Knowing the Flowers: A Floristic Analysis of the Diversity and Distribution of Flowering Plants on the Sunshine Coast, BC

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Abstract:

Flowering plants are a dominant biological force on this planet; they include an almost unimaginable number of species. British Columbia (BC) is no exception to this, housing a high number of angiosperm species. To help develop a clearer view of this diversity, this study focused on a small region of BC, the Sunshine Coast. I document the floral diversity of the area, and test whether a uniform level of species richness is supported across the area. The region lies across the boundary of two Biogeoclimatic (BEC) zones, the Coastal Western Hemlock (CWH) and Coastal Douglas-fir (CDF) zones, potentially giving it a combination of characteristics from both zones. I did floristic surveys in multiple sites in the CDF (n = 4) and the CWH (n=5) zones, and asked if there was any difference in species richness between the two. Variability in richness between wetland and non-wetland habitats was also examined. Two-sample t-tests failed to find a

difference in species richness between BEC zones or habitat types. I identified a total of 129 species of angiosperms from 44 floral families. The angiosperm Species/Genus ratio for the area was 1.29 and both the Species/Genus and Genus/Family distributions displayed hollow curves. These results indicate that angiosperms have a relatively consistent species richness throughout the study area and show that the group follows a stereotypical hollow curve distribution pattern.

Introduction

Take a step into the woods, run through a field, or sit down on a park bench, and you will be surrounded by one of the most prolific biological forces on Earth: the flower. Angiosperms are the most abundant and diverse group of plants in nature, with current estimates setting the known number of species at well over 300,000 (Joppa et al., 2011), and some estimating that the group may consist of as many as 450,000 species (Corlett, 2016). This diversity has evolved into many different forms, allowing the group to colonize every available patch of soil on this planet.

British Columbia (BC), Canada, is no exception to this floral diversity. The BC Conservation Data Centre has records of roughly 2481 species of vascular plants native to BC, of which the vast majority, 2318, are angiosperms (BC Conservation Data Centre, 2019). The goal of this study was to aid in our understanding of a portion of this diversity.

The Sunshine Coast lies in the southwest corner of BC, north of Vancouver and southwest of Squamish. Following the Biogeoclimatic (BEC) Zone classification system, the area straddles two zones, the Coastal Western Hemlock (CWH) zone, subzone xm1 (Pojar et al., 1991), and the Coastal Douglas Fir (CDF) zone, subzone mm (Nuszdorfer et al., 1991). Both regions are

characterized by a moderate climate, with cooler summers, mild winters and a long growing season (>4 months) (Pojar et al., 1991; Nuszdorfer et al., 1991). Its position on the border of these two zones may give the Sunshine Coast a higher diversity of flora due to its intermediate climate and habitat.

While a component of this study was to become familiar with the flora of the Sunshine Coast, it was also meant to test whether species richness was uniform across the entire study area. As the region is a site of overlap between the CWH and the CDF zones, species diversity was examined to determine whether a difference existed between the two. The diversity of wetland and non-wetland habitats in the area was also compared.

Methods

I surveyed nine sites (Table 1) throughout the Sunshine Coast between May and August in 2017. Sites were chosen based on their variability in location and microhabitat, to ensure that a wide range of habitats was studied. Sites were examined for the presence or absence of all identifiable angiosperm species. If a specimen was found that could not be identified to species in the field, samples and/or photographic images were taken and used for more detailed identification at a later time. For field identification, *Plants of Coastal British Columbia* (Pojar et al., 1994) was used. For later identification, the *Illustrated Flora of BC* (Douglas et al., Volume 1; Douglas et al., Volume 2; Douglas et al., Volume 3; Douglas et al., Volume 4; Douglas et al., Volume 5; Douglas et al., Volume 6; Douglas et al., Volume 7; Douglas et al., Volume 8) and E-Flora BC were used. Species lists for each site were compiled and the range of species distribution was graphically displayed using an ordination analysis.

Table 1. Locations, coordinates and habitat types of my nine study sites in the Sunshine Coast area, BC.

	Location	Ecosystem type	Lat/Long Coordinates	BEC Zone
Site 1	Sargeant Bay Provincial Park	Cobble shoreline	49.477071, -123.862138	CDF
Site 2	Trout Lake	Conifer forest-Lake border	49.507548, -123.876494	CWH
Site 3	Smugglers Cove Provincial Park	Conifer Forest-Wetland	49.513244, -123.953133	CDF
Site 4	Triangle Lake Trail Stop	Rocky outcrop/Cliffside	49.486194, -123.876217	CDF
Site 5	Porpoise Bay Provincial Park	Riparian-Sandy Shoreline	49.506761, -123.755983	CWH
Site 6	Dakota Ridge	Upland Conifer Forest	49.506196, -123.608551	CWH
Site 7	Chapman Creek Trail	Riparian-Conifer Forest	49.442748, -123.720585	CWH
Site 8	Lohn Rd, Halfmoon Bay	Semi-Urban Roadside	49.471164, -123.866392	CDF
Site 9	Wormy Lake, Sunshine Coast Regional District	Conifer Forest-Lake border	49.533719, -123.844693	CWH

Results

Over the nine sites, 129 species were identified in 100 genera within 44 different angiosperm families. Species/Genus (S/G) ratios and Genus/Family (G/F) ratios were used to help evaluate the diversity and taxonomic structure of the study sites. The S/G ratio for the study sites was 1.29. Both the S/G and G/F distributions displayed a hollow curve (Figure 1).

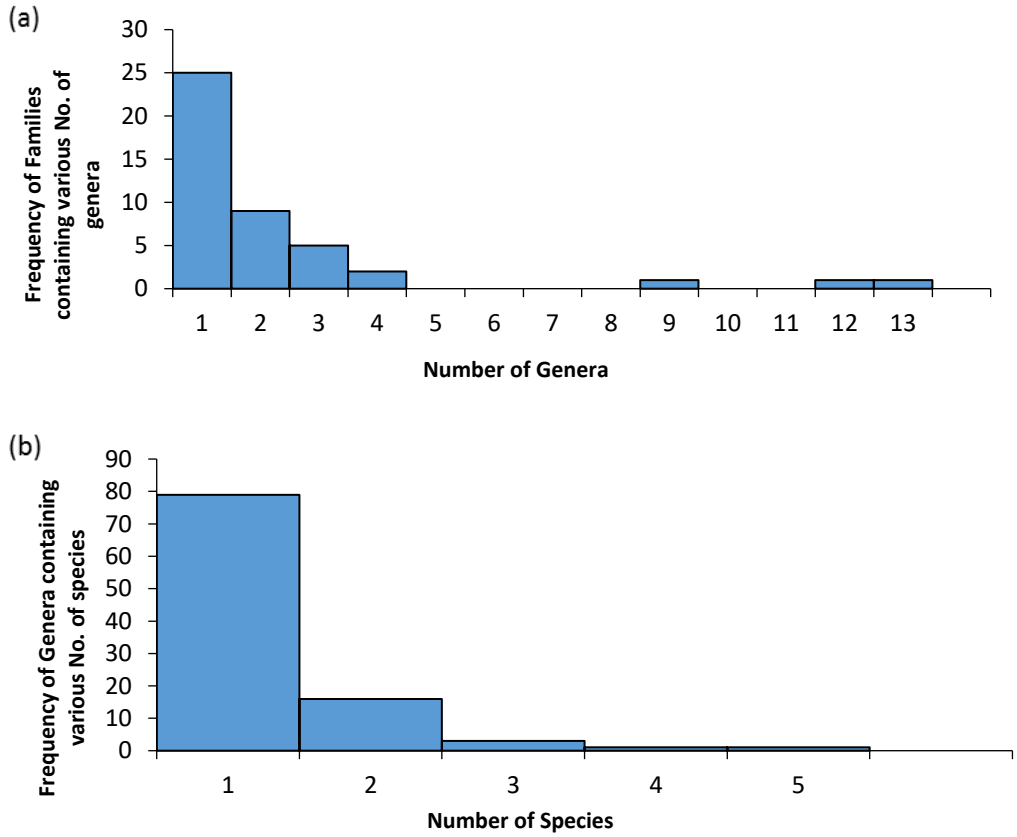

Figure 1. Distribution of genus diversity at the level of family (a) and species diversity at the level of genus (b).

The overall species distribution was graphically displayed with an ordination analysis (Figures 2 and 3) to help visually assess species-location relationships. From this, it appears that sites 1, 7, and 9 had the highest species concentrations. Of the 44 families represented in the study, the three most abundant families, Rosaceae, Ericaceae and Asteraceae, were represented by 18, 14 and 12 species, respectively; combined, the three constituted about 34.6% of the total species identified.

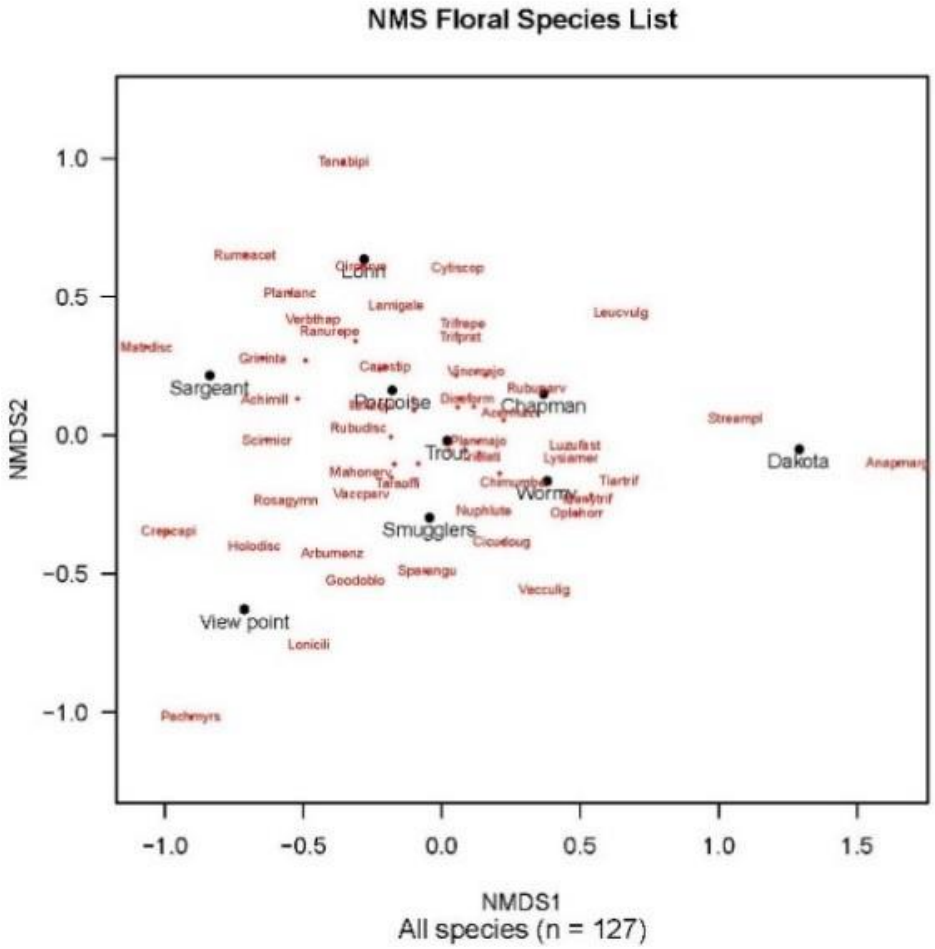

Figure 2. Results of an ordination analysis showing species-location relationship for all species.

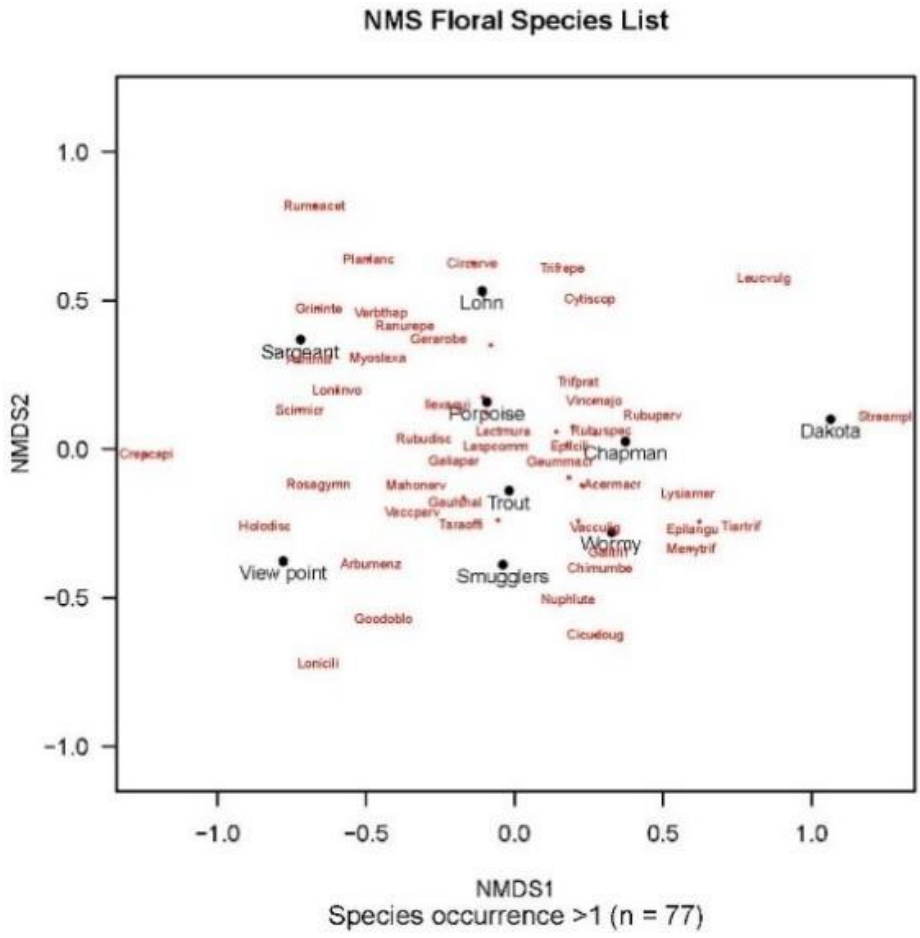

Figure 3. Results of an ordination analysis showing the species-location relationship for species found at two or more sites.

Interestingly, the presence of species across the various survey sites also forms a hollow curve, with no single species occurring at all nine sites (Figure 4).

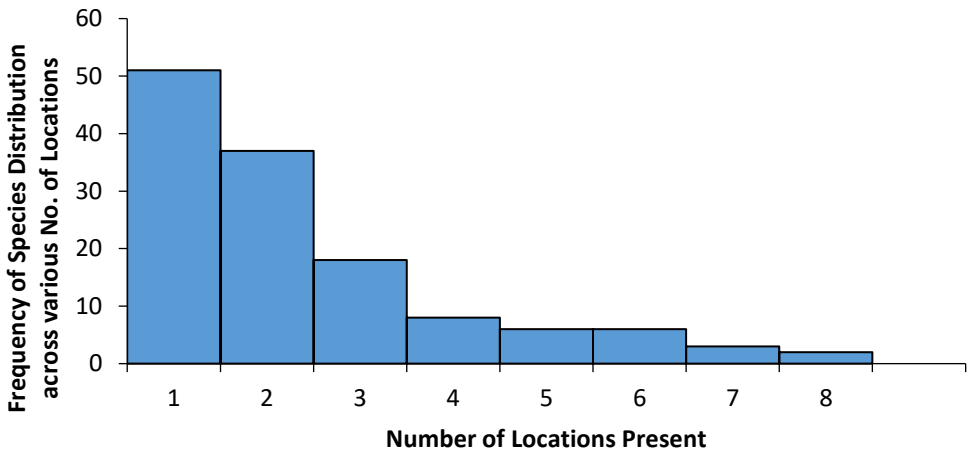

Figure 4. Frequency of species presence at 1 or more survey locations

Of the nine sites examined, four were within the CDF boundary and the other five were within the CWH boundary (Table 1). A 2 sample t-test failed to find a difference in species richness between the two zones (t = 0.396, p = 0.708). Similarly, a 2 sample t-test also failed to show a difference in species richness between wetland (sites 2, 3, 5, 9) and non-wetland (sites 1, 4, 6, 7 and 8) (t = -0.822, p = 0.457).

Discussion

Overall, this study indicated that species richness is fairly uniform throughout the Sunshine Coast area. When taking into account the overlap between the CWH and CDF zones, it seems likely that the boundary between the two zones is not a hard border, but more of a transitional area, and the close proximity allows for a blending of species across the two zones.

The results of the habitat diversity comparison are somewhat surprising. Wetlands tend to be zones of relatively high biodiversity, especially for organisms such as macrophytes (Hansson et al., 2003). Wetlands, especially riparian zones, also tend to have intermediate levels of disturbance (as a result of events such as flooding), which is believed to promote higher species diversity (Pollock et al., 1998). With this in mind, I would assume that wetland habitats would have a higher diversity than some other types of habitats, such as a forest understory. However, the results of my study suggest that this general trend does not hold for the Sunshine Coast. This may be due to the fact that disturbance level varied over the sites, and most of the disturbance was due to human activity; multiple locations were frequently used by the public for hiking, camping, and other forms of recreation. The effect of this type of disturbance is unclear, as there is evidence that recreational activity in protected areas can be damaging to plant diversity (Pickering and Hill 2007). With respect to the uncertain effect of disturbance seen in this study, it is critical to note that it was small in scale and only examined the presence/absence of species, not their abundance or health.

The S/G ratio of 1.29 is lower than expected, as it has been found that for most taxa, the global S/G ratio averages about 1.7 for locations above 40 degrees from the equator in both the Northern and Southern hemispheres (Krug et al., 2008). These results should be viewed with caution, however, as I only identified a portion of the total species within the region. Despite this, intrageneric and intrafamilial diversity measures displayed hollow curves (Figure 1), a pattern that occurs when there is a high number of taxa with low diversity and a low number of taxa with high diversity (e.g., many genera with 1 species and few genera with >1 species); it is observed within virtually all taxa of plants and animals (Holman 1985; Krug et al., 2008). This trend, as expected with such a low S/G ratio, indicates that there is an extremely high number of species-poor genera and a low

number of species-rich genera. The fact that this hollow curve was found, even though the study clearly did not identify all species in the region, indicates that the area likely experiences a relatively low intrageneric diversity in its flora, as is typical of northern temperate regions (Krug et al., 2008).

There are several issues stemming from the methodology of this study that should be taken into account when examining the results. The first, and probably the most important, is that replicate surveys were not done at each of the survey sites. This issue was due to time constraints, as surveying time was often limited. However, in future work, multiple plots should be surveyed in each location to provide more accurate estimates of species diversity.

Another major issue was my lack of experience with identification of plant species. As I had not practiced field identification on flowering plants previously, there was a large knowledge gap, which makes complete inventory difficult. This was especially true for graminoids, as identification of these plants is difficult. If I was better at graminoid identification, especially for the families Poaceae and Cyperaceae, the total number of identified species would have been higher. This would likely have been particularly important in wetland habitats, where graminoids were in very high numbers at multiple sites and it could help explain why the wetlands examined in this study were not found to have higher species richness than other habitats. If I had properly identified all graminoids, species richness may have varied more between habitat types.

One other issue is that the study was carried out over a long period—about four months. This meant that species with earlier or later growth and blooming times may have been omitted. Species found in the beginning of the study may have died back in locations surveyed later on, just as species which had a later growing season may not had been visible in sites visited earlier in the study. With this in mind, any future work should be conducted over a shorter period of time to

reduce variation caused by differing phenology among species. It would also be beneficial to conduct multiple surveys throughout the summer at different times to provide better coverage over the entire season.

Conclusion

From this study, it appears that the Sunshine Coast possess a relatively consistent, uniform level of angiosperm species richness. This indicates that the two BEC zones do not differ in species richness, at least in this local area. It may also indicate that the area represents a site of mixing between the CWH and the CDF zones. Future research could elaborate on this by studying floral diversity within each zone over a greater distance from the boundary between them. This would provide a clearer image of the floral diversity of each zone, and help show whether a significant difference in species diversity actually does exist between the CDF and CWH zones, or between the centre of each zone and the boundary between them.

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