
INVESTIGATING POPULATION VARIATION OF MELOSPIZA MELODIA AT UNIVERSITY OF BRITISH COLUMBIA

Final Project

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ABSTRACT

When investigating the spatial distribution of *Melospiza melodia* change between 2006 and 2011, it is important to have two identical maps. The contrasting data will show the change in the population of this species in the University of British Columbia. It is important to analyze the data and see why the population decreases from 2006 to 2011. Through this analysis we offer insight on how topography change has affected the variation of the population in the two different years. In 2006 the total area occupied by the roads, roadside habitat and buildings is equal to 1.88 square kilometres and in 2011 the new building and road area is 1.98 square kilometers. The following report outlines the methods used to achieve the viewing of the change in population alongside the errors and uncertainties we faced. The results of the analysis will be shown on the two maps of the University of British Columbia.

DESCRIPTION

Over the years, many areas have continued to see major developments in infrastructure which has led to a loss of habitats for species. For this project, we analyzed the UBC campus and the effect on the variation of *Melospiza melodia* species population in 2006 and 2011. Among the native sparrows in North America, it is easily one of the most abundant, variable and adaptable species. The Song sparrow favours brushland and marshes, but they thrive in human-dominated areas such as in suburbs, agricultural fields, and along roadsides. We analyze how the increase in population and construction have led to changes in the occurrences of *Melospiza melodia* and have seen a directly proportionate relationship. Our data analysis consists of many different layers that must be taken into account when witnessing the development of the land, alongside the spatial distribution of the biodiversity and seeing the type of environmental or urban impact with it. The land use on both the maps shows distinct land boundaries that have been utilized, and how they affect the spatial distribution of the *Melospiza melodia*. Understanding the *Melospiza melodia* species and how they interact with one another versus humans, and how they interact with one another after humans have had their impact on them will help us determine what has caused this significant decrease in species count in 2006 versus 2011. These types of studies on the distribution of the spatial patterns for species are important in planning future development and need to be considered as *Melospiza melodia* and other species are vital to the ecosystem.

METHODOLOGY

Acquire

In this project, we acquired data from four different resources. The database iNaturalist was used to acquire the occurrences of *Melospiza melodia* over different years at the University of British Columbia. UBC Geography Department GIS datasets (G:Drive) was used to acquire data for the roads and buildings for UBC. The UBC boundary was created using Google Maps as a source. Our census population data for Vancouver was downloaded from the University of Toronto CHASS site. Finally, we used the Abacus Dataverse Network to obtain data files for the Census Tract boundaries for Canada, rivers, lakes, coastal waters and provincial boundaries.

Parse and Filter

Our data needed to be modified to be used for our project. First, we parsed our data by creating a geodatabase and then we added all the data layers into this database and renamed them. Our *Melospiza melodia* data was converted from a .csv to a shape file by displaying the XY data, changing the projection to GCS NAD 1983 and then re-projecting to UTM Zone 10 N. We also needed to delete many attributes from this data as much of it was not necessary for the scope of our project. We also queried for any occurrences with individual count values that were not null and then exported this selection to a new layer.

Our data layers obtained from Abacus Dataverse Network needed to be re-projected to UTM Zone 10 N. The census population data was also trimmed of unnecessary attributes and then this table was joined to the UBC census tract layer table. This layer was then queried for just the CTUID for UBC area.

The editor tool was used to create a new polygon layer to make a boundary for UBC. We then separately selected the *Melospiza melodia* occurrences for 2006 and 2011 and exported this to two layers. These layers were clipped to the UBC boundary layer.

Mine

Discovering the difference in populations of *Melospiza melodia* during 2006 and 2011 and what may have caused this difference was the objective for this analysis. We first needed to figure out the individual count at each occurrence and the total. We did this by creating an output table by summarizing the species column by individual count. We also did a buffer proximity analysis on the roads to define our roadside habitat by 5 meters to determine if any occurrences were along roadsides. In our final analysis, we merged the road buffers and building layers and summed the Shape_Area column to determine the total area occupied in both 2006 and 2011.

Represent

Many considerations were made when we prepared our map. We included layers for the rivers, lakes and coastal waters to illustrate if the location of the occurrences were near water. We also created two different maps to show a better visualization of the difference between the time periods. To show the count and occurrences at each location of the species, we added a summary table to the map. An inset map was also added to indicate the location of UBC within the province. Consideration was also given to the size of the species locations, as we did not want to make it too big so it would look disproportional, but we also wanted it big enough to stand out. A textbox was added to explain what is being mapped and highlighted.

Table of Dataset

See appendix for Table 1: Dataset

DISCUSSION AND RESULTS

Human exploitation of land dates back to our earliest settlements, with massive, yet local destruction and deforestation¹. Urbanization is a global phenomenon with implications for birds as well as for all other animals. Due to the continued growth of the human population, existing urban areas in western countries are also predicted to intensify and develop in the future. The increase in population

and the resulting rise in demand for housing, has affected the sparrow's habitats in the census tract. Coupled with climate change, urbanization is considered one of the largest threats to wildlife⁴. The leading threat is habitat loss and fragmentation, which is non-conducive to a stable species richness and evenness and therefore forces hastened decisions such as immigrating to better-suited habitats or staying and coping with the new conditions. If the development continues, there is an added fear that species diversity entwined with climate change will drastically affect the ecosystem. Each species is important in the way the world works as they all contribute equally to enhance the rippling effects of natural devastation.

More specifically concerning the UBC area, more roads and buildings are being built; this will lead to a decrease in these species and thus contribute to the decline of species diversity in this specific area. All species are crucial for the way an area runs if the land cover is wiping out the species exponentially year after year, there is a fear that they will go extinct. Every time a species goes extinct a chain reaction takes place and soon humans won't be able to survive because everything they consume will vanish simultaneously. This domino effect will change species composition and community, including our own. The urban species often exploit anthropogenic resources such as the high abundance of different food sources and artificial nesting holes⁵. In temperate regions, birds can also benefit from the warmer climate caused by the so-called "urban heat island" effect- caused predominantly by the heat-absorbing properties of the impermeable surfaces and buildings together with the scattering effects of air pollution, within the atmosphere of the city. Dry conditions result in decreased territorial behaviour in free-living *Melospiza melodia*¹².

We used the surrounding topography of UBC including roads and buildings to determine areas that directly affected their habitats. We decided to make a buffer of 5m to represent that space as a roadside habitat. The roads determine the suitable size for roadside habitats and then we added layers of oceans and rivers to further help with identifying the locality of species. The relevant species of birds hunt on the ground, in shrubs or very shallow water. *Melospiza melodia* has a lot of enemies, ranging from parasites attacking their nests to cats, dogs and owls etc. Basic habitat requirements for this species include proximity to water, dense and concealing vegetation with exposed ground underneath, while architectural developments were taking place, native species habitat requirements were being shortened⁹. Vertebrate populations on campus are affected by campus structure and hence awareness with respect to their decline should be spread since many native species cannot cope with these major habitat changes¹³.

When comparing the two maps, we see a significant change in land cover; therefore, a decrease in habitats for the *Melospiza melodia* follows, which is unfortunate because it shows that in the 2011 map that urbanization (due to human demand) is taking place at a face pace destroying hundreds of habitats, yet this species is surviving through the Anthropocene, because the decline in their population is not as bad as other bird population in the area. One aspect of the urban environment we all complain about is the increase in noise. The din of modern cities is not only an annoyance to us humans (not to mention the toxicity eroding our health), but it also affects the life of wild animals that find themselves in an increasingly urban world¹⁰. High levels of noise pollution caused by urbanization are particularly problematic for animals that use sound to communicate, as it masks their signals and thus impairs the exchange of vital information. Recent studies have found evidence for genetic differences between city and forest populations of songbirds, and genetic differences might play a role in the differences between songs of urban and forest birds¹¹.

In the 2006 map, we see three main locations where the *Melospiza melodia* were spotted, thus portraying their preference and likeliness for closer proximity to water. None are detected in the centre of all the development, for several reasons spanning human disturbance, loss of habitat and noise pollution from people to construction. There were a total of 14 occurrences in the UBC boundary, but due to repetition, more than one bird was spotted in some areas, thus resulting in the 244 individual counts we found in the data. In the 2011 map, we see an increase in occurrences to 31 and the individual count dropped to 194 and when comparing both the maps we see that the *Melospiza melodia* migrated from their original habitats, some occurrences were in the centre, amidst all the madness where the buildings are roads were constructed. Still, the majority of occurrences demonstrate closer proximity to the water but if we look at data amalgamated in 2006, the species were spotted at much closer proximity to the water, and in more abundance, whereas through the individual count of 205 we can assume that there was a lesser abundance in amount of species spotted at that time. From first-hand experience, almost all UBC students can verify that the campus is always under construction somewhere or another. Urban ecology has shown through this census tract that the loss of habitat outweighs the sparrow's ability to adapt and thrive in the area as there is over a 20% decrease in Individual count for these bird species. In 2006 the individual count was 244, and now we see a decline in 2011 to 194 individual count and an increase in surface area development from buildings to roads and statues as well. With the utilization of buffer proximity analysis on the roads to define our roadside habitat by 5 meters to determine if any occurrences were along roadsides.

The extreme difference in density of *Melospiza melodia* between the two years exhibits the dire effort that the university needs to put in to counter urbanization since these native species as a priority and try to restore their habitats.

ERROR AND UNCERTAINTY

There are various sources of error and uncertainty which must be taken into account before concluding that this project is reliable. Although both our maps are completely identical otherwise, the second map was not made with the exact same boundary layer for UBC as the first map. This was an error which prevented the two UBC boundaries from being congruent with each other. The reason for this error was just that a boundary layer was drawn in accordance with google maps when we made our first map and then that same layer could not be drawn identically in the second map so we made the boundary congruent with the legal university boundary instead. Since the area of the boundary varies by an insignificant amount, we still hold the results from the second map as reliable for a comparison with the first map. Going further into this error, we also manually checked whether or not the animal in question had any occurrences in the specific part of the boundary layer which wasn't in common with both the maps and found that there would be no significant change in our results from the maps. This was an uncertainty which we knew about and took measures to minimize its variance. This was an uncertainty or error which we knew about while compiling our project, however we didn't take into account some other sources of possible error or uncertainty such as the complete effect of development. We only accounted for roads, buildings (including construction) and parking spaces, but these are not the only developments made by the university which would effect sparrow habitation. For example, an entire park was cleared out to make space for just the parking vehicles of a construction site in the Westbrook area of the UBC campus. This loss of greenery would most definitely effect *Melospiza melodia* as they mainly live and hop around in bushes and shrubs in green areas such as the

park which was leveled. Ongoing, the university also cordons off areas under investigation and makes temporary infrastructure for the various processes that go into the daily functioning of the university and the traffic that comes into the university on a daily basis would also have an effect on the density of *Melospiza melodia*. We can never be completely exhaustive or conclusive with our research as we also have to keep in mind that we are talking about an animal. The habitat and behavior of an animal is dependent upon many things, not nearly just buildings, roads and parking developments. A song sparrow might for example relocate due to the presence of predators such as bald eagles, or perhaps the noise pollution from the nearby stadium induces too much stress for the species to live nearby. It is also possible that there is a predator and a significant amount of noise pollution but the sparrow still decides to live in a place because it made its nest and laid eggs there before the noise pollution or predators came. The presence of food such as earthworms and other insects also dictates the habitational trends of *Melospiza melodia*. For the purpose of consolidation, we could not make our research exhaustive in all these aspects.

FURTHER RESEARCH AND RECOMMENDATIONS

This project was aimed at being conclusive not only for sparrows but it was hoped to reveal a blurb of a more general trend. Our findings are in no way exhaustive although they are reliable and accurate. If there was a generalisation to be made about the trends that every species follows along with the development of UBC, then we believe that more projects like this should be done with a collection of animals that reside in UBC. And if that was being one in the future, then comparing the trends of many more animals and then taking an average of the trends would be a more reliable conclusion. Another recommendation which would make this a lot more credible is if we spoke to people who were experts in the behavioral patterns of *Melospiza melodia* or animals of UBC in general. Although we did research as much of this as we could, we could get very specific information to sparrows in UBC perhaps if we spoke to an expert on that. Lastly, we did not compare the density of populations with areas around UBC. That is, the conclusions we make are only after looking at the densities of *Melospiza melodia* in UBC but it could be possible that the population density is changing drastically outside UBC and with the result there is a migration of sparrows from Kitsilano to UBC for example. In future, if similar maps were made for neighboring regions as well, then we would be able to include the knowledge of possible migration into our findings.

APPENDICES

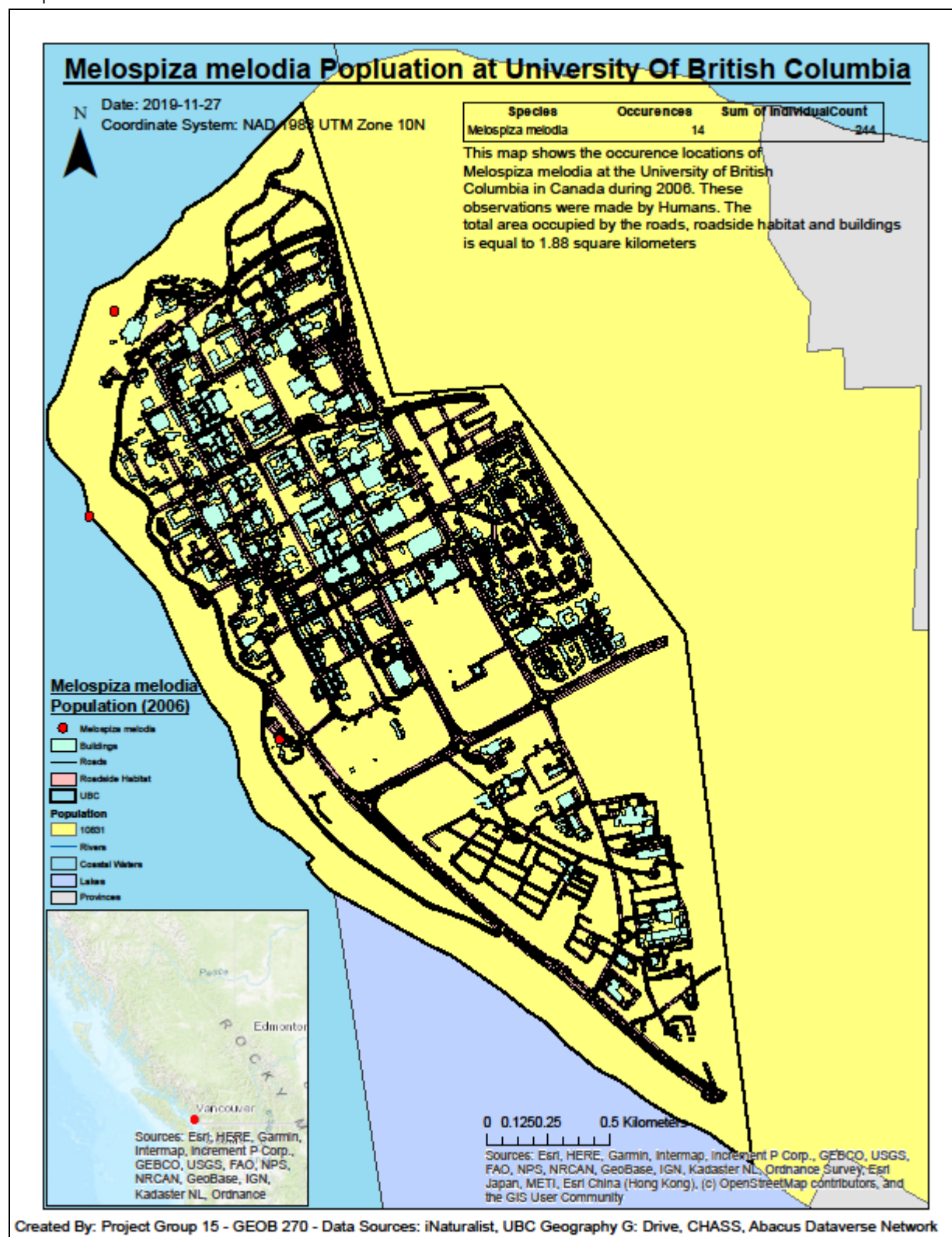
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Maps and Figures

Map 1:



Map 2:

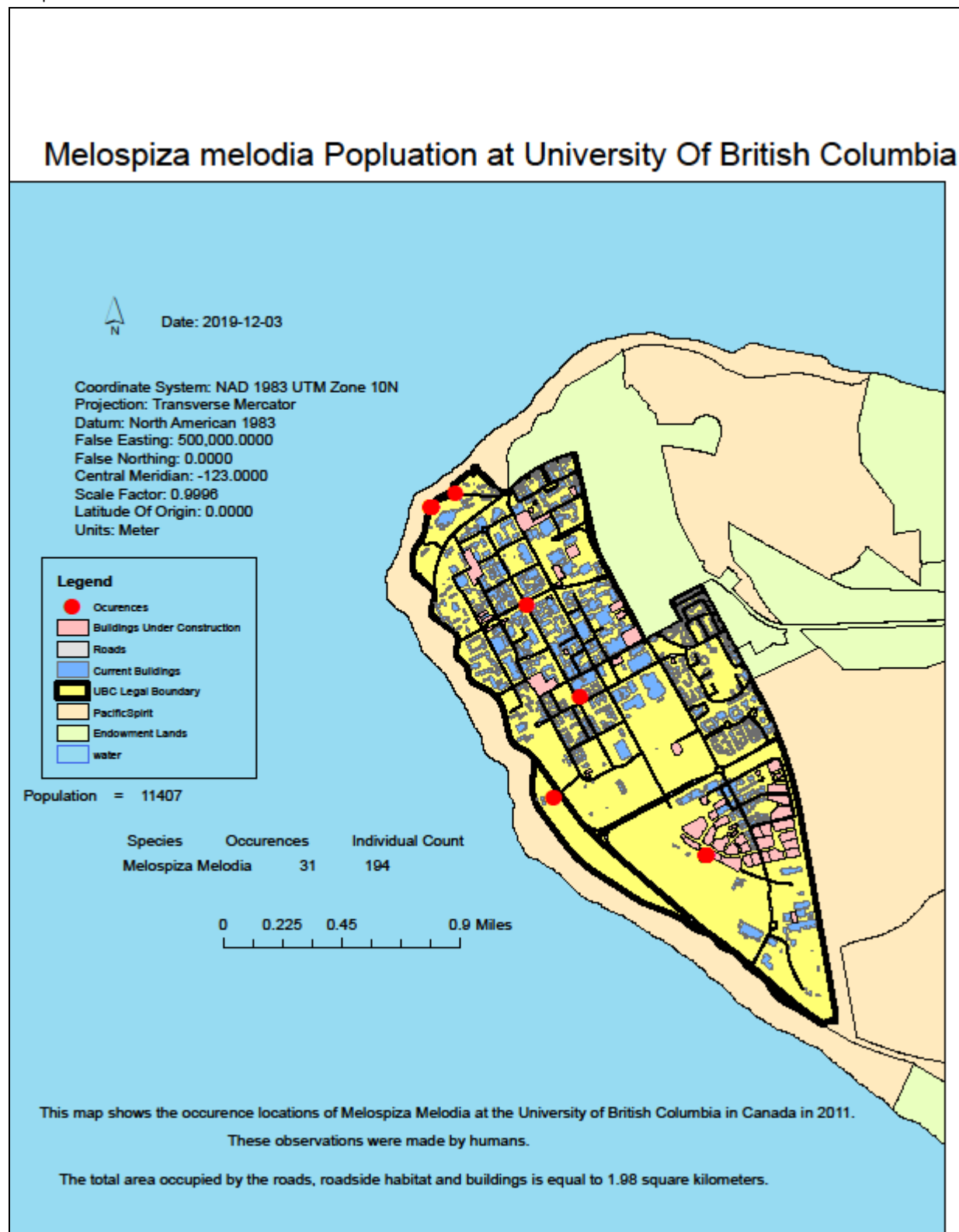


Table 1: Dataset

Layer / datafile name	Source	Uses	Entity/data model	Attributes	Modifications
<i>Buildings -> buildings_2006</i>	<i>G:Drive</i>	<i>Determine area</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Deleted attributes, merge</i>
<i>Buildings -> buildings_2011</i>	<i>G:Drive</i>	<i>Determine area</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Deleted attributes, merge</i>
<i>Buildings_cnstr -> Buildings_cnstr2011</i>	<i>G:Drive</i>	<i>Determine area</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Deleted attributes, clip, merge</i>
<i>Site_road -> roads_2006</i>	<i>G:Drive</i>	<i>Determine area and habitat</i>	<i>Vector polyline</i>	<i>Shape_Length</i>	<i>Deleted attributes, buffer, merge</i>
<i>Site_road -> roads_2011</i>	<i>G:Drive</i>	<i>Determine area and habitat</i>	<i>Vector polyline</i>	<i>Shape_Length</i>	<i>Deleted attributes, buffer, merge, clip</i>
<i>Gct_00b06a_e -> CanadaCT_2006</i>	<i>Abacus Dataverse Network</i>	<i>Census Tract for area of study</i>	<i>Vector polygon</i>	<i>CTUID, Population, Shape_Length Shape_Area</i>	<i>Project, query, delete attributes, join table, classify</i>
<i>Gct_00b11a_e -> CanadaCT_2011</i>	<i>Abacus Dataverse Network</i>	<i>Census Tract for area of study</i>	<i>Vector polygon</i>	<i>CTUID, Population, Shape_Length Shape_Area</i>	<i>Project, query, delete attributes, join table, classify</i>
<i>Ghy_00f06a_e -> coastal_waters2006</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>Ghy_00h11a_e -> coastal_waters2011</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>Ghy_059c06a_e -> lakes_2006</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>Ghy_000c11a_e -> lakes_2011</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>Ghy_059d06a_e -> rivers_2006</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polyline</i>	<i>Shape_Length</i>	<i>Project, delete attributes</i>

<i>Ghy_000d11a_e -> rivers_2011</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation, location of species</i>	<i>Vector polyline</i>	<i>Shape_Length</i>	<i>Project, delete attributes</i>
<i>Gpr_000b06a_e -> provinces_2006</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>Gpr_000b11a_e -> provinces_2011</i>	<i>Abacus Dataverse Network</i>	<i>Used for map presentation</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Project, delete attributes</i>
<i>1kIS15Q0c_data -> pop_2006</i>	<i>CHASS</i>	<i>Determine Census Tract population</i>	<i>Vector, point</i>	<i>CTUID, Population</i>	<i>Query, join table</i>
<i>LerfLMdVi_data -> pop_2011</i>	<i>CHASS</i>	<i>Determine Census Tract population</i>	<i>Vector, point</i>	<i>CTUID, Population</i>	<i>Query, join table</i>
<i>0014051-191105090559680 -> Melospiza</i>	<i>iNaturalist</i>	<i>Determine species occurrences and locations</i>	<i>Vector, point</i>	<i>Species, ScientificName, Country, Province, Year, collectionCode, Latitudedecimal, Longitude Coordinate, individualCount</i>	<i>Project, query, clip, create table, delete attributes</i>
<i>UBC_boundary</i>	<i>Google Maps</i>	<i>Boundary for UBC to show area of study</i>	<i>Vector polygon</i>	<i>Shape_Area</i>	<i>Editor tool</i>

Flowcharts

