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Conservation Guide
The Osoyoos Desert Centre

Survey and Occurrences of Behr's Hairstreak at the Osoyoos Desert Centre

During Summer 2021 and Analytical Comparison of 2021 to 2003 and 2004.

It is no secret that the decline of insect populations is notable as the years pass by; we have records of such events in impressive magnitudes (Leather 2017). Less and fewer insects cover windshields every time we go on a road trip, an effect that is especially noticeable in ecosystems susceptible to anthropological activity (Wagner 2020). As species lose the habitats they grow and depend on; they will slowly diminish in numbers until they disappear along with those ecosystems they used to live in. Such is the case of Behr's Hairstreak (*Satyrium Behrii*); emphatically, the Columbia subspecies originally from BC (Tews et al. 2004). The member of the Hairstreak family is dependant on Antelope-brush (*Purshia tridentata*); thus, being restricted to ecosystems where this brush is present (Southern Interior Invertebrates Recovery Team 2008). Females of the species lay their eggs on *P. tridentata*, the larvae of *Satyrium Behrii* feed and grow on this plant until adulthood when these lepidopterans expand their wings to look for flowering plants and mates (Southern Interior Invertebrates Recovery Team 2008).

The Antelope-brush ecosystem in Canada is extremely endangered, presenting estimations where only 9% of the ecosystem is left intact (Ministry of Environment, Lands and Parks 1995) and is restricted to the South Okanagan valley; an area famous for its wine and fruit production. The area is also presenting a rapid development of its cities and towns. These anthropogenic activities stress the ecosystem, eventually causing its decrements as the plants the ecosystem is named after are removed or swap with plants for economical use. Such decrement is worrisome as it means the plant *S. Behrii* is dependant for their larval stage is becoming rarer and rarer, meaning that mothers have fewer chances of finding areas to lay eggs, and directly affecting the number of individuals in the following generation. Several areas where *P. tridentata* is present is protected to prevent the destruction of what remains; however, these areas are fragmented and separated from each other, lacking corridors that allow the movement of species between such fragments becoming islands of species with little diversity as it is challenging to move between patches.

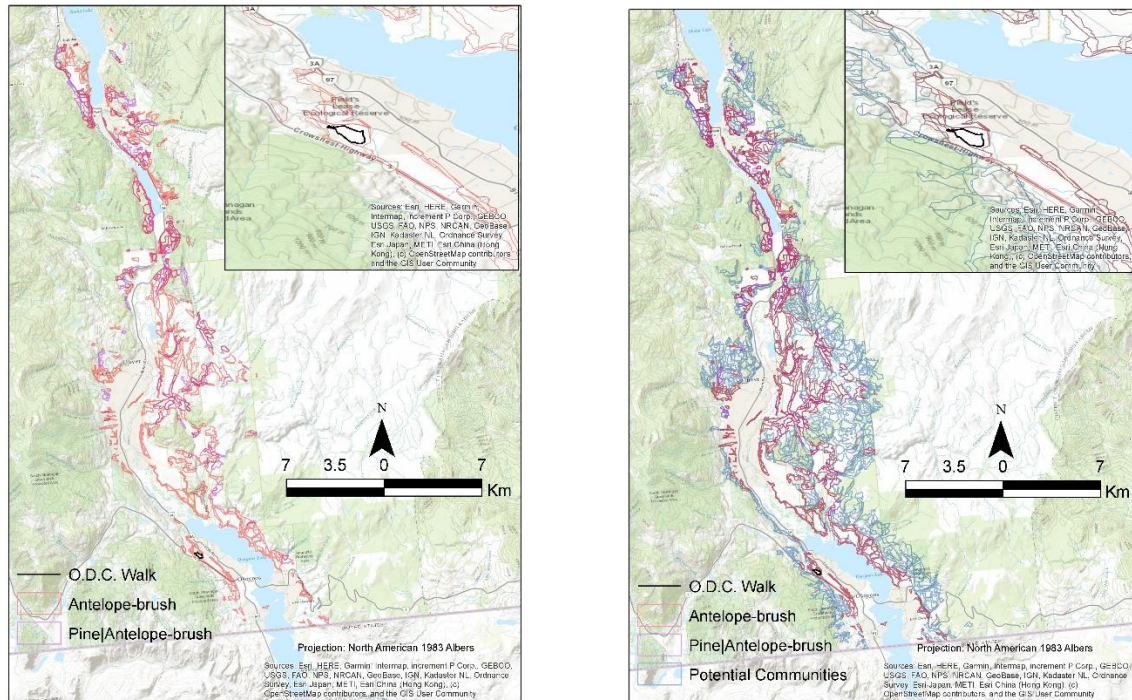


Fig 1. Extant patches of Antelope-brush ecosystem within Canada (Left). All patches are restricted to the South Okanagan. Inclusion of potential communities that are not part of the antelope-brush ecosystem but present antelope-brush plants (Right) within South Okanagan. The mini maps present the same information but closer to the ODC.

Among such protected areas is found the Osoyoos Desert Centre (ODC). A centre dedicated to the restoration, conservation and education of visitors, enhancing the protection of this imperilled ecosystem and owned by the Osoyoos Desert Society. The non-for-profit safeguards 27 Ha of Antelope-brush ecosystems and is one of the places that has been surveyed in the past for *S. behrii*. The last recorded survey dates the year 2004 (17 years to the date of this report being written) and used different methods to the ones used in this survey; mainly, they captured, marked, and released individuals of the population to count and identify individuals more than once (St. Jhon and Desjardins 2003). In this survey, such strategy has not been pursued as it was dimmed to intrusive and could be detrimental for the species; they have been under enough stress already.

Even though *P. tridentata* is vital for *S. behrii*'s larval state, it is not the only plant on which the species is dependent. Yarrow (*Achillea millefolium*) plays a critical role in the nutrition of these butterflies, being the most associated nectar plant due to how available it is (Southern Interior Invertebrates Recovery Team 2008). Yarrow is in an interesting position within British Columbia, as its status recently changed. The province presents endangered species of yarrow; however, it has been stated that the scientific name *A. millefolium* is unsatisfactory as the North American species of yarrow present genetic differences with its European counterpart (*A. millefolium* var. *millefolium*) known by the same name; the new given scientific name covering all North American varieties is *Achillea borealis* (Ramsey et al. 2008). Due to this new change, the exact kind of yarrow the Osoyoos Desert Centre homes is unknown; it could be the native *A. borealis* or the introduced *A. millefolium* from Sweden. For such a reason, all yarrow will just be considered one group of plants necessary for *S. behrii*. As yarrow is a group

of endangered species, its occurrences are scarce, which makes the requirements for an ecosystem to host *S. behrii* even harder, for they need not only to host the larval food but also the adults preferred food source. Mind you, these butterflies can obtain food from other sources, and many native angiosperms can cover such niche, but as mentioned, yarrow is the most commonly associated plant to Behr's Hairstreak.

The Osoyoos Desert Centre fills such parameters, making it the ideal location to survey these butterflies. Not only do they have these plants, but gardens are dedicated to their preservation, areas of spread and little interference with the ecosystem besides their activities in education and invasive species control. They also host several species of angiosperms that can benefit *S. behrii*, including a species native to the area but not commonly found within the desertic ecosystem, Smooth Sumac (*Rhus glabra*). This species, usually found in more humid areas of the Okanagan, has been noted as a food source for the adult butterfly (St. Jhon and Desjardins 2003).

Behr's hairstreak is reported to be actively flying from mid-May to the end of July, being the most active in mid-June and their larval stage is active from March (Government of Canada 2003); however, distinguishing larval stages among different species of lepidopterans is complex and requires years of experience, which sadly, we lack. It is also important to note that many of the flying lepidopterans generally seen are males (Acorn and Sheldon 2006) looking for mates.

Methods.

Pollard walks were done within the Osoyoos Desert Centre from May 27, 2021, to July 28, 2021. These walks started from the back of the Interpretive Centre, going into the Yarrow garden, the Native Garden, Pollinators Garden, boardwalk and ending by the side of the Restoration Trailer. Walks started between 8:00 to 10:00 AM, when there were no strong winds (6 or above on Beaufort Scale). Based on the analysis of available data from previous years (2003), surveys were preferable done in temperatures below 30°C as more activity seemed to be present under such conditions; however, no other information could be found that reinforces such assumption.



Fig 2. Aerial view of the Osoyoos Desert Centre showing the areas of interest for the Pollard walk. Arrows indicate the direction of the walk. At the entrance of the boardwalk, the observer views their right. Coming from the Pollinator garden, the observer is to start to the right side of the boardwalk.

The surveyor used a mobile app developed to survey Hairstreak butterflies' Hairstreaking'. Through the application, the date, time, temperature, light condition (Lux), rain condition, and wind condition (in Beaufort Scale) were recorded to distinguish variances in sightings between weather conditions along the season. Light conditions were collected using the side application 'Lux Light Meter Free'. After the weather conditions and time scales have been recorded, if a hairstreak is seen, the species sighted were recorded alongside the coordinates, the number of individuals seen, and the closest vegetation to them. It was possible to add species of butterflies or plants as needed on the app to satisfy any possible variation.

The survey would include a radius of 5 meters from the surveyor in all directions, as they would be in the middle of the path or boardwalk. This same radius compensates for the error of the in-app GPS that measures the latitude and longitude of the sighting as it has a ± 5 -meter error. In areas where the surveyor would transverse more than once, they would look to their right, avoiding watching the same region more than once.

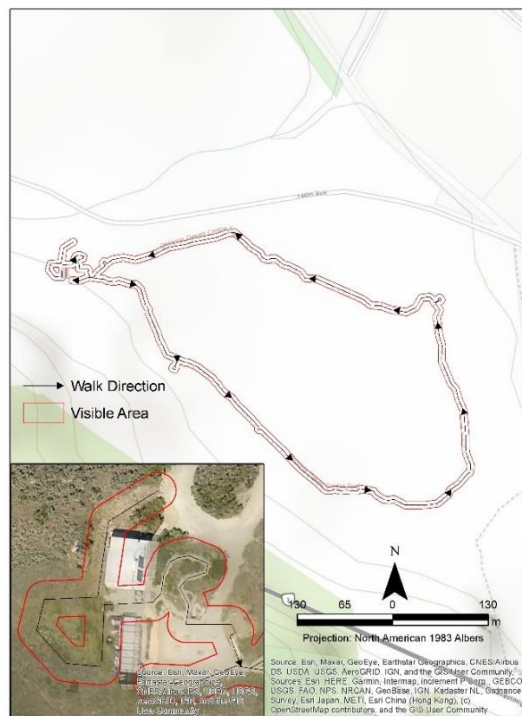


Fig 3. The direction of the Pollard walk, including the entire boardwalk, arrows indicate the direction of the walk. The 5-meter buffer represents the area that is part of the study. The mini-map represents the area within the reception area of the ODC, showing how it covers most of the area.

All surveys were done at a velocity of 3 Km/h, observing vegetation typically associated with Behr's Hairstreak and butterflies present in the area; however, no stops or slowing down was done, unless special conditions, to prevent biasing the number of observations. Special conditions refer to stops to

ensure the proper identification of the species, such as when using binoculars. Binoculars were used to distinguish individuals at the farthest region of the perimeter, and preferably while walking. If the observer had to stop, they would continue to walk, ignoring any new butterfly that arrived while stopping. Once a member of the genus has been spotted, it was recorded using the ‘Hairstreaking’ application.

Such vegetation to be specially noted include, but are not limited to: *R. glabra*, *Achillea spp*, Grey Horsebrush (*Tetradymia canescens*), Buckwheat (*Eriogonum spp.*), Creambrush Oceanspray (*Holodiscus discolor*), Tall Baby’s Breath (*Gypsophila paniculate*) and Sweet-Clover (*Melilotus spp.*) (Oren 2021).

P. tridentata was also observed as Hairstreaks use more extensive vegetation for resting and shelter from inclement conditions such as extreme hot temperatures (Southern Interior Invertebrates Recovery Team 2008). Considering *P. tridentata* is among the most extensive vegetation available and the lack of trees such as conifers within the observable area to offer to cover, *P. tridentata*’s study seems logical.

The distance covered during the survey was divided into 14 equidistant transects (124.36 m). Each transect’s dominant vegetal species were noted, along with any unique characteristic inside the said segment, to establish a connection between Hairstreaks and vegetation. Such unique characteristics are nectar plants, buildings, water sources, or invasive flowering species. For example, a transect presents *T. Canescens*, so this would be noted as this plant is a food source for Behr’s Hairstreak (Oren 2021).

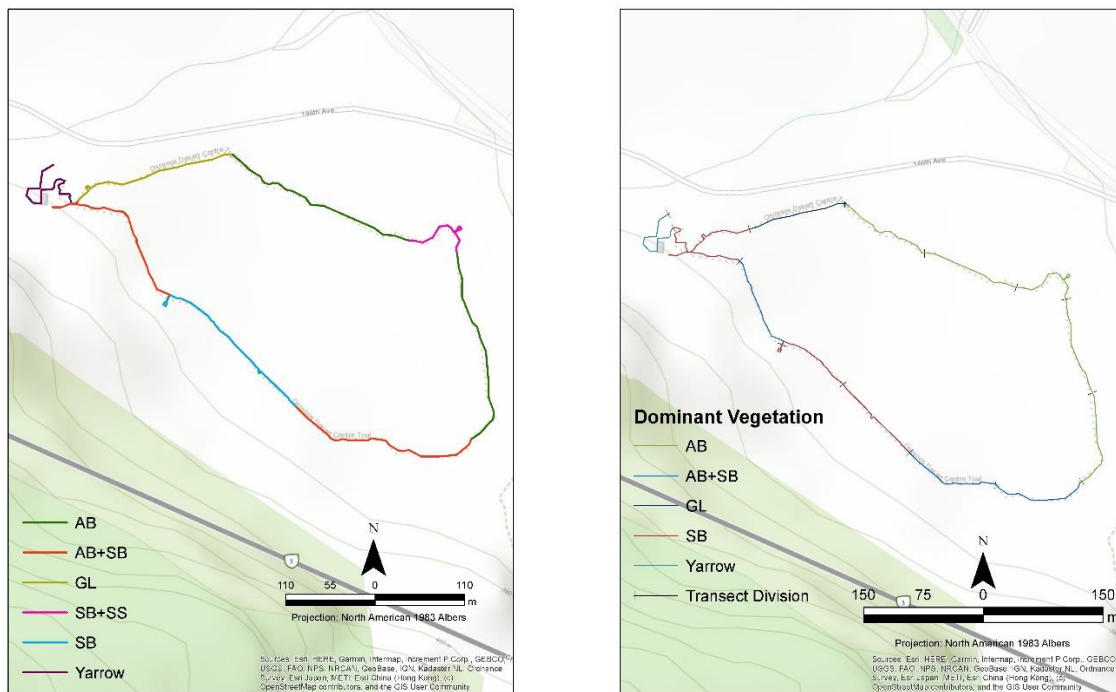


Fig 4. Maps of the general vegetation neighbouring the reception area and boardwalk within the Osoyoos Desert Centre. The map to the left shows the general vegetation despite the transect, while the one to the right represents the dominant vegetation.

Table 1: Unique characteristics within each transect of the walked path. All transects present *P. tridentata* and *A. tridentata* to some extent, so their presence is omitted.

Transect Number	Unique Characteristics
1	Trailers, water tanks, gardens
2	Gardens, Wavy leaf thistle (<i>Cirsium undulatum</i>)
3	<i>C. undulatum</i> , south pond, white clematis (<i>Clematis longifolia</i>)
4	Kiosk, yarrow, mint (<i>Mentha spp</i>), mustards
5	Mullein (<i>Verbascum thapsus</i>)
6	Mullein (<i>Verbascum thapsus</i>)
7	<i>T. canescens</i>
8	
9	
10	<i>R. glabra</i> , yarrow pocket
11	
12	Dalmatian toadflax, alfalfa
13	Dalmatian toadflax, alfalfa
14	North pond, Dalmatian toadflax, Yarrow, picnic area, mustards

All observations recorded through the mobile application during the Pollard walk were automatically saved to a databank created in 'Google Sheets.' This 'live' recording allows the observations to be automatically stored if something fails or simplifies its edition if some information is erroneous or miss recorded.

Incidental reports were also recorded through the application alongside the Pollard walk; thus, they were stored in the same databank. However, these Observations were catalogued as "incidental" to be distinguished. The addition of these incidental reports was done to understand the species, especially their population, better.

Regarding the weather conditions for surveys and incidental observations, any blank spot in the sheet was deliberately left empty, which means it shares the same conditions as the previous observation. When these blank cells were found, the information from the upper cells was dragged down until a cell with new information is found. If empty cells were found on the 'Species' section, it was assumed that it means either none or zero, depending on the information of the cell (If nominal or ordinal). In coordinates, empty cells mean there was no observation, as only observation should have coordinates. If no species were seen, but there is a coordinate, it was erased to prevent confusion during the data analysis.

Data available from previous years (2003, 2004) was also digitalized from the archives of the Desert Centre. Only the date, species and the number of individuals were digitalized from these records as some pages lacked information regarding time, location, coordinates, and vegetation. Resightings were also added as observations independent of how many times they were seen on the same day or following days; as per our procedure, we would not have a way to distinguish individuals, and resight would be counted as new individuals regardless.

All data recorded from the 2021 survey was mapped and analyzed through external software (ArcMap 10.8.1) to compare the coincidence of sightings depending on the dominant plant species at each segment, specific plants, climatic conditions and the date. All recorded data from previous years alongside 2021's surveys were analyzed using a Kruskal-Wallis Rank Sum Test in R (Ver. 4.0) to test the difference in the medians of the observations for the three years. The Kruskal-Wallis test was chosen as the data violates the equal variance assumption of an ANOVA test. A pairwise comparison was conducted using the

Wilcoxon rank-sum test with continuity correction to identify statistical differences between the studied years; this used a BH method of adjustment for the P-value.

Results.

2021 Survey:

No observations were recorded during the Pollard walks.

Three incidental reports occurred in June. Unfortunately, no accurate analysis can be done due to the small number of observations; thus, no association between weather conditions and *S. behrii* incidence can be established.

Table 2: Summary of observations for the sighting of *S. Behrii* during summer 2021 at the Osoyoos Desert Centre.

Date	T (°C)	Light (Lux)	Wind (Beaufort)	Obs.	Species	Location (UTM)	Transect Number	Quantity Observed	Vegetation
27-05-2021	16	36000	6	AM	None	-	-	0	-
04-06-2021	29	47400	3	AM	None	-	-	0	-
09-06-2021	21	40682	2	AM	None	-	-	0	-
09-06-2021	22	39812	4	INC	<i>S. behrii</i>	11 316336 5436084	7	1	<i>T. canescens</i>
11-06-2021	13	20547	3	AM	None	-	-	0	-
17-06-2021	21	35505	1	AM	None	-	-	0	-
22-06-2021	37	100000	0	INC	<i>S. behrii</i>	11 315883, 5436499	1	1	Yarrow
23-06-2021	31	100000	2	INC	<i>S. behrii</i>	11 316336 5436084	7	1	<i>T. canescens</i>
24-06-2021	29	18000	3	AM	None	-	-	0	-
01-07-2021	34	14500	1	AM	None	-	-	0	-
08-07-2021	23	20800	3	AM	None	-	-	0	-
15-07-2021	28	23887	4	AM	None	-	-	0	-
21-07-2021	23	27200	5	AM	None	-	-	0	-
28-07-2021	24	20500	3	AM	None	-	-	0	-

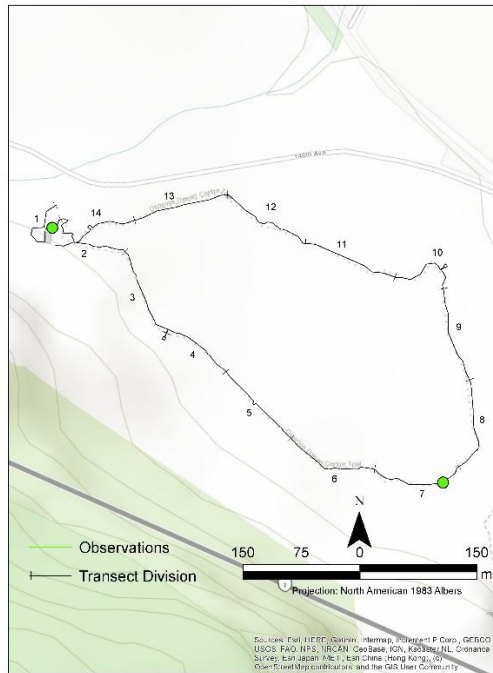


Fig 5. Ubication of the places where *S. behrii* was observed during the Pollard Walks. The green spots represent the diameter from the path's center with a +/- 5 meters error radius. Numbers along the boardwalk indicate the transect.

Based on the three observations, the following was found: All observed butterflies were on flowers. Two individuals were observed on *T. canescens*, and one individual was seen in yarrow, emphasizing the importance of these species for *S. behrii*.

Comparative Analysis to Previous Years:

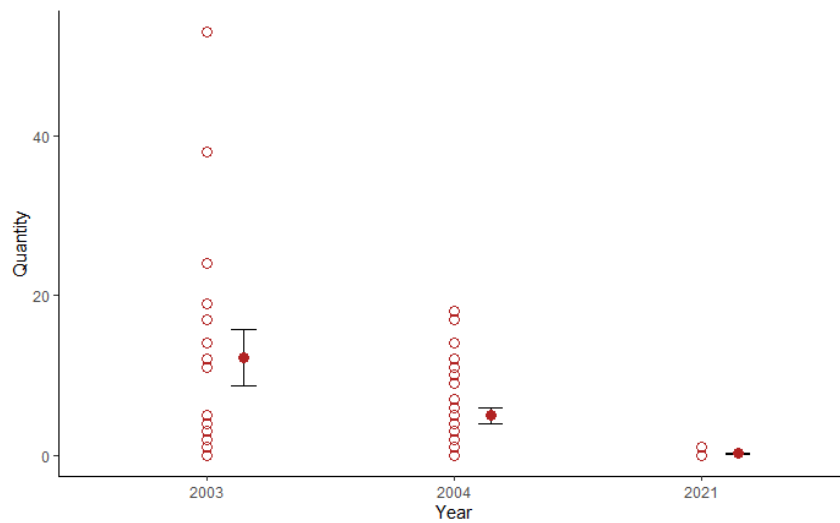


Fig 6. Strip chart of the daily number of sightings of *S. behrii* for the three years of interest. Solid circles denote group means, and bars +/- one S.E. Hollow circles represent the number of sightings per day and have been slightly displaced to ease observation.

In 2003, daily observations presented more individuals than any other year, with one day reaching 53 butterflies. In 2004 the maximum number of sighted butterflies totalled 18, and in 2021 it was 1 (Fig 6). There were 208 *S. behrii* recorded in 2003, 173 in 2004 and 3 in 2021.

Table 3: Summary statistics for the number of *S. behrii* sighted during the summer season based on the number of days the observations occurred in 2003, 2004 and 2021.

Date	Mean	Standard Deviation	Sample size (Days)
2003	12.235	14.7204	17
2004	4.943	5.5675	35
2021	0.214	0.4258	14

Table 4: Kruskal-Wallis rank-sum test results for the mean number of butterflies observed for 2003, 2004 and 2021.

	Quantity
Chi-square	19.483
Df	2
P Value	5.88e ⁻⁵

Table 5: Pairwise comparisons using Wilcoxon rank-sum test with continuity correction for 2003, 2004 and 2021. Values represent the P-Value for the comparison between years.

	2003	2004
2004	0.06036	-
2021	0.00014	0.00066

There is a statistically significant difference between the number of *S. behrii* observed for 2003, 2004 and 2021 (Table 4; Kruskal-Wallis rank-sum test; Chi-square = 19.484, df = 2; P < 0.05). However, the year that presented the greatest difference in variance is 2021 when compared to either 2003 or 2004. Between 2003 and 2004, no statistical difference of importance was detected; however, the P-value given by the Wilcoxon rank-sum test is somewhat close to the generalized alpha value of 0.05 (Table 5).

Discussion.

The results, although surprising, are not unexpected. The species' decline has been noted for few years, and several plans for its recovery were built (Southern Interior Invertebrates Recovery Team 2008, Environment Canada 2014); however, it is unknown if efforts have taken place and to what degree of success. Other surveys co-occurred while this procedure took place but as far as it is known, they were not more successful. The fact that all observations were incidental is interesting, but due to the low amount of Hairstreak observations, it is, at best, just a coincidence or mere chance.

Some loose things can be said based on the observations of *S. behrii*, but not with much confidence due to the small sample pool. First, all incidental observations occurred on flowers; this is important as it goes according to the stipulated methods and previous literature (St. Jhon and Desjardins 2003, Southern Interior Invertebrates Recovery Team 2008). Due to the nature of the observation being incidental, it is possible to assume that observer bias was not introduced as the observations were just

accidents and occurred randomly. Second, *S. behrii* presents strong heat tolerance, being active at high temperatures (Table 2), rejecting our previous belief. Thirdly, individuals seem more active during sunny days than on days with lower radiance (Table 2, 37°C). Finally, lower winds allowed the observation of more butterflies, which is expected as they would have to spend less energy moving and are more active on sunny days (Table 2); however, it is important to remember, there is no actual statistical evidence that corroborates these statements. Sadly, the information from previous years lacked many of these variables and were often not recorded.

Due to the distance between the three individuals seen during the 2021 survey, both temporally and geographically, it is possible to assume with some degree of confidence that there were at least two different members of the same species. Between the butterflies seen at the same place, there is a temporal difference of 17 days, and it could be possible that they are the same as it is estimated that the minimum lifespan of *S. behrii* is six days (Environment Canada 2014), but no reports indicating the maximum life span were found. However, when it comes to comparing the individuals observed in the yarrow and those in *T. canescens*, it is sure they are two separate individuals as *S. behrii* presents an average seasonal dispersal of 100m (Environment Canada 2014), and there is a distance of 580.81 meters between both places (Fig 5). Furthermore, even in the case of the butterfly moving the seasonal average each day, the individual in yarrow was observed just one day before the one in *T. canescens*, not giving enough time for the butterfly to cover such distance.

The species is exceptionally imperilled. From a total of 53 observations in 2003 in a single day, we now have three observations in the entire season (Table 2, Fig 6). The significant difference in the mean variation for the years further shows the decline the species has suffered (Table 4), and it was found that the significance is only present when comparing 2021 to either 2004 or 2005 (Table 5).

The species' decline could be explained through various reasons, being habitat loss probably the most notorious one (Tews et al. 2004, Leather 2017). The Osoyoos Desert Centre lies in a well-sized patch when compared to other patches of the antelope-brush ecosystem; however, it is still a patch that is somewhat isolated from the rest of the ecosystem; as a matter of fact, everything that remains of this ecosystem is through small patches especially on the western side of the Okanagan (Fig 1) (St. Jhon and Desjardins 2003). The closest patches to the ODC patch are 415 meters southeast, 1,400 meters north, and 169 meters northwest. There could be some exchange and migration between the west and ODC patch; however, it would be minimal considering the size of the west patch and the dependency on the proper flora to be present to allow such exchange. Populations located on eastern patches are considered too far to allow viable movement as those butterflies that embark on such a journey would face the lake, with no cover vegetation to rest and highway 97. The most viable exchange point between the west and east patches would be close to Vaseux Creek (St. Jhon and Desjardins 2003).

A series of ecological corridors should be implemented that connect the separated pockets of the ecosystem to allow a better possible exchange in genes and members of *S. behrii* to allow a healthier population where the species is still extant. Distances between patches are, sometimes, kilometres long (Fig 1), and due to the limited mobility of *S. behrii*, it would be impossible for them to move such distances within one generation, an effort that would be even more difficult if there is neither food nor refuge for them as they move between patches.

A corridor of antelope-brush ecosystem connects the ODC to southern communities, including the community 425 meters SE; however, this corridor runs through highway 3. Highways represent a threat to insect populations, especially pollinators (Baxter-gilbert et al. 2015). It was found that from a 2 Km stretch of highway 1 in Ontario, 117675 insects died, from which 4763 individuals were Lepidoptera.

This event occurred from May 1 to August 31, 2015 (Baxter-gilbert et al. 2015). Such highway is heavily transited, as is highway 3 being the connection between south-eastern British Columbia to the Vancouver area. Based on the effect of highways, one could imply that the corridor, being proximal to the highway, could represent more a threat to Behr's Hairstreak than it would prove advantageous.

Potential surrogate communities that house *P. tridentata* (Fig 1) could serve as corridors between actual antelope-brush ecosystems as they also house nectar plants such as yarrow. However, the study of *S. Behrii* populations in these communities has been insufficient, to say the least, as there is a strong bias towards the study of populations within antelope-brush ecosystems, especially antelope-brush needle and thread (Dyer 2021). Even if these surrogate communities serve as corridors, it is essential to note that these ecosystems on the west side of the Okanagan neighbour highway 97, a heavily transited highway as it connects the northern parts of the Okanagan with Osoyoos and the US border; bringing the possibility that it presents the same level of threat as highway 3. On the other side of these ecosystems, there are several farms, and if any of them use insecticides, it may be a reason for sub-lethal and lethal effects on the local insects, not only Behr's Hairstreak (Chensheng 2020)

Local habitat quality could be a reason for the low presence of *S. behrii* within the desert centre, considering how patchy plants use as food by the species are; however, Ulh et al. found that the quality of the ecosystem does not equal a relevant reason for the variation of a population of moths in patches (Ulh et al. 2020). Although the study does not relate to *S. behrii*, it explores the idea of insect populations, and it uses a lepidopteran as part of its study. Regardless, the study does state that plant diversity directly affects lepidopteran diversity. For this reason, it would be essential to try and expand species used as food sources by the local pollinators, especially when considering *S. behrii*. Yarrow is present in several transects of the boardwalk; however, it is in small, distant patches that could be too far a distance for a Hairstreak. Regardless, yarrow has a strong presence close to the trailers and gardens where it is planted, but it could not be enough to attract *S. behrii* from the opposite side of the centre, as the lack of its presence cannot form a corridor. *T. Canescens* is present only in two areas close to the boardwalk, and nowhere else within the explored area is seen again. Those two plants are neighbours less than two meters apart. Although local habitat quality causes slight variation (Ulh et al. 2020), it could be beneficial to increase plant diversity if any efforts on the reintroduction of *S. behrii* are to be made.

Touristic activities within the Osoyoos Desert Centre seem not probable to cause a low number of observations. Two of the incidental observations occurred during guided tours, and the other observation occurred beside the Interpretive Centre, an area with high traffic of people. The butterflies were also very calm while being observed and would fly away only when disturbed for a while; however, they would move to another area within the plant, not flying far away. Therefore, it is uncertain if humans movement or non-destructive activities would be enough to deter the species from approaching the boardwalk.

It could be possible that the data from 2004 is an underestimate as sightings may have begun before and continued after the dates recorded; sadly, no methods were found regarding this year. On the other hand, information could have been lost as the years progressed or confused. It seems all data for the year 2003 is complete (St. Jhon and Desjardins 2003); however, they admit that their calculation could underestimate the actual population. Furthermore, there seem to have several iterations of the same data as the observers tried to organize it. If such was the case, then *Satyrium behrii*'s condition is even more worrisome than expected, but this is only speculation.

Regardless, the reality is that the population of *S. behrii* has suffered a severe decline since 2004 and habitat loss is the prominent director (St. Jhon and Desjardins 2003, Leather 2017). Therefore, it could be probable that the species is extirpated from the study area, and those sighted are the last

remnants; however, this assumption will only be confirmed or prove wrong with further studies and other surveys. For this reason, it is highly recommended to continue surveying the area in the following years and, if possible, survey other areas north and south to have a more thorough understanding of the metapopulation of Behr's Hairstreak.

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Index I.

Scales:

Lux scale From the Lux Light Meter Free Application

Lux (Illuminance)	Surfaces illuminated by
5	Dark limit of civic twilight under a clear sky
35	Public areas with dark surroundings
50	Living room lights
80	Office building hallway/toilet lighting
100	Very dark overcast day
150	Train station platforms
300 – 500	Reading/Studying
400	Sunrise or sunset on a clear day
1000	Overcast day
1200	TV studio lighting
10000 – 25000	Full daylight
32000 – 100000	Direct sunlight

Beaufort Wind Scale:

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind

8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Index II

Hairstreak application manual:

Hairstreaking

Some indications on how to use it, it is many pages; but probably you will not even need from point 4 onwards:

The tool was made to make recording information somewhat simple and easy; however, this little document should help anyone get started.

DOWNLOADING IT:

1. The app opens through AppSheet, a tool by Google that helps to create apps. (Keep in mind, this app is not fully published, so the only way to spread it is by sharing it through e-mail)
 - a. Download AppSheet from your app store.



2. Once you have received the mail with the link, follow it, and the app will be downloaded.

Inbox Sharing the 'Hairstreaking' app with you - install 'Hairstreaking' on your mobile device, click on <https://www.appsheet.com/n...>

To install 'Hairstreaking' on your mobile device, click on <https://www.appsheet.com/newshortcut/4200bef0-0feb-4f1a-81c5-f000f8340d42>

(powered by AppSheet.com)

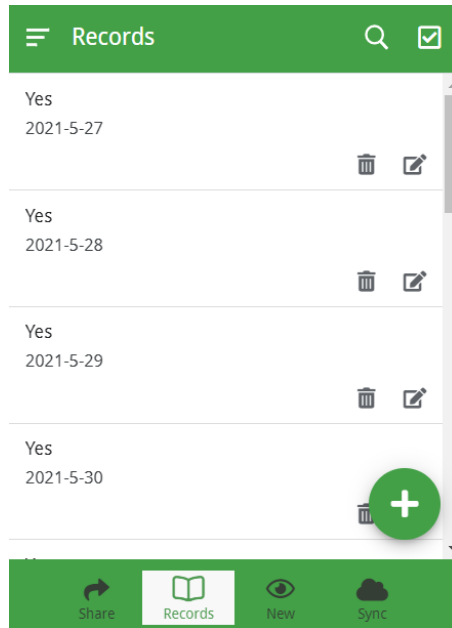
Sent from [Mail](#) for Windows 10

OPENING IT:

3. You can now open the app through either the AppSheet Icon or the new “Hairstreaking” Icon that should have appeared.
 - a. I recommend storing the butterfly icon on your home screen. I could not find it in my app menu.
4. This is the opening screen, and it will automatically sync any other sighting from your or any device (Please be responsible with the data you submit, the idea of this tool is to be able to conduct some studies or at least store the sightings)




5. This is the Home screen of the app. Here you can see:




- a. Top:
- i. Three lines: if you press it, you will see:
 1. The name and picture of the app.
 2. The assistant: If you want to go all techy and try the voice assistant. (Full disclosure, no idea if it works)
 3. About: It will tell you about the app and whats for, also that all information collected is Open Source (ALL DATA IS FREE TO USE FOR AND BY ANYBODY FOR ANY PURPOSE)
 4. Share: This is the button to press when you want to send the app to someone else. It will direct you to different media, but I recommend you do it through e-mail.



Hairstreaking

 Assistant

 About

 Share

- ii. Magnifying glass: You can search for stuff there.
 - iii. Select box: For when you have to erase more than one observation at a time.
- b. Centre:

- i. This is the screen of the app; you will see the records from previous observations there.
- c. Bottom:
 - i. Share: Same as above
 - ii. Records: The home screen.
 - 1. “Yes” or “No” indicate if the weather conditions have changed.
 - 2. The date, of course, indicates when the observation was done.
 - 3. The garbage can logo is to erase an observation, so be careful around it.
 - 4. The pen-on-paper logo serves to edit an observation.
 - 5. The GPS logo serves to see the map of the area where the butterfly was observed.
 - iii. New: New and the big plus in a circle are to make new observations, more on this latter.
 - iv. Sync: The button to actualize the data. After an observation, you should see a one above it for a few moments. (All data is supposed to be sent immediately to the sheet, so you need access to the internet)

MAKING NEW OBSERVATIONS:

(THE WEATHER AND CONDITIONS)

- 6. To make a new observation, press the eye or the big white and green plus. Once you have done this, you will be directed to a new screen.

← New

Date

2021-06-24

New Conditions

Yes No

Incidental Report

Yes No

Cancel Next

- Date: Should actualize automatically; it follows the YYYY-MM-DD pattern if you need to make changes.
- New conditions should be pressed every time. If you have more than one observation in one day and the weather does not change, you can skip everything further down but the incidental report question.
- Incidental report: Was the observation an accident? Not when you were conducting your methods? Are you not part of any study? Then you press “Yes”; if the observation was done while you proceeded with your study, then press “No.”

After filling the first part, as you scroll down, you will see:

Time

06:29:05 PM

Temperature (C)

Light Condition

- d. Time: It should also be automatic, but if you need to change it, press the clock symbol, and a menu will allow you to do it.
- e. Temperature: When pressed, a new window will open where you can select the temperature in centigrade. The range goes between 10 to 45 degrees. You will need a thermometer for this or the weather app on your phone.

Temperature (C)

Search

10

11

12

13

14

15

16

Done

- f. Light Condition: You will need a tool or app to measure the amount of light outside. I recommend using Lux scale, as that is the tool available for Android and Apple, and its how is recorded in the sheet. In the end, it is up to you if you want to make conversions.

Again, scroll down, and you will see:

Rain

Wind

Observer

Cancel **Next**

- g. Rain: It will give you a few options to choose the amount of rain falling. If it rains, it is going to be challenging to see any insect.

Rain

- None
- Drizzle
- Shower
- Rain
- Heavy rain
- Thunderstorm

Done

- h. Wind: Same as with rain, you will choose the option that best accommodates.

Wind

Search

- 0 (Calm)
- 1 (Light)
- 2 (Light breeze)
- 3 (Gentle breeze)
- 4 (Moderate)
- 5 (Fresh)
- 6 (Strong)

Done

- i. Observer: Who are you? You can use your initials or your name, up to you.
7. After filling in all the information, which takes less time than it seems, press “Next.”

(THE RECORDING OF SPECIES AND DATA)

Observation

Species

Location

Behr's Quantity

0

Prev Cancel Save

- a. **Species:** Here, you can select what species you have seen. You can select more than one or add species as needed. Once you have selected the species, just press done.

Species

Add or search

Behr's Hairstreak

California Hearstreak

Gray's Hairstreak

Coral Hairstreak

None

Select All Done

- b. **Location:** Very self-descriptive. If you need to change the GPS location in the app, press the curved arrow and give it a little bit of time to calibrate. This tool has an approximate error of around 5 meters.
- c. **Behr's Quantity:** You can either use the plus and minus sign to add them or write them.

California's Quantity

 - +

Gray's Quantity

 - +

Coral's Quantity

 - +

- d. This is the continuation of the quantities, just as with the previous field.
- e. Continue scrolling down, and you will find vegetation. In this field, you can pick in what species of plant was the butterfly found. Just as with the “Species” field, you can add more if needed.

Coral's Quantity

 - +

Other's Quantity

 - +

Vegetation

 +

Prev Cancel Save

- f. After all that, you press “Save,” and all the information should be recorded in the sheet document.

THE SHEET DOCUMENT:

This Google Sheets doc is linked directly to the application, and it will actualize its information every time there is a change through the app. That is why your device should be connected to the internet; so the information can be uploaded as soon as possible.

You might have to do a little work on this document. If you choose “No” and skipped recording new conditions, you will have to drag the information to fill any empty cell. Maybe you will need to fill empty cells with zeros or stuff like that.

This document can only be shared by e-mail, but anyone with access can enter and edit the information or use it for any purpose. Please, be responsible.