Addressing issues large and small

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Canada Goose abundance within Powell River, 2019

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Summary

I surveyed Canada Goose (*Branta canadensis*) numbers at 21 locations within the Municipality of Powell River during summer of 2019. Field methods were basic: I used binoculars, spotting scope, notepad and my smart phone. My "experimental design" was also basic: I followed a randomly-selected "path" for each weekly survey, reasoning that repeating "the same path" might lead to bias introduced by systematically "missing" or "double-counting" the same birds.

On a "per location" basis, goose counts showed poor "repeatability". Birds move around – a lot. There were a few consistent "hot spots" (*Mowat Bay*, *Willingdon Beach*), but the larger trend was that large groups of birds can and did show up late in the season, making school grounds and playing fields quickly unusable (*J.P. Dallos*, *Cranberry Field*).

I cannot provide a goose population estimate with firm confidence levels. However, I believed there were about 150-200 birds within the Powell River Municipality in summer of 2019. Ancillary data (*eBird* and observations provided by "informants") suggest that this estimate is reasonable, and that I didn't miss large numbers of birds. Combined with historical *Christmas Bird Counts* (2002-2018), I conclude that the popular idea that "goose populations are expanding exponentially" is not supported by the data.

There were a few places (e.g., *Mowat Bay* or *Abbotsford Street*) where I can envision the corralling and harvest of flightless geese during their annual molt. Mid-July is probably the optimal "window" for catching most birds "on the ground" although there was no week that I did not see flying geese. I think more thought and discussion is required concerning the scale of the harvest and levels of pre-harvest and post-harvest monitoring. It makes no sense to conduct a harvest without being able to evaluate its effectiveness.

Introduction

There's a wealth of information available about the "Canada Goose problem" facing Powell River and other communities (e.g., Clermont 2015, CRD 2012). The history of Canada Geese in B.C. is also interesting – particularly for someone like me, who knew almost nothing about this species before taking on this project

Thus I was interested to learn that Munro and Cowan (1947) described *Branta canadensis occidentalis* as a "coastal goose" of the Queen Charlottes and *Branta canadensis canadensis* as an uncommon "winter resident" of the Lower Mainland. I was also intrigued to read Campbell et al (1990), who reported that while the distinction amongst these two subspecies "was once well understood", the situation had changed as a result of transplants of flightless young during the 1960s and 1970s by organizations such as Ducks Unlimited, the B.C. Wildlife Branch and the Canadian Wildlife Service.

In particular, I was impressed by Dawe and Stewart's (1990) history of the unfolding-of-goose-events on Vancouver Island. Not for the first time have I been reminded of that cartoon character "Pogo", who famously said "we have met the enemy and he is us".

In March of 2019 I was approached by Mike Kaban to undertake a "baseline" survey of goose populations within the Municipality of Powell River. This I agreed to do, and this document is the result.

Study areas and timing:

I was initially asked to monitor 7 sites within the Municipality of Powell River during "the summer months". After some discussion, the study was expanded to include additional sites, survey dates and data sources.

In the end I surveyed n=21 sites from 15 May through 2 October, and utilized checklists from *eBird* and an informal network of people who, like me, took an interest in the subject (see Acknowledgments).

Methods:

I first "pre-planned" the survey by ordering my projected travel routes in random order. By doing so I hoped to avoid double-counting the same birds that might have moved between site "x" and site "y" while I was travelling between them. I also reasoned that random order would minimize bias introduced by my counting sites at predictable times.

I conducted surveys during daylight hours. While I did not randomize survey times, I often broke surveys into "morning" or "afternoon" sessions. I recorded count data as: number of birds (N), number of pairs (PAIRS), and number of young-of-the-year (YOY). In practice, by the end of July it became difficult to reliably distinguish pairs and even goslings, particularly if the birds were offshore – I did not analyze these data further.

I compiled goose records and calculated summary statistics using a Geographic Information System (QGIS) and a statistical software package (SYSTAT). Analyses were straightforward. I estimated statistical repeatability (R) using Fisher's (1954) intraclass correlation coefficients; this yields an estimate of how well consecutive measurements record "the same thing", with R=0 meaning "not at all" and R=1 indicating "the numbers are completely repeatable". Think of measuring your own height for a year…with high repeatability being *good*…and low repeatability being *very strange indeed*.

To evaluate changes over time I first log-transformed the raw abundance data. This facilitates the plotting of "very large numbers" and "very small numbers" on a common scale. More importantly, it allows for comparison of *trends* over time even if the *magnitude* of the numbers is very different (e.g., Krebs 1989). I used Cleveland's (1979) locally-weighted regression (LOWESS) to visualize the results.

To address relationships over space I used Moran's *I* (Sokal and Oden 1978). This is similar to a typical "Pearson correlation coefficient" that you can perform in Excel, except that it's designed to evaluate whether things are similar or dissimilar in a spatial context. Like Pearson's *r*, coefficients close to 1.0 indicate that similar values tend to cluster together, and values approaching -1.0 indicate that dissimilar values tend to cluster together. The computations are involved and needn't concern us here – but the method was a useful way of asking myself: "was I missing birds because they were two blocks away in the *other* spot?"

I compared my adundance estimates with published *eBird* checklists using standard Pearson *r* correlations (Zar 1974). I also compiled historical *Christmas Bird Count* (*CBC*) data. The latter were not analyzed statistically, are reported here to further inform the question: "what might I have missed?"

Results:

General results

I made a total of 414 counts at 21 locations on 20 sampling days from May 15th through October 2nd of 2019 (Figure 1). I recorded 1172 geese and drove 1140 km in the process. I did not survey every site on every day. Specifically I added four sites after my 1st survey on May 15th and another site after my 2nd survey on May 22nd. Hence my data structure is imperfect (I made 414 counts instead of 420).

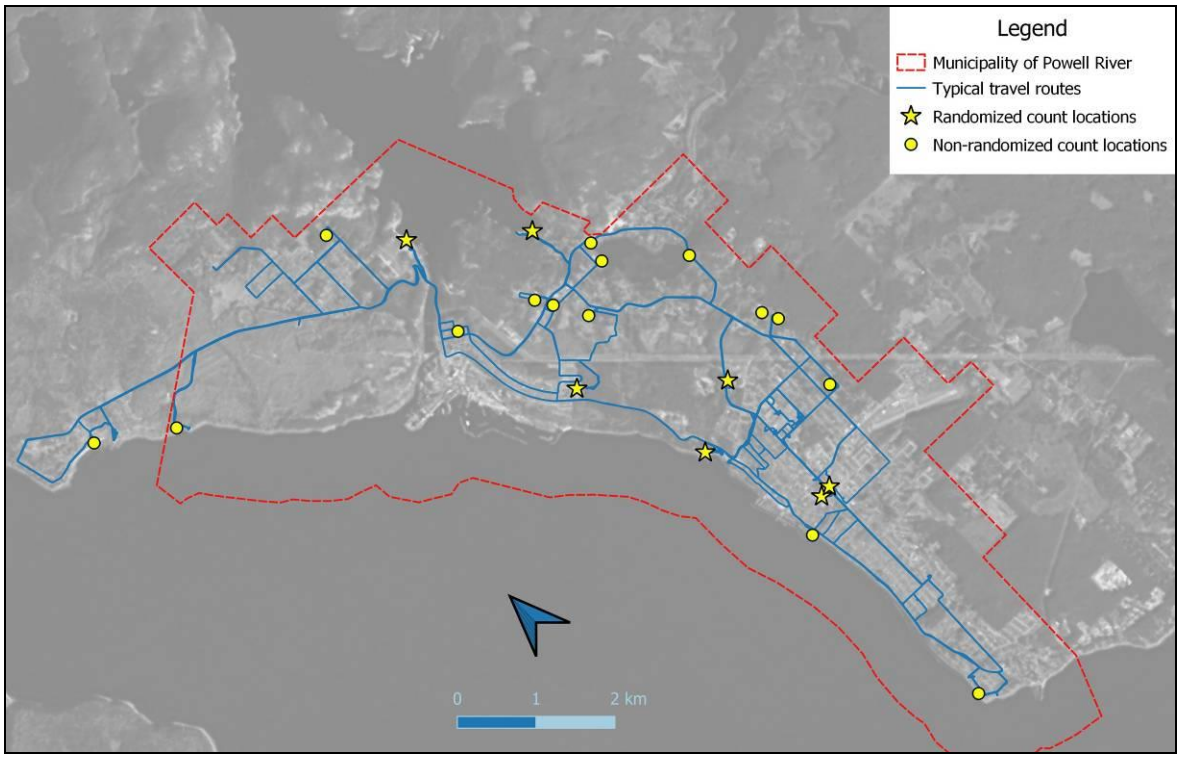

Figure 1: Extent of study area and typical travel routes.

Nor did I conduct surveys exactly on a "weekly" basis. Work commitments and weather sometimes forced me to go out a day or so earlier (or later) than planned; thus my average between-survey interval was 7.4 days (SD = 1.6 days, n = 19). I doubt these imperfections had any influence on the results.

No geese were seen at seven of the 21 locations (*Kinsmen Beach*, *Brooks School field*, *Larry Gouthro Park*, *Grief Point Park*, *Sunset Park*, *Gibson's Beach*, and *Henderson Field*). I note that no goose droppings were detected at these sites, and consequently omitted them from further analysis – they constitute "zero data", although this is not evidence that these sites are never used by geese. Indeed, I know from Brooks Secondary staff that geese can indeed be a problem there.

Repeatability of counts

Overall, repeatability (R) of counts at the remaining 14 sites was "poor" (Table 1).
I explored this result further by arbitrarily dividing the data into "big" sites (those with ≥ 5 geese per visit on average) and "small" sites (< 5 geese per visit). There was no obvious improvement in repeatability; indeed the reduced sample size makes things worse.

I conclude that goose count data show high variation *among* weekly surveys, and would therefore caution against placing much credence upon "per-site" estimates of abundance. Very simply, the birds move around – too much – to make that approach effective.

Table 1: Repeatability of goose counts (with 95% confidence intervals).

Variable	all sites	≥ 5 geese	< 5 geese
N of counts	275	97	178
Effective N of counts N_0	19.6	19.4	19.8
df (num, denom)	13, 261	4, 92	8, 169
Repeatability R	**0.202**	**0.076**	**0.011**
95% confidence intervals	0.177 - 0.235	0.161 - 0.096	0.004 – 0.022

Per site abundance

"Per site" abundance estimates are suspect because they show low repeatability.

For this reason it makes little sense to express the data as averages with a measure of variance (e.g., a "standard deviation") over time. A simple histogram of total abundance with an "accumulation curve" conveys the picture more accurately (Figure 2).

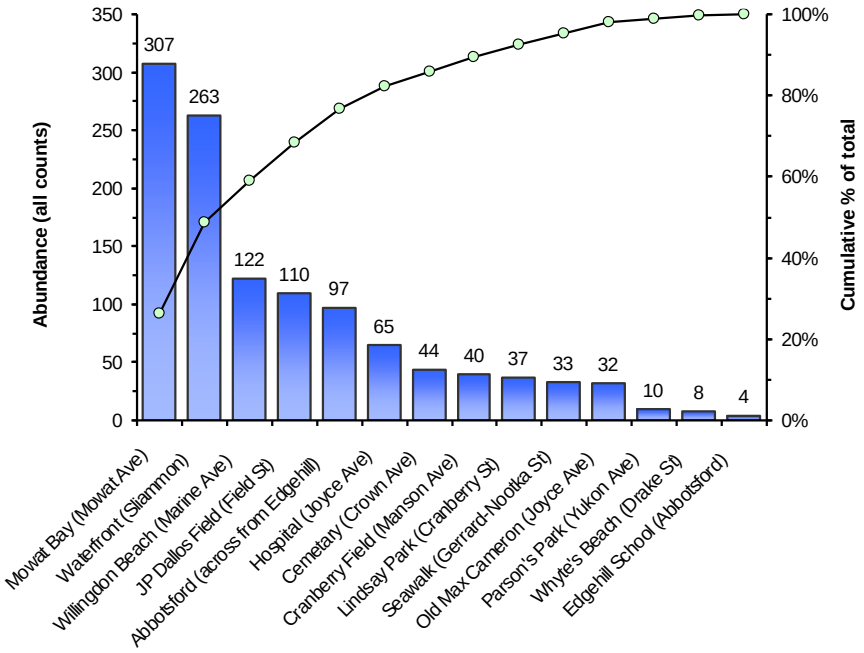

Figure 2: Total goose detections at 14 locations, 15 May – 2 Oct. Count totals are shown. As can be seen from the "accumulation curve", almost half of the detections (49%) were made at *Mowat Bay* and *Sliammon waterfront*.

Changes over time

Just as "per site" abundance estimates are fraught with limitations, so are estimates made "over time" (Figure 3).

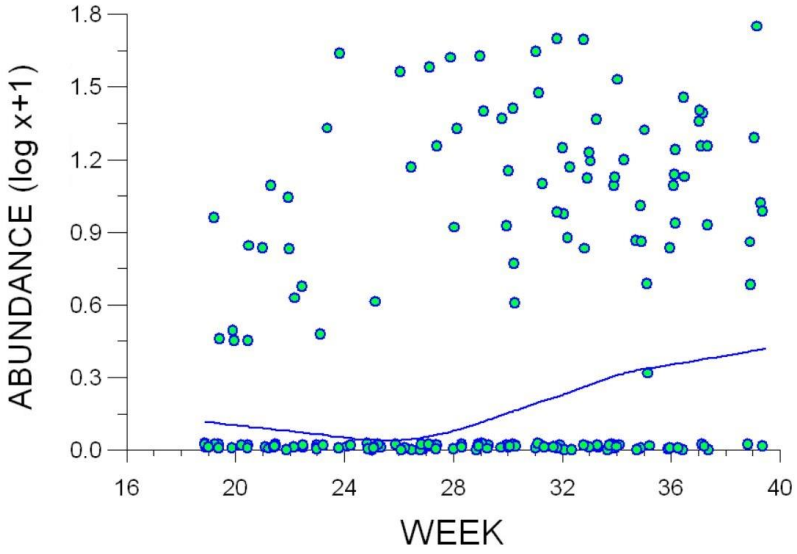

Figure 3: Log-transformed goose abundance at 14 locations, 15 May – 2 Oct. The line is a locally-weighted regression (LOWESS: Cleveland 1979). I've added random "jitter" to make the data points more legible.

Two things about Figure 3 deserve comment. First, many of the data are "zero-counts", which keeps overall abundance low (20 birds is 1.3 on a log-scale, and 50 birds is 1.7). The problem is that birds move around. It was a common to return to a "hotspot" such as *Mowat Bay* and see no birds at all. I also visited *PR Regional Cemetery* repeatedly, only to finally learn from the groundskeeper that "oh, we usually have a bunch every morning…and I just chase 'em off with the rider-mower".

Second, there was noticeable increase in detections after week #28 (17 July). This is presumably the result of young birds born elsewhere moving into the area. This was particularly noticeable at *Mowat Bay* and *Sliammon waterfront*.

Spatial correlation

Ecologists often wish to learn whether nearby things are more-or-less similar, i.e., whether they are "spatially autocorrelated". I explored this using *Moran's I*. This index ranges from 1 (similar values cluster together) to -1 (dissimilar values cluster together). The results were perhaps unsurprising (Figure 4).

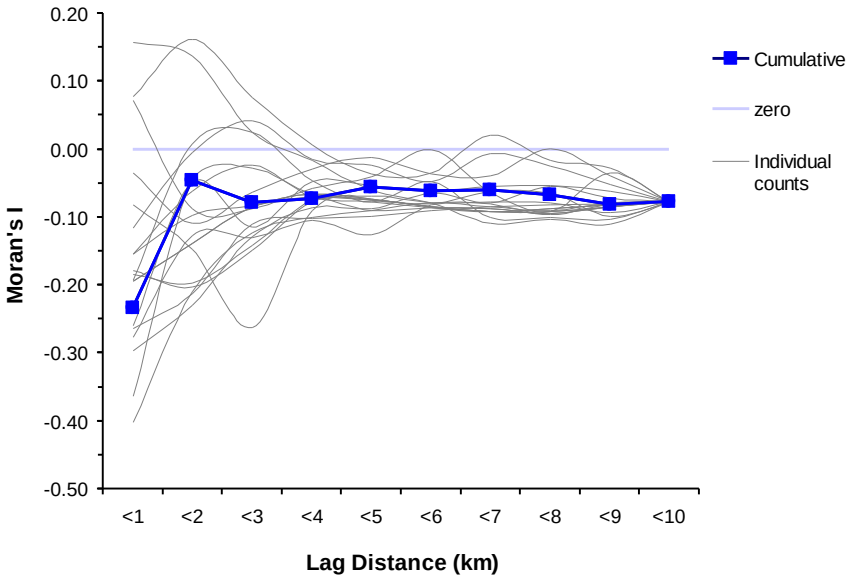

Figure 4: Spatial autocorrelation of goose abundance. Data are *Moran's I* calculated at increasing "effect-radius" intervals. Abundance was negatively correlated between sites less than 1 kilometer apart. Other correlations were non-significant.

This rather scary-looking graph says something quite simple. At nearby distances (<1 km), finding geese at, say, *J.P. Dallos Field* meant that I was less likely to see them across the street at the old *Max Cameron* area (the correlation is negative, and significantly so). However, at larger distances the spatial effect is essentially zero (and non-significant). Seeing numerous geese at *Willingdon Beach* had no effect on what I was likely to see at *Sliammon waterfront* on the same day.

Hot spots

Taken as a whole, the survey was useful in identifying areas of high goose abundance within the Municipality. Also of note are the obvious changes over time (Figure 5).

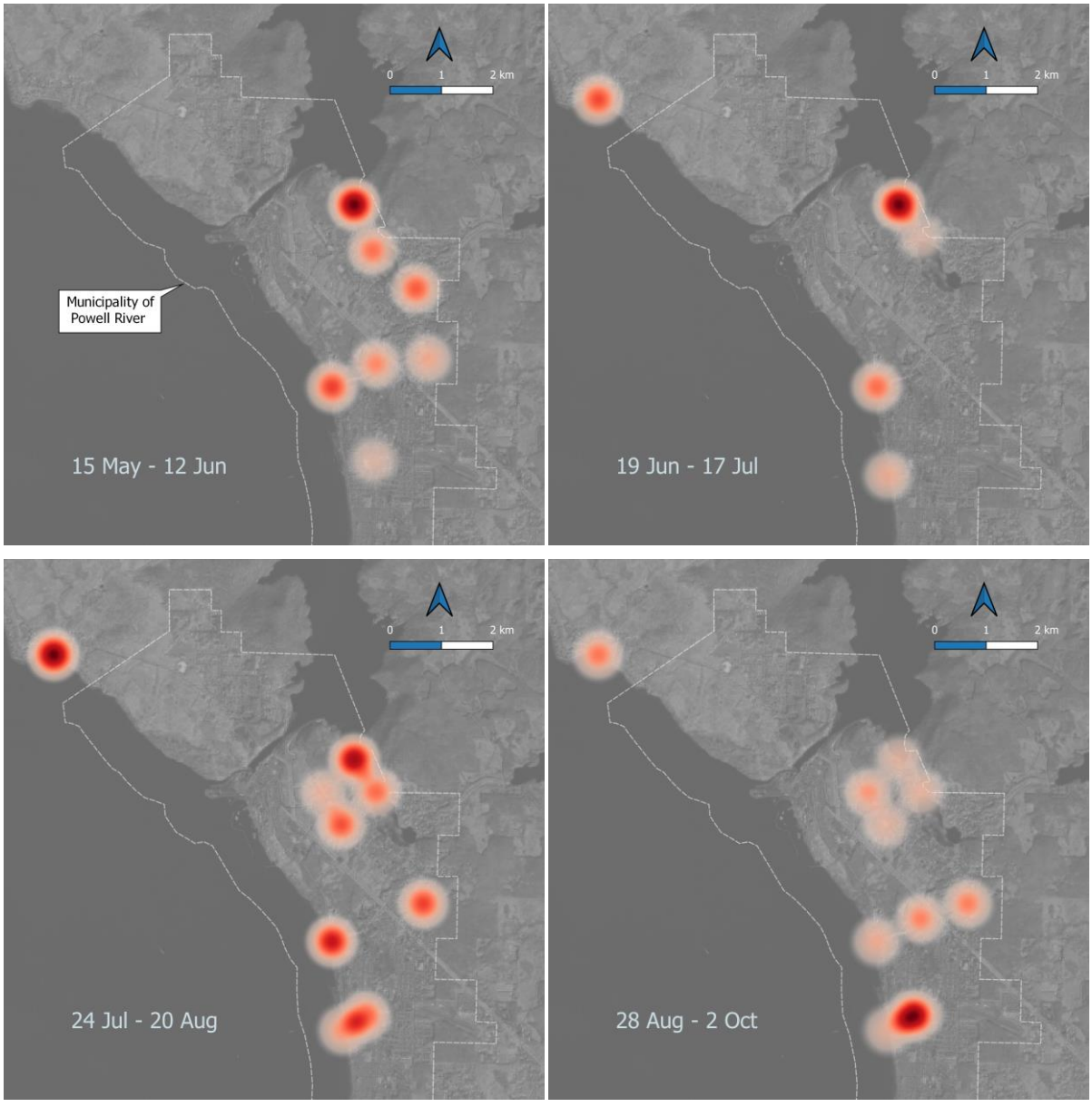

Figure 5: Evolution of goose "hotspots" over time, 2019. Each map reflects five repeated surveys, with "heat maps" being generated from log-transformed count totals. Another version of this map is available here.

Other datasets

The on-line network of birders that is *eBird* is a resource of considerable (and growing) value to ecologists. You don't need to be a birder, or a registered member to take advantage of it. Thus I can provide a link and presto, magic, you're looking at exactly the same dataset that I *queried* in order to write this document.

But *eBird* does have its quirks. It has its own sense of time, for example. Every weekly report starts on the first of the month – regardless of day. I needed to select "week ending" intervals and convert these to "Julian Days" to facilitate plotting. The bigger problem with *eBird* data is answering the question of whether contributors were counting geese at the same places I was. For the most part they were, although there were also numerous checklists submitted from places like *Myrtle Rocks, Brew Bay* or *Saltery Bay*, which were well outside my study area. It's not surprising that *eBird* numbers are larger.

Similar problems exist when trying to compare my count results with the larger, longer-term *Christmas Bird Count* data, in which observers counted geese at locations as far south as *Lang Bay* and as far west as *Texada Island*. We don't live in a perfect world…but I think the data permit some reasonable inference about how well my own observations "fit" with the existing "body of knowledge".

There are some similarities and differences among datasets (Figure 6).

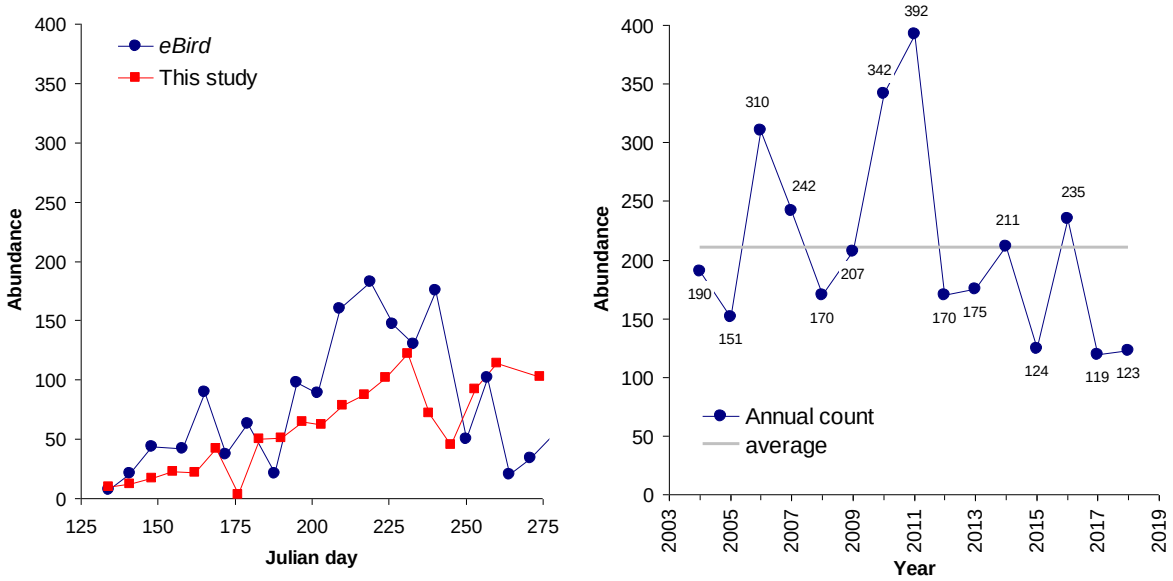

Figure 6: Comparison of goose abundance with published *eBird* and *Christmas Bird Count* (CBC) estimates.

My abundance data were significantly correlated with Julian day (Pearson $r = 0.86$ with 18 df, $p<0.05$), but the *eBird* data were not ($r = 0.31$ with 18 df, $p=0.18$). In short, my goose numbers kept increasing over time, while the *eBird* numbers rose higher in July but declined after about Day 230 (19 Aug). The two estimates were correlated, although not strongly ($r = 0.19$ with 18 df, $p=0.05$).

Compared to *CBC* data, both mine and *eBird* values are in "the same ball park". My high count was 122 birds (20 Aug), *eBird's* was 183 (for the week ending on 7 Jul), and the *CBC* average was 211 (*n*=15 years). The *CBC* data are more variable, and this likely reflects "real" changes in goose abundance as well as differences in observer-effort and weather. Because *CBCs* occur on a single day, the latter take on huge importance.

Discussion:

Given that *Branta canadensis* is a large, hard-to-miss species, the very low repeatability of count data surprised me. An *R*=0.2 is far lower than what I estimated for the endangered Vancouver Island marmot, for example, when that animal was being counted by volunteers (*R*=0.6; Bryant and Janz 1996). In a word, Canada Geese are *really* unpredictable.

There were some "areas of relatively high abundance" in Powell River – but even those areas showed enormous variation over the course of a single summer. So I was surprised (more than once) to return to *Mowat Bay* and find nothing…two days after I'd counted 30 or 35 birds there. While I did not test this idea formally (you can't do much with "zero-counts"), my strong suspicion is that the absence of birds at a given spot on a given day had less to do with lawn-mowers, or people, or dogs, or even weather, than it did with the idea that geese are highly social and political creatures that "go with what they perceive to be in their own self-interest". In this case, they simply fly somewhere else where the grass is greener.

Moran's spatial autocorrelation index provided a useful glimpse into what was going on. Or, more precisely, it helped me to better understand the relationship between the "J.P. Dallos geese" and the "Max Cameron geese". Or the "Abbotsford Road/Edgehill School" and "Mowat Bay/Cranberry Lake" geese. I think the jury's still out on the latter group, and I tend to think that like so many other Powell Riverites, a lot of the *Mowat Bay* geese just "head up the lake".

There are indeed goose "hotspots" in Powell River, but they evolve over time, and can just as quickly vanish. Bill Stewart reported 46 geese at *Willingdon Beach* on 10 June, but I only counted 2 on the 12th. Chris Carlos reported 18 birds at the *Evangel Church* on 22 June, but they were gone by the time I got there an hour later.

It would be nice to be able to report a goose population estimate with 95% confidence. Alas, I doubt this would be possible even with a dozen people monitoring sites on a daily basis – the birds are just that unpredictable. Having said that, I believe that Powell River has a resident summer population of something like 150-200 birds, with perhaps double that in the entire Regional District.

Based on the CBC data, the population is certainly not growing "exponentially", but it doesn't have to. A flock of 30-40 birds can do tremendous damage in a short period of time, and when you have consistent use at places like *Mowat Bay*, well you have a problem.

Conclusions

In terms of options for management, I like the concept of a "harvest". I think this deserves careful consideration, and it will need to be tempered by realistic expectations.

- You're not going to find the birds predictably. If I were bringing a crew from Vancouver Island to conduct the trapping, I'd recommend not doing it "cold". Even at an obvious location like *Mowat Bay*, I'd suggest having some monitoring in place prior to their arrival. You don't want to waste valuable trapping time by having to look for birds.
- You're not going to find all birds in molt simultaneously. There was not a single week that I did not see flying geese. This is presumably the result of an extended breeding season in coastal B.C. Having said that and knowing that "some will get away", I think *Mowat Bay* is the logical place to start, and I think mid-July would catch most of the birds being in molt.
- I suggest some additional thought is needed concerning the "scale of harvest" and the political acceptability of same. You're never going to convince everybody of the need for goose management, but I think it will be easier if you place limits on it from the outset. I could easily see taking 20-50 birds from the population without having much of a population impact, but that begs the next question:
- To achieve a useful outcome, any management effort must first have in place the tools to ask "is it working?" So at the moment we have some rough population estimates and a much better idea about *why* the estimates are so rough…which is more than we had before. But we need to develop the means to evaluate the effectiveness of a harvest, and given the mobility of geese and the unrepeatabilty of counts, this will not be straightforward.

Acknowledgments:

I thank Mike Kaban and Ray Boogaards for initial contact and supervising this contract. Karen Vandenameele provided a clipped raster from 2016. Guy Monty, Neil Dawe and Tim Clermont provided encouragement, literature and ideas.

I also thank the *eBird* community, which in the Powell River Area largely means Pierre Geoffray, Iwan van Veen, Kathie and Ken Pritchard, Yves Perreault and Neil Hughes. Chris Carlos and Bill Stewart also provided records.

Finally I thank the Powell River *Christmas Bird Count* community. This list could get long in a hurry, but special thanks to Heather Harbord, Joan and John Treen, *Bird Studies Canada* and the *Malaspina Naturalists*

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Appendix 1: Simple abundance at 14 sites where geese were seen. Juveniles are shown in parentheses (e.g., 7 of 11 birds at Mowat Bay on 29 May were young).

N	Date	Mowat Bay	Sliammon Waterfront	Willingdon Beach	JP Dallos	Abbotsford St	Hospital/Joyce	Cemetary	Cranberry Field	Lindsay Park	Seawalk	Old Max Cameron	Parson's Park	Whyte's Beach	Edgehill School
1	15-May	-		-	-		-	-		-	-	-	8(3)	2	
2	22-May	-	-	2	-		-	-	-	-	-	2	2	6	-
3	29-May	11(7)	-	6	-	-	-	-	-	-	-	-	-	-	-
4	05-Jun	10(6)	-	3	-	-	6	-	-	-	-	-	-	-	4
5	12-Jun	20(3)	-	2	-	-	-	-	-	-	-	-	-	-	-
6	19-Jun	42(7)	-	-	-	-	-	-	-	-	-	-	-	-	-
7	26-Jun	-	-	-	-	-	-	-	-	3	-	-	-	-	-
8	03-Jul	36(6)	14(6)	-	-	-	-	-	-	-	-	-	-	-	-
9	10-Jul	35(5)	16(4)	-	-	-	-	-	-	-	-	-	-	-	-
10	17-Jul	39(8)	-	19	-	-	-	-	-	-	7	-	-	-	-
11	23-Jul	39(7)	-	23(6)	-	-	-	-	-	-	-	-	-	-	-
12	30-Jul	23(8)	14	5	26	-	-	-	7	-	3	-	-	-	-
13	06-Aug	12	46	29	-	-	-	-	-	-	-	-	-	-	-
14	13-Aug	14	46	9	-	17	-	-	-	7	9	-	-	-	-
15	20-Aug	14	51	-	-	17	-	6	21	13	-	-	-	-	-
16	27-Aug	-	33	-	-	13	15	11	-	-	-	-	-	-	-
17	03-Sep	-	1	6	6	-	19	9	-	4	-	-	-	-	-
18	11-Sep	12	-	-	-	26	16	-	12	6	8	12	-	-	-
19	18-Sep	-	24	8	22	24	-	18	-	-	-	18	-	-	-
20	02-Oct	-	18	10	56	-	9	-	-	4	6	-	-	-	-
	Totals	52	233	99	110	97	65	44	40	37	33	32	2	8	4