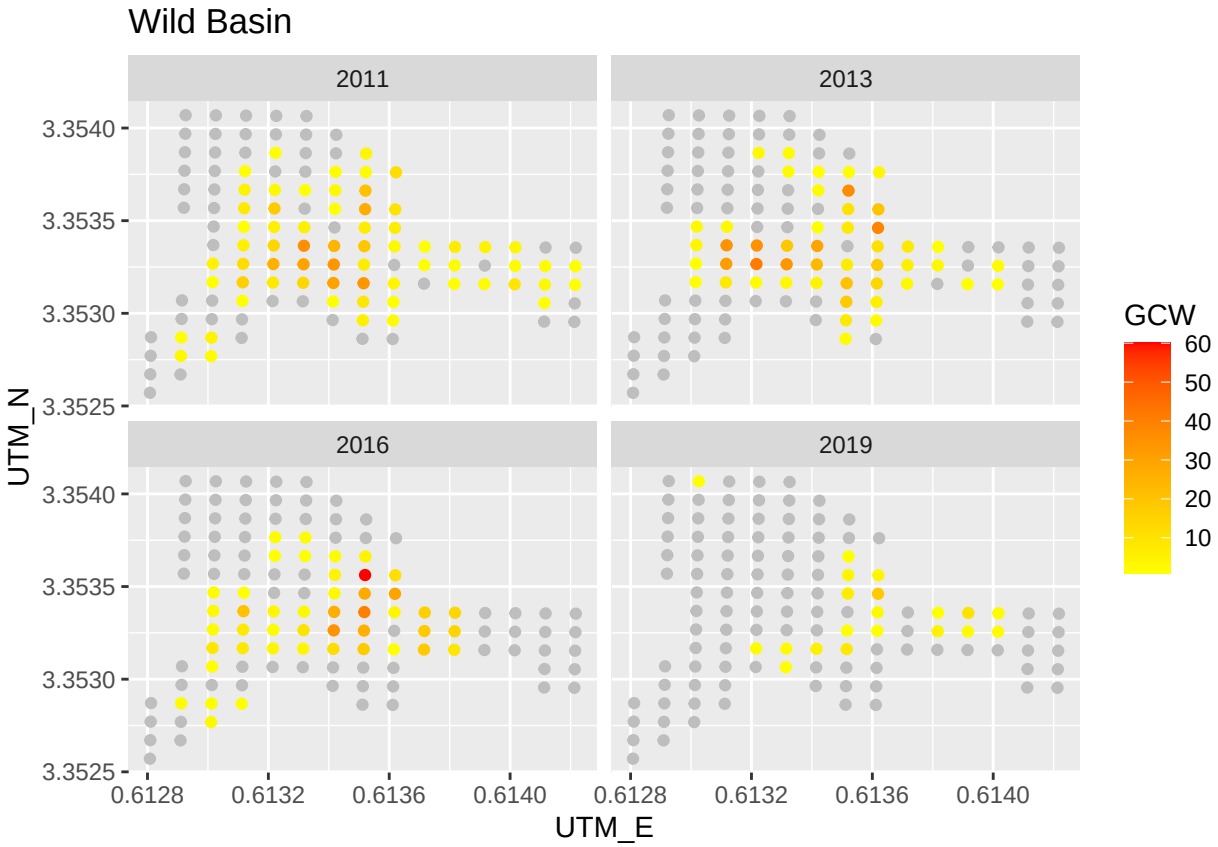

From the graphics above that map `GCW` to `UTM_E` and `UTM_N`, we can see that for each of the different reserves, the number of birds (`GCW`) is higher along the center of the preserve with respect to `UTM_E`, while also being generally true for `GCW` with respect to `UTM_N`. We can also see that for the graphics that map `MeanImp` to `GCW`, there are higher numbers of birds for lower values of `MeanImp` with lower numbers of birds for higher values of `MeanImp`.

### Point Maps of Birds per Cell

The graphics below show the number of birds in a cell (100m x 100m) for each of the preserves for four of the years (2011, 2013, 2016, and 2019). Grey indicates cells that had no birds observed, while colored cells (gradient from low of yellow to high of red) indicates cells with at least one bird observed. Lighter blue indicates less birds observed in the cell, while darker blue indicates more birds observed in the cell. It needs to be noted, however, that the scale range differs for each of the preserves, since the minimum and maximum number of birds found in a cell for a property varies.

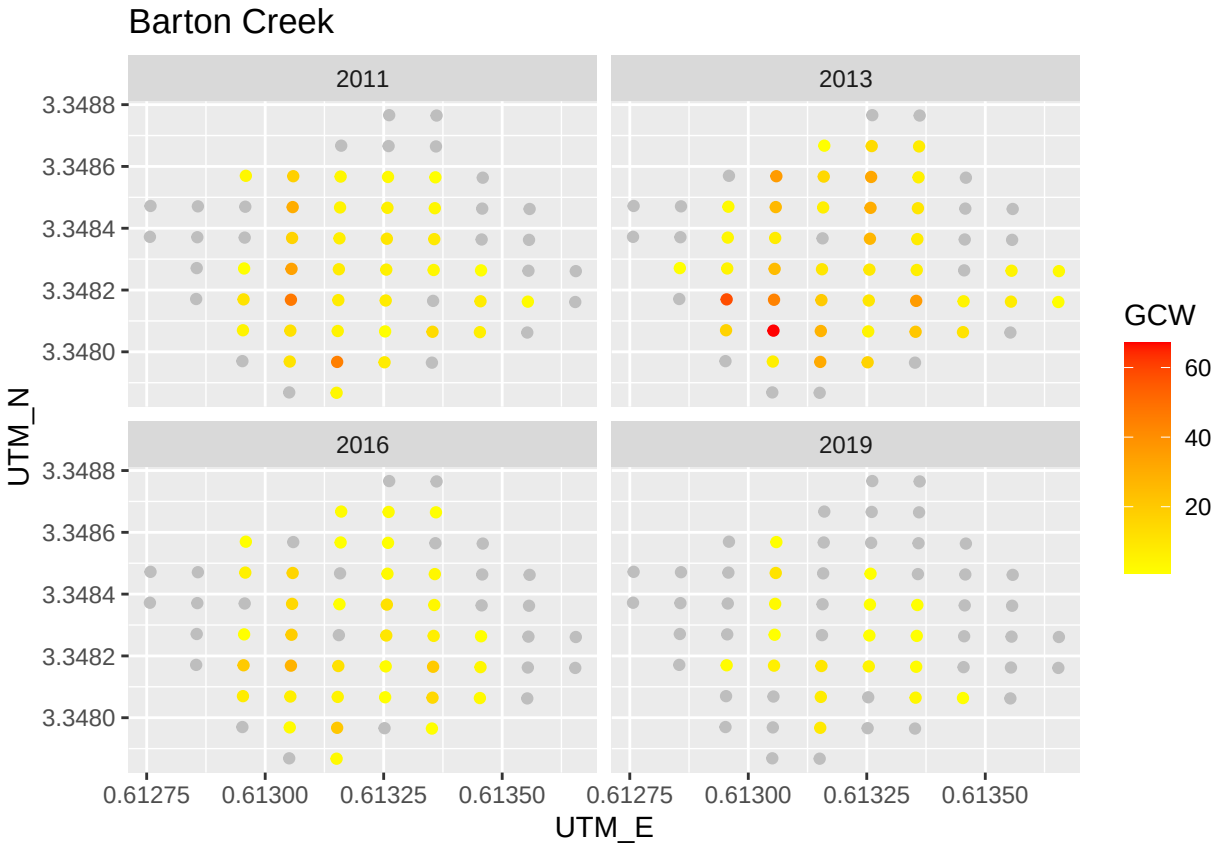
```
birds_zeros <- birds %>% mutate(non_zero = GCW > 0, zero = GCW == 0)
```

```
birds %>%
  filter(Property == "Wild Basin")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E)) +
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Wild Basin"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Wild Basin"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Wild Basin")
```



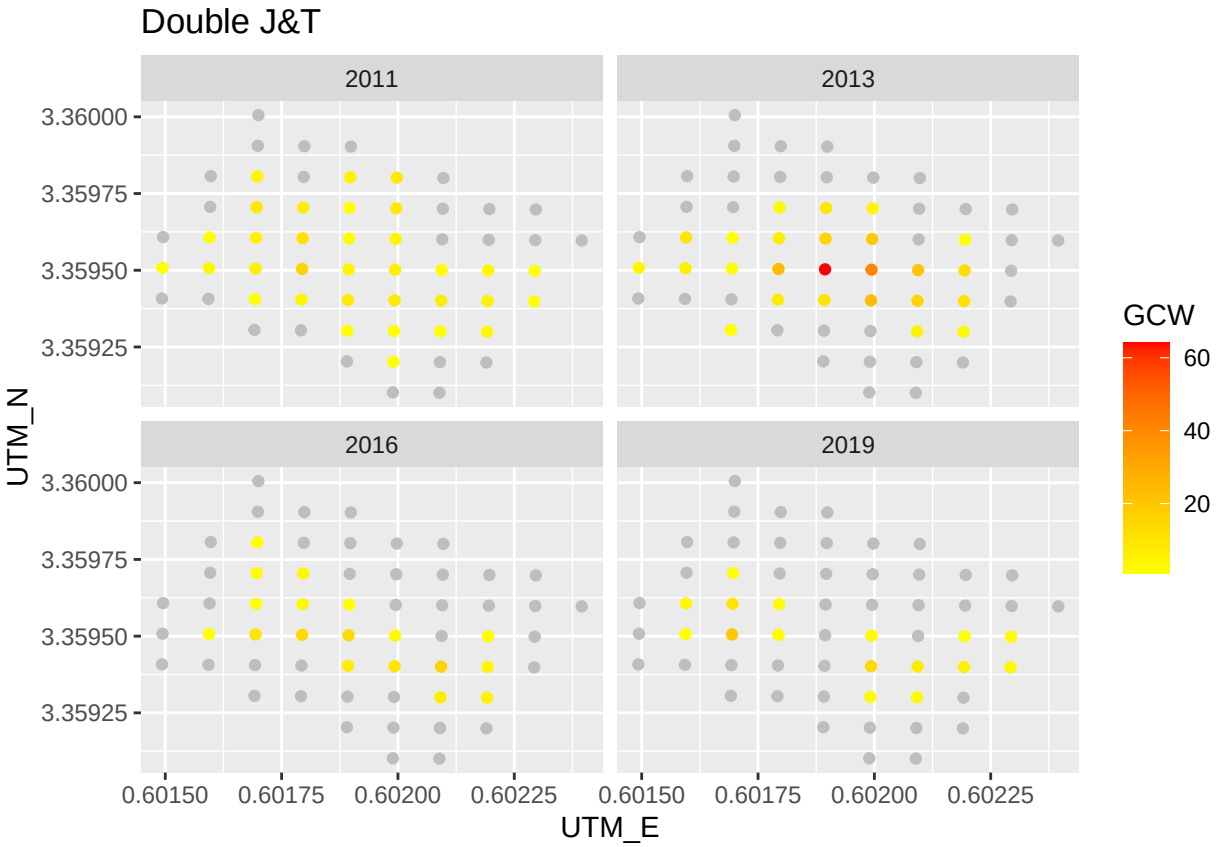

From this map for Wild Basin, we can see that as time goes on, here are increasingly more cells with no Golden Cheeked Warblers observed, with the difference being most stark when comparing 2011 with 2019.

```
birds %>%
  filter(Property == "Barton Creek")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E)) +
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Barton Creek"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Barton Creek"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Barton Creek")
```



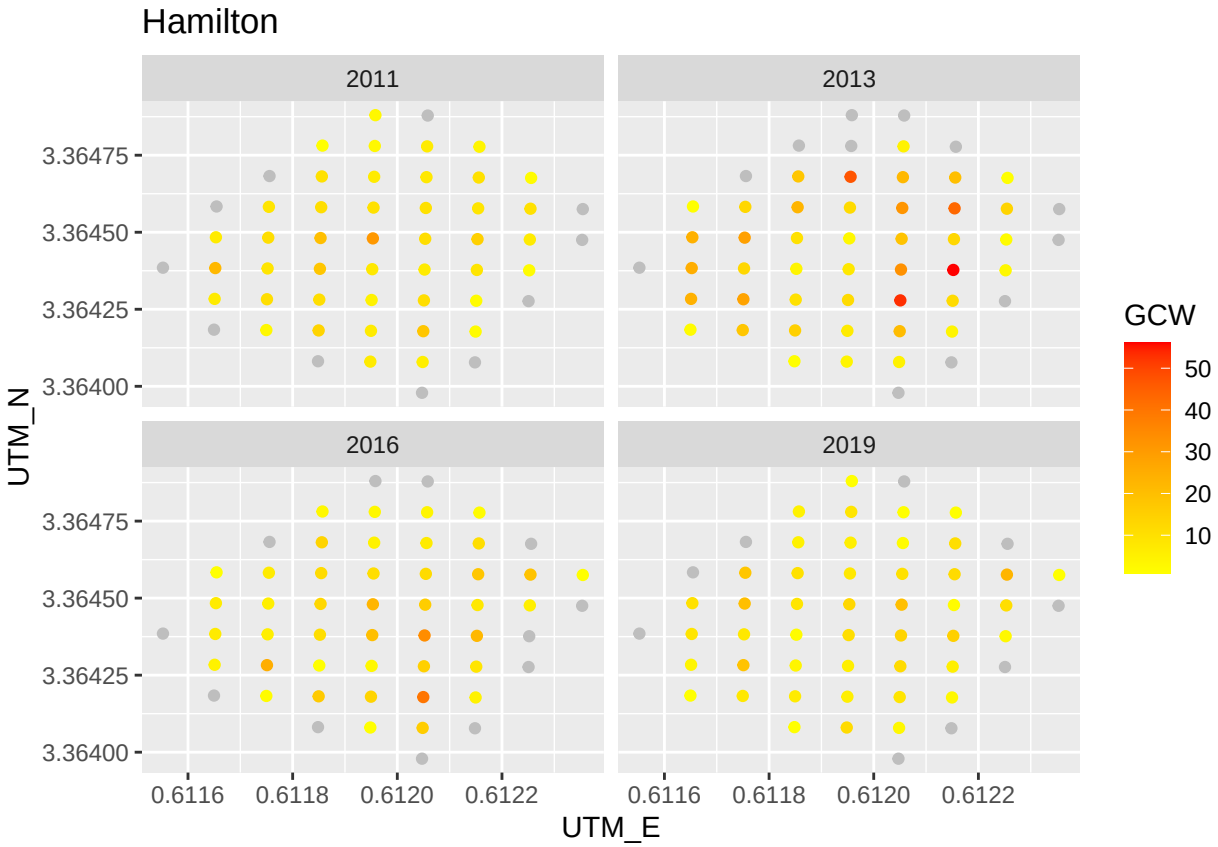

This map of the Barton Creek preserve also shows little changes in the number of Warblers observed between 2011 and 2016, with a noticeable increase in the number of cells in 2019 where no Warblers were observed while cells that had a large number of Warblers also decreased in 2019 compared to 2011.

```
birds %>%
  filter(Property == "Double J&T")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E))+
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Double J&T"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Double J&T"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Double J&T")
```



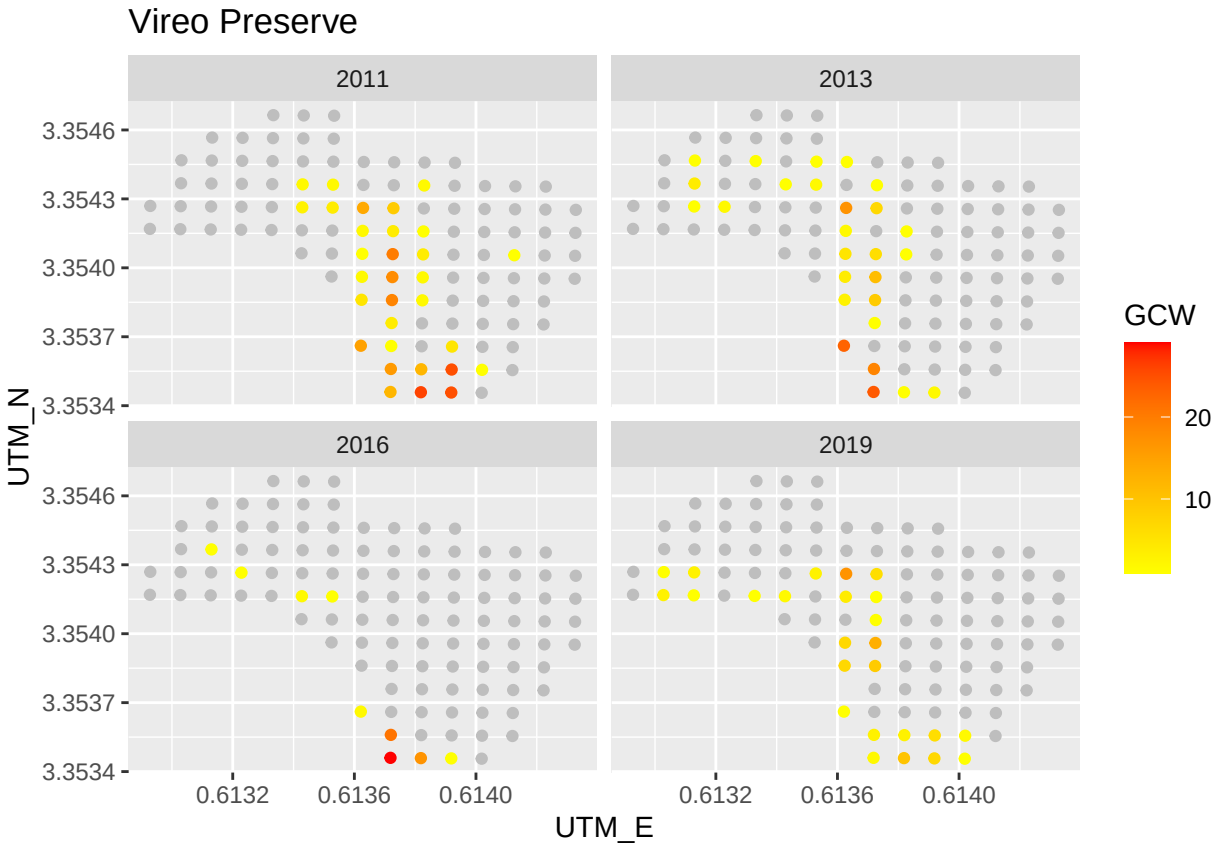

This graphic above of the Double J&T preserve also shows the number of cells where no Warblers were observed had increased markedly between 2011 and 2019. Changes between the years appear to be marginal, but the difference between 2011 and 2019 is much more marked.

```
birds %>%
  filter(Property == "Hamilton")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E)) +
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Hamilton"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Hamilton"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Hamilton")
```



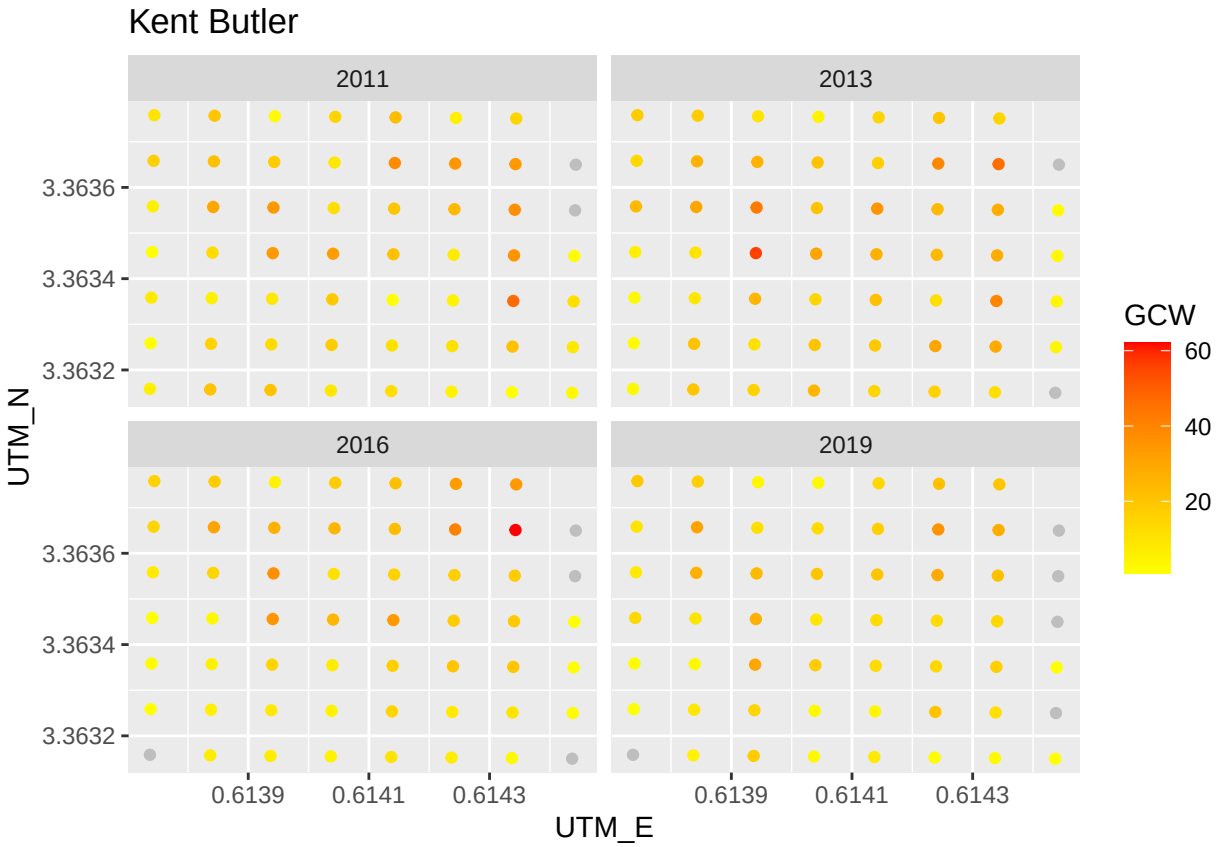

This graphic above shows a map of the Hamilton preserve. Unlike the other preserves shown above, Hamilton does not have a marked increase in the number of cells where no Warblers were observed.

```
birds %>%
  filter(Property == "Vireo Preserve")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E)) +
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Vireo Preserve"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Vireo Preserve"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Vireo Preserve")
```



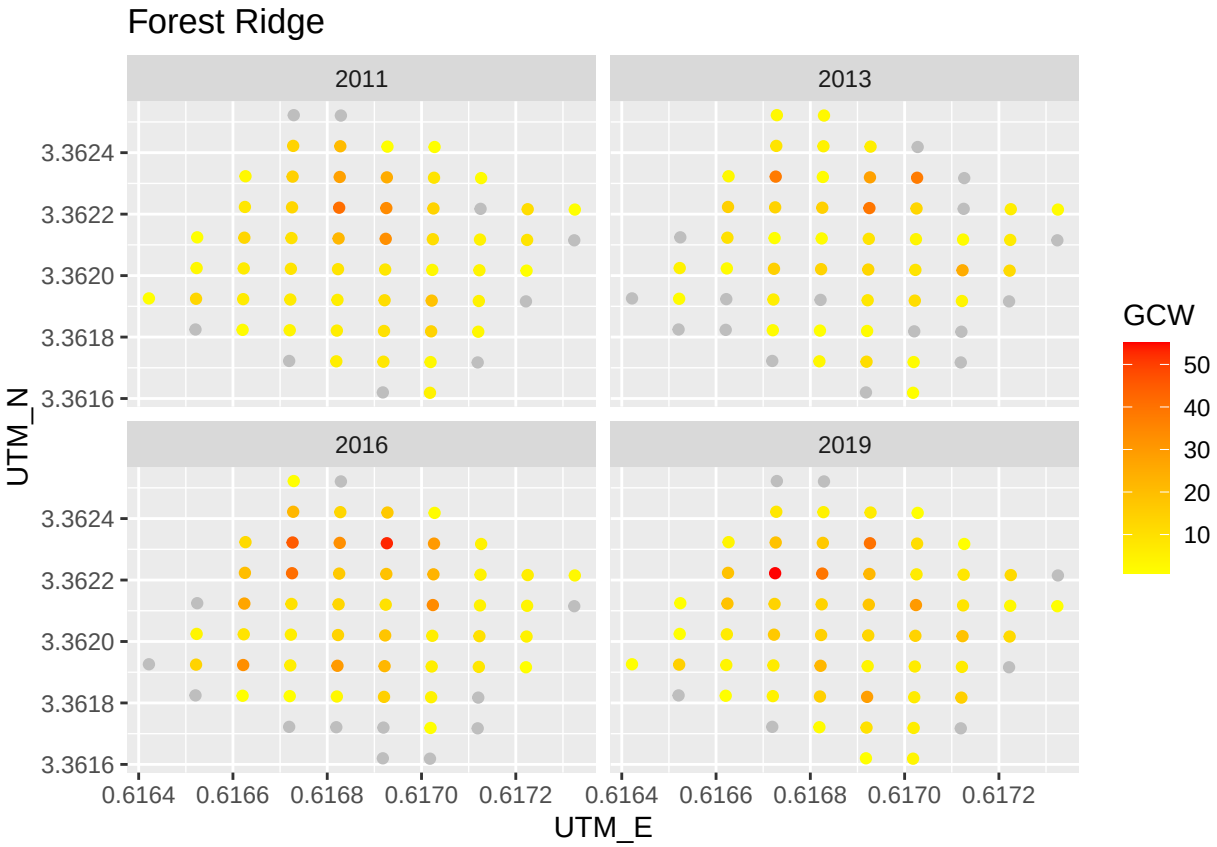

The graphic above shows the map of the Vireo Preserve. The number of cells with no Warblers observed appears to reach a peak in 2016, and then decreases somewhat in 2019. It is important to note, however, that the maximum number of Warblers found in a cell for this property never goes beyond 30, which suggests very few Warblers in the entire preserve even in 2011.

```
birds %>% filter(Property == "Kent Butler") %>%
  ggplot(aes(y = UTM_N, x = UTM_E))+
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Kent Butler"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Kent Butler"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Kent Butler")
```



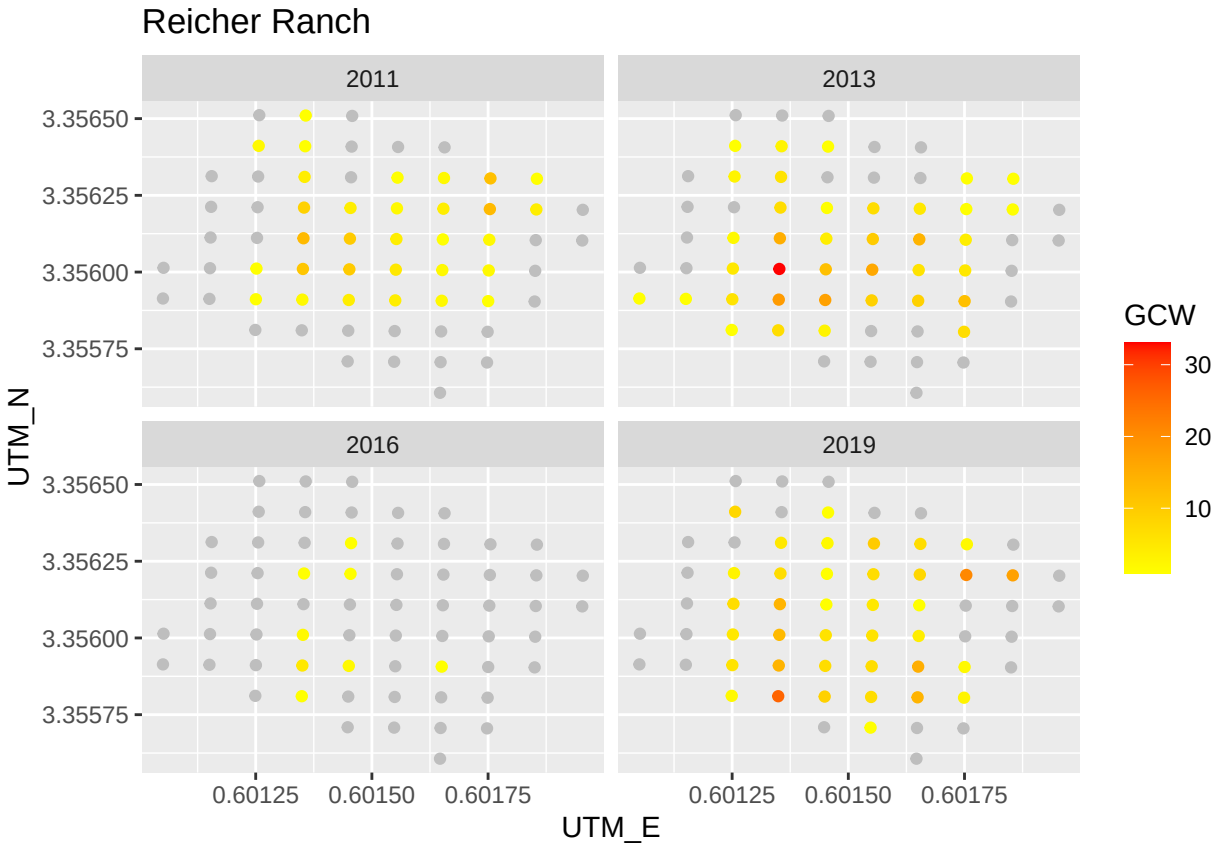

The graphic above shows the map of the Kent Butler preserve. We can see that the number of cells with no Warblers observed did not increase significantly in comparison to the total number of cells for the preserve between 2011 and 2019.

```
birds %>%
  filter(Property == "Forest Ridge")  %>%
  ggplot(aes(y = UTM_N, x = UTM_E))+
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Forest Ridge"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Forest Ridge"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Forest Ridge")
```



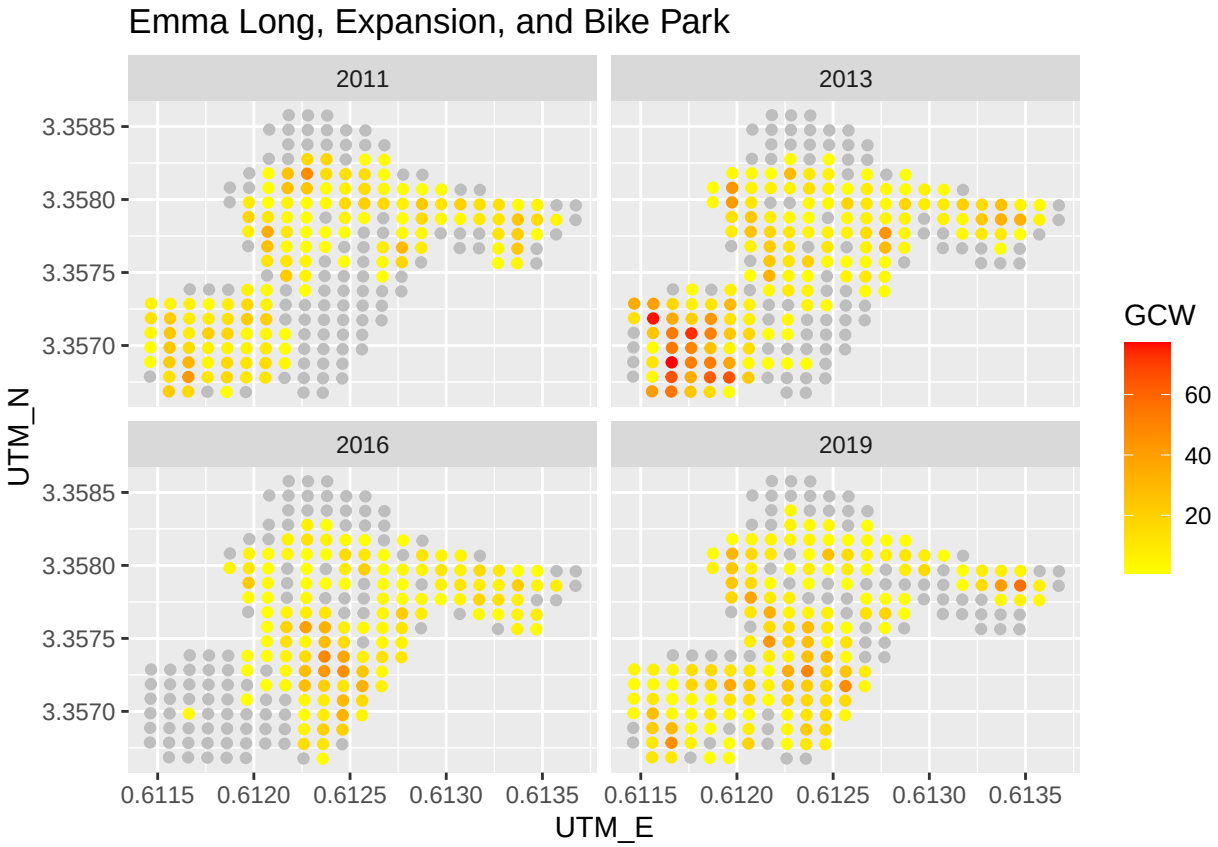

The graphic above is a map of the Forest Ridge preserve. The cells that have no observation of Warblers only appear around the edges of the preserve, though there is no significant increase in the total number of cells with no observation of Warblers.

```
birds %>% filter(Property == "Reicher Ranch") %>%
  ggplot(aes(y = UTM_N, x = UTM_E))+
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property == "Reicher Ranch"),
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property == "Reicher Ranch"),
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Reicher Ranch")
```



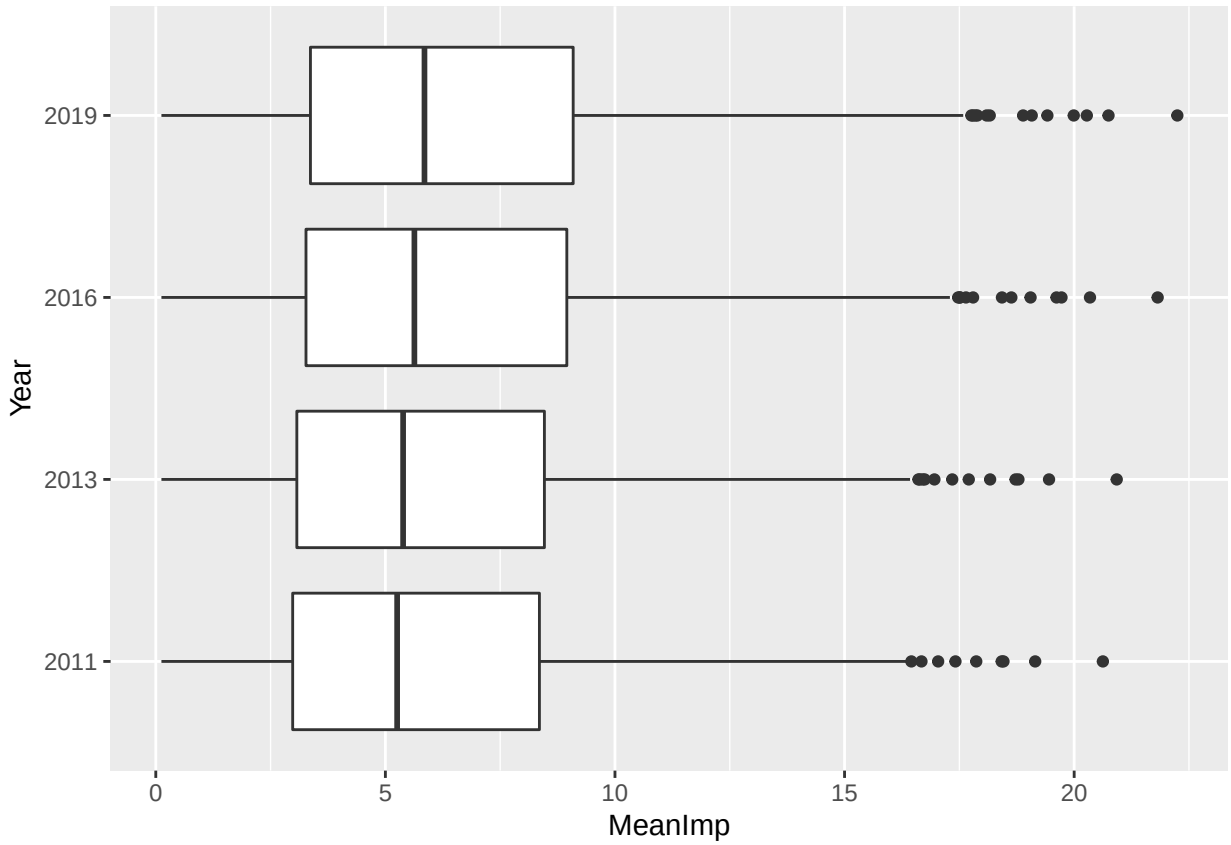

The graphic above shows the map of the Reicher Ranch property. We can see a sudden increase in the number of cells with no observation of Warblers in 2016 compared to 2013, but a decrease again in 2019 that returns the distribution similar to what it was in 2013. This could suggest that something happened in 2016 that led to the sudden decrease in the number of Warblers in Reicher Ranch in that year compared to 2013, although it could be a attributable to the particular day(s) the survey of the property was conducted.

```
birds %>%
  filter(Property %in% c("Emma Long", "Emma Long Expansion", "Bike Park"))  %>%
  ggplot(aes(y = UTM_N, x = UTM_E)) +
  facet_wrap(vars(Year)) +
  geom_point(data = filter(birds_zeros, zero == TRUE, Property %in% c("Emma Long", "Emma Long Expansion
             color = "gray") +
  geom_point(data = filter(birds_zeros, non_zero == TRUE, Property %in% c("Emma Long", "Emma Long Expans
             aes(color = GCW)) +
  scale_color_gradient(low = "yellow", high = "red") +
  labs(title = "Emma Long, Expansion, and Bike Park")
```



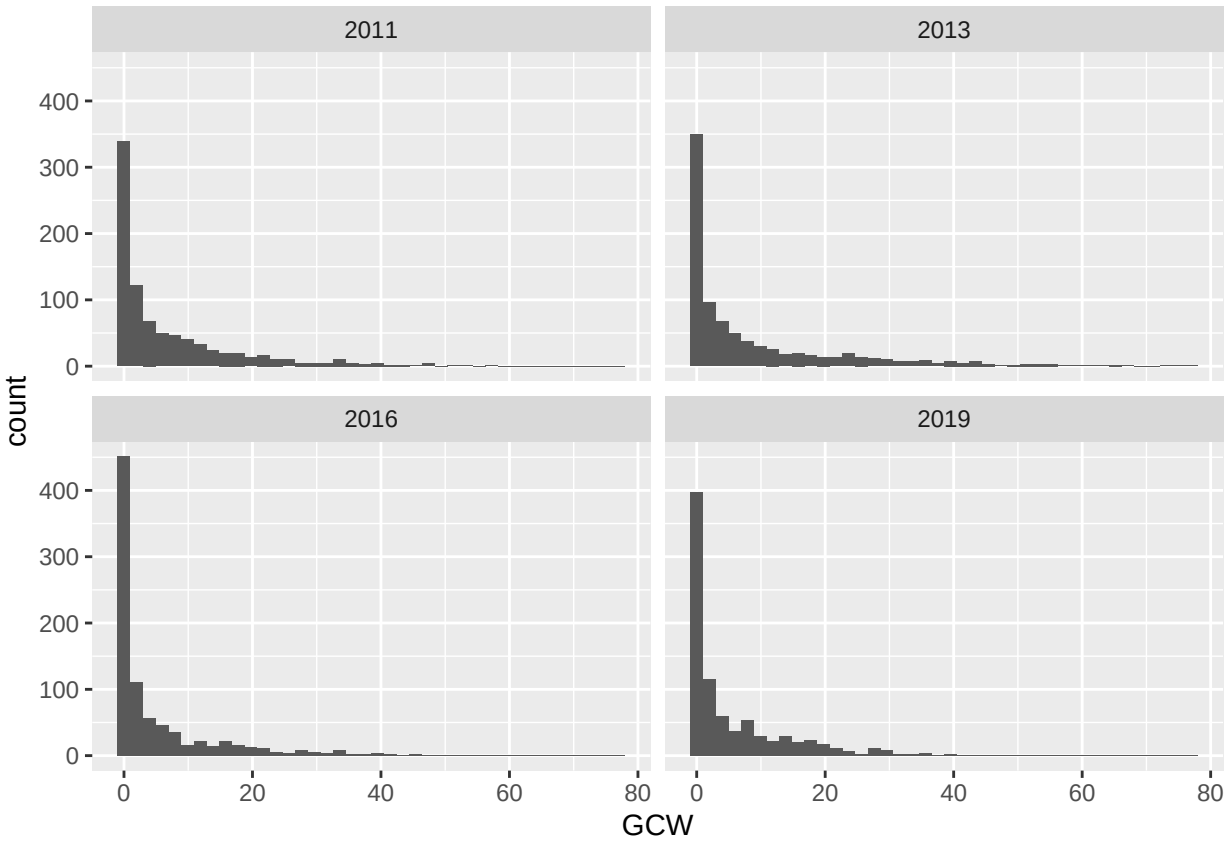

The graphic above shows a single continuous map of the Emma Long, Emma Bike Park, and Emma Long Expansion properties which are contiguous to each other. The graphic suggests a decrease in the number of cells with no observation of Warblers over time, although there was again a sudden increase in the number of cells with no Warblers in 2016 in the southwestern region. This is similar to the maps of Reicher Ranch and Vireo Preserve, where there was a sudden decrease in the number of observed Warblers in 2016 before returning to levels similar to 2013 in 2019.

```
birds %>% ggplot(aes(x = MeanImp, y = Year))+
  geom_boxplot()
```




From the boxplot above, we can observe a slight increase in the median of `MeanImp` with later years, with a corresponding increase in the outlier values. This suggests that as expected, there was an increase in development that was in proximity to the preserves as years progressed.

```
birds %>%
  ggplot(aes(x= GCW)) +
  geom_histogram(bins = 40) +
  facet_wrap(~Year)
```




The histograms above show the distribution in the number of birds in cells for a particular year, showing that there were a lot of cells with no birds observed in all years, leading to distributions that were skewed right. However, we can also observe when comparing the years, that the number of cells with no birds observed (values of 0), increased to over 400 in 2016 and hovered around 400 in 2019, compared to 2011 and 2013, where the number of cells with no birds observed had a maximum of 350 cells. We can also observe that 2011 and 2013 had distributions that were more skewed right, while the level of skew for 2016 and 2019 decreases as there are less cells with more than 40 birds observed in the cell.