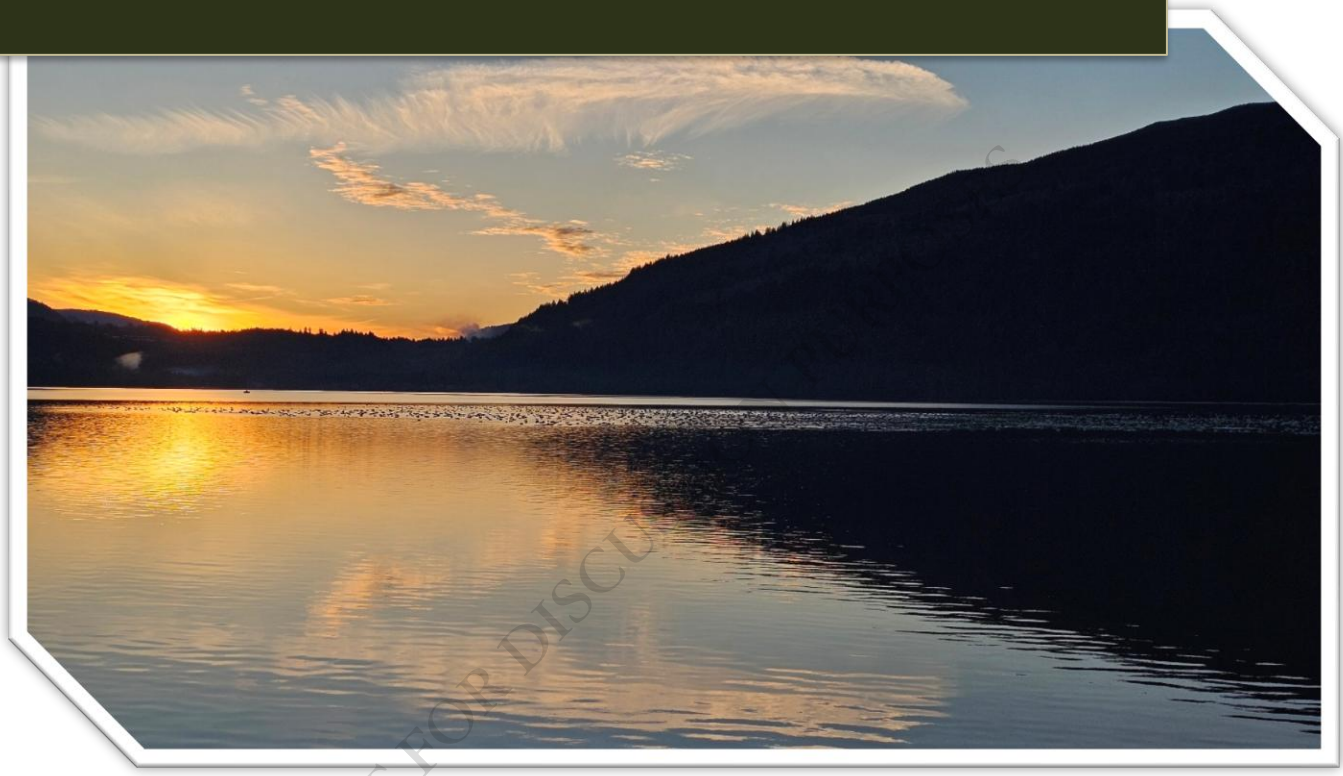
# CULTUS LAKE GULL ROOSTS

## A Review of Night Roost Use by Glaucous-winged Gulls on Cultus Lake in Winter 2025-2026



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Prepared for

Cultus Lake Aquatic Stewardship Society

June 16, 2026

TerraFauna

*Bridging Wild and Cultivated Systems through Science and Stewardship*

# EXECUTIVE SUMMARY

TerraFauna Consulting was retained by the Cultus Lake Aquatic Stewardship Society (CLASS) to conduct winter gull surveys at Cultus Lake, British Columbia during the 2025/26 overwintering season. The primary objective was to update population estimates for roosting Glaucous-winged Gulls (*Larus glaucescens*) approximately ten years following the baseline surveys conducted by Selbie (unpublished, Fisheries and Oceans Canada) and reported in Putt (2014) and Putt et al. (2019). Supplementary drone imagery was collected and analysed using computational image analysis methods, providing an independent count for comparison against manual passage counts over pre-determined ground-based observation points.

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## KEY FINDINGS

- **Survey events: 5 counts (November 2025 – February 2026).**
- **Peak roost counts of 9,700–10,790 birds, as compared to baseline of Putt et al (2014) of 9,500–12,500 birds. Population broadly consistent over the past decade.**
- **Regional CBC trend: Chilliwack and Harrison River CBC circles showed a flat trend from 2012–2020; Audubon CBC trend data indicate a -2.8%/yr decline in the northern Pacific Rainforest region from 2013–2023, against which the Cultus Lake roost counts appear broadly stable.**
- **Bald Eagle (*Haliaeetus leucocephalus*) harassment through late winter caused the roosting flock to abandon Cultus Lake; counts had declined to 745 birds by February 15, 2026**
- **Drone image analysis helped validate manual counts and align with observer estimates**
- **Nutrient loading is likely similar to baseline estimates at peak season; shortened occupation period likely reduces total seasonal guano-derived phosphorus loading relative to prior modelled values**

Peak roosting counts of 9,700–10,790 birds recorded during November 2025 through January 2026 are broadly consistent with the 9,500–12,500 bird baseline established a decade earlier. The roosting population at Cultus Lake does not appear to have changed substantially over the intervening period, a finding reinforced by analysis of Glaucous-winged Gull count data from the Chilliwack and Harrison River Christmas Bird Count (CBC) data for 2012–2020, which showed an effectively flat combined trend. This local stability is notable in the context of a documented -2.8%/yr population decline in the broader northern Pacific Rainforest region over 2013–2023 (National Audubon Society 2026), suggesting the Cultus Lake roost may be more resilient than regional trends alone would predict, potentially reflecting the continued availability of rich foraging resources in the Fraser Valley. Some methodological caution is warranted given that the 2025/26 surveys were conducted from Jade Bay rather than the waterslide tower vantage point used in the baseline, which may introduce a modest undercount bias.

A notable finding of the 2025/26 surveys was the slow abandonment of the Cultus Lake roost between late January and mid-February 2026, coinciding with sustained harassment of the roosting raft by at least two pairs of resident Bald Eagles (*Haliaeetus leucocephalus*). Counts had fallen to 745 birds by February 15, after which incidental observations confirmed the flock did not return in meaningful numbers. This pattern is consistent with eagle-gull disturbance dynamics documented in the Salish Sea region by Henson et al. (2019). The early roost abandonment likely reduced the total seasonal guano-derived phosphorus load below prior modelled estimates, though detailed recalculation is outside the scope of this report.

Drone imagery collected on December 31, 2025 provided a useful supplementary dataset. Computational image analysis of the highest-quality nadir images detected approximately 4,400 birds per frame, consistent with representing approximately 45% of the manually-counted total of 9,700 birds on that date. The exercise also demonstrated that a significant proportion of the roost consisted of grey-plumaged immature birds that are substantially undercounted by conventional brightness-threshold detection methods, with implications for future drone-based survey protocols.

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## ACKNOWLEDGEMENTS

We would like to acknowledge and thank CLASS for their continued interest and support of stewarding Cultus Lake and its associated watersheds.

## AUTHORSHIP

TerraFauna Team members who contributed to this report include:

Myles Lamont, RPBio, PAg, CWB, CE .....Primary Author

Professional Signoff: _____

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# 1 INTRODUCTION

Cultus Lake is a peri-urban, oligo-mesotrophic lake located approximately 80 km east of Vancouver, BC, within the Cascade Mountains adjacent to the Fraser Valley. The lake and its 69 km² transboundary watershed support critical habitat for two federally listed species at risk; the endangered Cultus Lake sockeye salmon (*Oncorhynchus nerka*) and the threatened Coastrange Sculpin (*Cottus aleuticus*, Cultus population) both found in the lake. The area also receives 2 to 3 million visitors annually.

A comprehensive study of watershed nutrient loading conducted over 2011–2013 identified migratory Glaucous-winged Gull guano as a significant seasonal source of phosphorus (P) to Cultus Lake, contributing an estimated 22% of the total annual P load during that period (Putt et al. 2019). Gulls follow a consistent diurnal pattern: departing the lake each morning to forage at agricultural fields, waste disposal sites, and waterbodies in the Fraser and Chilliwack River Valleys, then returning at dusk to raft and roost on the lake overnight, depositing guano directly onto the lake surface. The population estimate underpinning the baseline nutrient budget ranged from 9,500 to 12,500 birds (mean 11,000; Selbie, unpublished; Putt 2014).

Approximately ten years have elapsed since the baseline surveys. Changes to the regional landscape, including modifications to the Bailey Sanitary Landfill in Chilliwack, continued agricultural expansion in the Fraser Valley, and potential shifts in regional gull population dynamics, may have altered the size of the winter roosting population at Cultus Lake. An updated population estimate was identified as a priority by CLASS to determine whether baseline conditions have changed, and to support ongoing monitoring of lake health and nutrient dynamics. This work also contributes to the CLASS Phase II Economic Valuation Study.text here

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## 1.1 Project Area

Cultus Lake is situated at the southwestern edge of the Cascade Mountains in the Fraser Valley of British Columbia, approximately 80 km east of Vancouver and 10 km south of Chilliwack (Figure 1). The lake lies within one of the most agriculturally productive regions in Canada, with the Fraser Valley's mix of dairy operations, poultry farms, berry fields, and managed pasture extending northward from the lake toward the Chilliwack River valley and the broader Lower Mainland. The region is also home to the Bailey Sanitary Landfill and other waste handling facilities that provide year-round food resources for large gulls. This combination of agricultural abundance and waste disposal infrastructure makes the Fraser Valley an exceptionally productive winter foraging landscape for Glaucous-winged Gulls, which breed primarily along the Pacific Coast from Washington State north through Alaska and disperse inland to winter

roost sites throughout the region. Cultus Lake, positioned at the mouth of the Columbia Valley and naturally enclosed by Vedder Mountain and International Ridge, provides an accessible and sheltered overnight roosting site for birds that spend their days foraging up to tens of kilometres away in the valley. The lake therefore functions as a key wintering point within a broader regional movement system, connecting a large coastal and inland gull population to the agricultural and waste resources of the eastern Fraser Valley.

## 1.2 Objectives

The objectives of the 2025/26 gull surveys are:

- Update the roosting gull population estimate at Cultus Lake approximately ten years following the 2012–2014 baseline surveys, using comparable visual passage count methods.
- Collect supplementary drone imagery and assess the utility of computational image analysis as a complementary counting tool for future survey efforts.
- Provide high-level commentary on implications for guano-derived nutrient loading to Cultus Lake relative to prior modelled estimates.

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# 2 SITE CONTEXT

Cultus Lake is a warm monomictic lake bounded by Vedder Mountain to the west and International Ridge to the east, with the Columbia Valley to the south and the community of Cultus Lake at the northern end. The basin is steep-sided with limited littoral area and hosts approximately 1,000 permanent residents. The lake is currently classified as oligo-mesotrophic and has been documented to be eutrophying from its natural oligotrophic state as a result of multiple anthropogenic nutrient sources, as well as natural sources such as gull guano (Putt et al. 2019).

## 2.1 Gull Roosting Behaviour and Flight Corridor

Glaucous-winged Gulls have used Cultus Lake as a winter roosting site for several decades, with populations documented in the area since at least the late 1970s through National Audubon Society Christmas Bird Count data. The birds follow a consistent diurnal pattern, returning each evening from foraging areas in the Fraser and Chilliwack River Valleys through the natural corridor formed by the gap between Vedder Mountain and International Ridge at the northern end of the lake. This geographic constriction concentrates returning birds and provides an

effective counting station for visual passage surveys. No observations of birds coming from the south end of the lake have ever been observed, nor access up and over Vedder Mountain.

## 2.2 Survey Location

The baseline surveys 2012-2014 were conducted from an elevated vantage point at the top of the waterslide facility at the southern margin of the waterslide park, overlooking the Vedder Mountain–International Ridge corridor. Access to this vantage point was not granted during the 2025/26 surveys despite repeated requests from CLASS and DFO. Counts were instead conducted from ground based locations that provided good visual opportunity- primarily Jade Bay on the eastern shore of the lake. This location provided a clear sightline to the main gull flight corridor and allowed observers to track birds flying south to roost on the lake with a >180° vantage of the lake. The dark and higher contrast backdrop of Vedder Mountain also allowed birds to be more easily detected than looking at a white and often cloudy or foggy sky during winter months. The change in survey location is noted as a source of potential methodological difference relative to the baseline and is discussed further in Section 5.

# 3 METHODS

Five survey events were conducted between November 2025 and February 2026, distributed across the overwintering period to capture seasonal variation in roosting numbers (Table 1). Counts commenced at the onset of dusk, with most arrivals beginning around 60min before dusk and continuing past sunset. The majority of the flock arrived evening gull passage (approximately 15:00–16:30, varying with sunset time through the season) and continued until passage had substantially ceased for the evening or visibility was compromised and birds could no longer be reasonably detected. The overwintering season was assumed to span approximately October through March, consistent with the baseline study period and eBird migratory data, however our efforts were focused on the peak winter months of December – February.

**Table 1- Summary of Survey Dates, Locations and Conditions**

| Survey Event | Date | Survey Time | Observers | Survey Location | Conditions |
|---|---|---|---|---|---|
| **A** | 30-Nov-2025 | 15:40-16:47 | ML, EB | Maple Bay Beach | 4C, 7km/hr wind, broken skies, no rain |
| **B** | 31-Dec-2025 | 16:05-17:00 | ML, EB | Jade Bay | 4C, clear skies, low wind |

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| | | | | | |
|---|---|---|---|---|---|
| **C** | 07-Jan-2026 | 16:30-17:10 | ML, GF | Jade Bay | 5C, overcast, low wind |
| **D** | 23-Jan-2026 | 16:50-17:00 | ML, EB | Jade Bay | 5C, sunny, no cloud, wind 15km/hr |
| **E** | 15-Feb-2026 | 16:45-17:45 | ML, EB | Jade Bay | 4C, overcast, partial cloud, no wind/fog |

## 3.1 Vantage Point Count Methodology

At each survey event, gulls passing south through the Vedder Mountain–International Ridge corridor during the evening return flight were tallied continuously using a hand counter in groups of 10, primarily from Jade Bay observation point. When two observers were counting, estimates were averaged; M. Lamont was the primary observer on all survey. Any birds already rafting on the lake upon observer arrival were estimated using fixed-width strips (1m) and added to the passage count total to produce a survey-event population estimate.

Roosting numbers appeared to be fairly stable through the 2025/2026 season, until tapering off in February and March as the roost was slowly abandoned. The gull raft regularly divided into two to three groups distributed across different areas of the lake- often mid survey. As rafts became large, some birds would split off into other parts of the lake and begin another raft location. Occasional eagle forays would also result in rafts lifting off the water and re-settling- further complicating estimates. These additional complications introduce some uncertainties into totals for the higher-count survey events, as simultaneous observation of all groups from a single vantage point was not always possible. This limitation is acknowledged in the results.

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## 3.2 Drone Imagery and Computational Bird Counting

Supplementary aerial drone imagery was collected on December 31, 2025 using a DJI Mavic Mini3 drone at an altitude of 120m above the lake surface in order to capture the greatest portion of the flock while still maintaining visual of individual gulls. Images taken after dusk or from oblique angles with significant sun glare or variable water-surface contrast were assessed as unsuitable for reliable quantitative counting. Two nadir (straight-down) images were selected for computational analysis.

Bird counts were derived using computational image analysis (Python; OpenCV 4.x). Two detection approaches were compared: brightness threshold detection applied a fixed greyscale threshold to identify pixels significantly brighter than the dark water surface, followed by connected-component analysis to enumerate discrete bird-sized blobs (area 4–600 pixels;

aspect ratio <8:1). This approach reliably detects white-plumaged adult gulls but under-detects immature birds of mottled grey-brown plumage which more easily blend into the background of the dark lake.

Local deviation detection estimated a local background brightness for each pixel as the mean brightness within a 41×41 pixel neighbourhood, then identified pixels exceeding that local background by more than 18 brightness units as candidate bird detections, with the same blob-filtering criteria applied. This approach captures both white adults and grey immature birds that are brighter than their immediate surroundings. Count stability was confirmed across neighbourhood sizes of 25–61 pixels and brightness cutoffs of 18–25 units (counts varied <3%). Detections were visually validated by the field observer; no obvious false positives from water surface texture were apparent at the detection settings used.

Results from the December 31 drone imagery are compared directly to the manual passage count total from the same date in Section 4.4.

It is worth noting that in order to capture the majority of the roosting flock, drone images need to be taken towards the end of the evening when light conditions become increasingly challenging. As light levels drop, noise distortion begins to cause blur, making image analysis difficult during low light hour of the winter months.

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# 4 RESULTS

Results from the four survey events are summarised in Table 2. Peak roosting counts of 9,700–10,790 birds were recorded across the November 2025 through January 2026 surveys.

**Table 2- Mean Estimates of Roost Counts During Winter 2025-2026**

| Date | Mean Estimate |
|---|---|
| 30-Nov-2025 | 10,640 |
| 31-Dec-2025 | 9,700 |
| 07-Jan-2026 | 10,790 |
| 23-Jan-2026 | 2,320 |
| 15-Feb-2026 | 743 |

On December 31, approximately 3,000 birds were already rafting on the lake upon observer arrival. A further 6,700 birds were counted during the evening passage flight, yielding a total estimate of 9,700 birds. On December 31, January 7 and January 23, the roosting flock regularly divided into two to three groups positioned in different areas of the lake, which complicated simultaneous observation from the Jade Bay vantage point and introduces some counting error into these totals. Despite this, the consistency of estimates across the three peak-season surveys (9,700–10,790 birds) provides confidence in the order-of-magnitude estimate.

The February 15 survey recorded only 745 birds (observer 1: 740; observer 2: 750), a substantial reduction from peak counts. A full flock account occurred and arrived slowly, and in smaller numbers allowing for a strong estimate. Towards the end of the survey, a predation foray was attempted by one of the resident pairs of eagles which resulted in the entire flock lifting off the water and flying north. Only a few birds remained after this event. Incidental observations subsequent to February 15 indicated that the roosting population did not return to Cultus Lake in meaningful numbers during the remainder of the 2025/26 overwintering season (pers. comm. C. Tower, March 2026).

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## 4.1 Comparison with Baseline

The 2025/26 peak roosting counts of 9,700–10,790 birds are broadly consistent with the 9,500–12,500 bird baseline established by Selbie (unpublished) and reported in Putt (2014) from surveys conducted in 2012–2014. For this season, there appears to be no substantial change in the peak roosting population at Cultus Lake over the intervening decade.

While the population estimates are similar in range, it is noted that the survey methodology differed between periods. The baseline surveys were conducted from the top of the waterslide facility, a higher and more commanding vantage point, while the 2025/26 surveys were conducted from Jade Bay. The impact of this change on count completeness is not quantified but is considered a source of potential additional uncertainty.

## 4.2 Drone Imagery: Comparison with Manual Count

Drone imagery collected on December 31, 2025 provides a direct comparison with the manual count total of 9,700 birds recorded on the same date. Results from the two nadir images suitable for computational analysis are presented in Table 3.

**Table 3- Comparison of Drone Count 31 December 2025, Cultus Lake.**

| Image | View | Method | Birds Detected | As % of Manual Count | Notes |
|---|---|---|---|---|---|
| DJI_0456 | Nadir | Brightness threshold (adults) | ~4,018 | ~40% | Partial roost; best contrast image |
| DJI_0456 | Nadir | Local deviation (all ages) | ~4,400 | ~45% | Includes grey immature birds; field-validated |
| DJI_0449 | Nadir | Brightness threshold (adults) | ~2,000 | ~20% | Partial roost; different perspective area |
| DJI_0449 | Nadir | Local deviation (all ages) | ~6,000 | ~60% | Includes grey immature birds; field-validated |

DJI_0456 was identified as the highest-quality image in the dataset, with good contrast between white-plumaged birds and the dark water surface, a straight-down nadir viewing angle, and minimal image artefacts. The local deviation method, applied to detect both white adult and grey immature birds, yielded a count of approximately 4,400 birds, representing approximately 45% of the manual total. Field observation confirmed that the imaged portion of the lake captured approximately 40–45% of the total roosting flock at the time the image was taken, with the remainder of the birds distributed across other areas of the lake surface not captured in the frame.

DJI_0449 was taken minutes later from a different angle and captured a larger but partially overlapping portion of the lake. The local deviation method detected approximately 6,000 birds in this image, representing approximately 60% of the manual total. The higher proportion of immature birds detected in DJI_0449 (approximately 73% of detections, versus 19% in DJI_0456) likely reflects differences in lighting effects and possibly the composition of the portion of the flock captured in each frame, as immature and adult birds may raft in distinct aggregations, however we suspect low lighting effects is the primary mechanism for this variation.

Taken together, the drone imagery analysis is broadly consistent with and corroborates the manual count total. The exercise demonstrates that nadir drone imagery with computational analysis can serve as a reliable supplementary counting tool for this site. Refinements to image protocol, particularly systematic nadir coverage at a consistent altitude to capture the full roost extent, would substantially improve the method's ability to generate a standalone whole-roost count independent of manual passage surveys.

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## 4.3 Roost Abandonment

Bald Eagle activity at the Cultus Lake roost was first noted in November 2025, with feather piles observed along the beaches of Maple Bay consistent with plucking locations indicative of successful predation events. At least two pairs of resident Bald Eagles were observed making repeated foraging forays at the roosting raft across multiple survey sessions through the winter, with a confirmed successful predation on December 31, 2025. Eagle activity appeared to increase in frequency and intensity through January and into February 2026, coinciding with a progressive decline in roosting numbers. By the February 15 survey, only approximately 745 birds remained on the lake. During that survey a predation attempt flushed the entire remaining flock from the water, after which birds did not return to the roost site in meaningful numbers. Incidental observations from lake residents confirmed the roost continued to decline through the remainder of the 2026 winter season (pers. comm. C. Tower, March 2026). The current roost location of the displaced population is unknown. Eagle predation on Glaucous-winged Gulls at Cultus Lake is not without precedent; feather evidence consistent with eagle kills was also observed during the winter of 2021/2022 (M. Lamont, pers. obs.). The timing of the 2025/26 roost abandonment, approximately six weeks earlier than the mid-March end date assumed in the baseline nutrient loading model, has implications for estimates of total seasonal guano deposition, as discussed in Section 5.

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# 5 DISCUSSION

## 5.1 Population Stability Over the Decade

Peak roosting counts of 9,700–10,790 birds recorded during the November 2025 through January 2026 surveys are broadly consistent with the 9,500–12,500 bird baseline established by Selbie (unpublished) and reported in Putt (2014) from surveys conducted in 2012–2014. There is no evidence of a substantial change in the peak roosting population at Cultus Lake over the intervening decade, with the 2025/26 mean of approximately 10,377 birds falling within the baseline range.

To provide broader regional context for population trends, Glaucous-winged Gull count data from the Chilliwack and Harrison River Christmas Bird Count (CBC) circles were compiled for the period 2012–2020. The Chilliwack CBC circle encompasses Cultus Lake and the surrounding Vedder Mountain–International Ridge corridor, making it the most directly relevant regional dataset available. Combined counts across both survey areas ranged from 4,358 birds (2014) to 8,751 birds (2019), with a mean of approximately 6,150 birds and a very modest positive trend of approximately +60 birds per year over the period- effectively flat. The year 2019

recorded the highest combined count in the dataset (8,751), with the Chilliwack circle alone recording 8,082 birds, suggesting elevated regional gull activity in that year for reasons we have not attempted to speculate.

It is important to note that CBC counts and evening roost passage counts measure different aspects of gull presence and are not directly comparable. The CBC is conducted during daylight hours when the majority of the roosting flock is absent from the Cultus Lake watershed, foraging at agricultural fields, waste disposal sites, and waterbodies in the Fraser and Chilliwack River Valleys. The evening passage counts, by contrast, tally birds returning to roost at dusk and reflect the size of the roosting population within a regional context near Cultus Lake specifically. The consistently higher roost counts relative to CBC totals in overlapping years (e.g., 2012: roost count 9,453 vs. CBC combined 7,640; 2013: roost count 9,632 vs. CBC combined 5,942) are therefore expected. The two datasets are complementary with CBC data providing a relative indicator of regional population trends, while roost counts provide an estimate of the size of the population specifically using Cultus Lake as a roosting site.

Taken together, both the roost survey data and the CBC trend data support the conclusion that the regional Glaucous-winged Gull population using the Chilliwack area in winter has remained broadly stable over the 2012–2020 period, with the 2025/26 Cultus Lake roost counts consistent with this picture. CBC data for 2021–2025 were not available at the time of reporting but would be valuable to examine to determine whether this stability has continued through to the present. The Audubon's website provides interactive data interpretation from 2013-2023, which show an overall population decline of 2.8% per annum during this ten year period for the northern Pacific Rainforest region population.

Some methodological caution is warranted when directly comparing 2025/26 counts with the baseline. The original surveys were conducted from the elevated waterslide tower vantage point, which provided superior sightlines through the narrow Vedder Mountain–International Ridge corridor. The 2025/26 surveys from Jade Bay, while providing a good general view, may have missed some portion of the passage flight, particularly when the flock was large and distributed across multiple groups simultaneously. It is therefore possible that the 2025/26 counts are modest underestimates relative to the true peak, and that the true population could be slightly above the surveyed range. Our data also represent a single year of collection in the last decade and any inferences should consider this point.

## 5.2 Implications for Guano-Derived Nutrient Loading

The 2025/26 population estimates are broadly similar to the baseline values used to model guano-derived nutrient loading in Putt et al. (2019), suggesting that the peak-season component of the guano loading estimate has not changed substantially. However, the early

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abandonment of the Cultus Lake roost in late January 2026 (approximately six weeks prior to the mid-March end date assumed in the baseline nutrient loading model) represents a meaningful reduction in the total duration of occupation. The baseline model assumed a 181-day occupation period (October 15 to April 15) with an 8-hour overnight roosting window. If the 2025/26 occupation ended in early February rather than mid-March, the effective occupation period may have been approximately 30–35% shorter than assumed, with a proportional reduction in total seasonal guano deposition. Whether this abbreviated season was a one-off event associated with the resident eagle pairs or reflects a broader trend is unknown, but it highlights the value of monitoring occupation duration alongside population size.

A more comprehensive reassessment of guano-derived nutrient loading would require multi-year survey data to establish whether the 2025/26 season was representative, together with updated estimates of occupation start date and daily roosting duration. The present survey was scoped specifically to update the peak population estimate rather than to revise the nutrient budget, and detailed nutrient loading calculations are outside the scope of this report. However, the qualitative indication from this survey is that guano loading at Cultus Lake is likely in a similar range to baseline estimates at peak season, with the possibility of reduced total seasonal loading in years where eagle harassment shortens the occupation period.

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## 5.3 Eagle-Mediated Roost Abandonment

The documentation of Bald Eagle harassment leading to complete roost abandonment is an ecologically interesting finding- arguably of equal value to the roost counts themselves. Bald Eagles are known to associate with large waterbird roosts as foraging opportunities, and Glaucous-winged Gulls are a documented prey item. The presence of resident nesting pairs at or near Cultus Lake may have been a recurring influence on gull roosting behaviour in prior years, but this has not been systematically documented.

The behaviour observed is consistent with documented disturbance effects of Bald Eagles on Glaucous-winged Gull populations in the broader Salish Sea region. Henson et al. (2019) demonstrated that increasing Bald Eagle activity at a large Glaucous-winged Gull colony on Protection Island, Washington, was the primary driver of significant population-level declines in that colony from the 1990s onward, with a predator–prey model, predicting either stable coexistence or, in approximately 11% of modelled scenarios, local gull colony extinction. While the Cultus Lake observation involves a winter roosting aggregation rather than a breeding colony, the sustained harassment leading to site abandonment is consistent with the eagle-gull disturbance dynamics documented by Henson et al. (2019) in the same geographic region and involving the same species pairing.

If sustained harassment by eagles regularly abbreviates the overwinter occupation of Cultus Lake, this represents a natural, non-lethal mechanism limiting guano-derived nutrient loading that has not previously been accounted for in nutrient budgets for the lake. Future surveys should consider documenting eagle presence and behaviour alongside gull counts.

## 5.4 Drone Imagery — Assessment and Recommendations

The December 31, 2025 drone imagery exercise demonstrated that nadir drone imagery with computational analysis can reliably corroborate manual passage counts and detect individual birds across both adult and immature age classes. The local deviation detection method, which identifies birds as locally bright relative to their immediate water-surface background rather than using a fixed absolute brightness threshold, substantially improved count completeness by capturing grey-plumaged immature gulls that would be missed by simple brightness thresholding.

The primary limitation of the current dataset was the absence of a single image capturing the full roost extent, requiring comparison at the partial-count level. Future drone surveys should implement a systematic nadir grid or transect protocol at a consistent altitude, with sufficient frame overlap to allow tiling of adjacent images into a whole-roost mosaic count. Flat or overcast light conditions, a calm water surface, and timing during the period of active bird arrival (before full darkness) would optimise image quality for computational analysis. With these refinements, drone imagery could potentially provide a full roost count independent of passage counts and with reduced sensitivity to the observer-location limitations encountered in the 2025/26 surveys

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# 6 CONCLUSIONS & RECOMMENDATIONS

## 6.1 Key Conclusions

The 2025/26 winter gull surveys at Cultus Lake, conducted by TerraFauna on behalf of CLASS, provide the first updated population estimate for overwintering Glaucous-winged Gulls at this site in approximately ten years. The surveys also generated new observations regarding roost dynamics, eagle-mediated disturbance, and the utility of drone-based counting methods that have value beyond the core population update objective. Key conclusions and recommendations are presented below.

- Peak roosting counts of 9,700–10,790 birds during November 2025 – January 2026 are broadly consistent with the 9,500–12,500 bird baseline from Putt (2014), suggesting the peak roosting population has remained relatively stable over the past decade.
- The roosting population abandoned Cultus Lake in late January to early February 2026 following sustained harassment by a resident Bald Eagle pair, approximately six weeks earlier than the mid-March end date assumed in baseline nutrient loading models. This likely reduced the total seasonal guano-derived phosphorus load below prior modelled estimates.
- Drone imagery collected December 31, 2025 corroborated the manual count: computational analysis of the best nadir image (DJI_0456) detected approximately 4,400 birds (~45% of the manual total of 9,700), consistent with the portion of the lake captured in the frame.
- A meaningful proportion of the roosting flock consisted of immature (grey-plumaged) birds, which would be significantly undercounted by brightness-threshold methods or unaided visual observation in low-light conditions.

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## 6.2 Future Survey Recommendations

The following recommendations are made for future gull monitoring at Cultus Lake:

*Survey methodology*

Sustained effort should be made to regain access to the waterslide tower vantage point for future surveys. This location provides the optimal sightline through the primary gull flight corridor and was used for the baseline surveys; without it, direct methodological comparability with the 2012–2014 data cannot be assured. CLASS is encouraged to engage directly with the waterslide facility operators to establish a formal access arrangement for future winter survey periods. Failing access, we suggest Jade Bay is likely a reasonable survey location for repeated surveys given the wide viewing angle and dark backdrop of Vedder Mountain.

*Survey frequency and timing*

Surveys should be repeated on a 2-3 cycle to track population trends over time. Within each survey season, a minimum of four counts distributed across the October–March overwintering period is recommended, with at least one count in each of early winter (October–November), mid-winter (December–January), and late winter (February–March) to capture the full seasonal profile including arrival, peak, and departure or any roost abandonment events.

### *Eagle monitoring*

Bald Eagle presence and behaviour should be recorded systematically alongside gull counts in future surveys, including the number of individuals present, hunting behaviour observed, and any flush events recorded. This would allow a more rigorous assessment of whether eagle-mediated disturbance is a consistent feature of the Cultus Lake roost and its effect on occupation duration. The identification of nest locations would help with confirming overall predation pressures along the lake.

### *Roost tracking*

Determining where the displaced gull population relocates following roost abandonment at Cultus Lake would meaningfully improve understanding of regional gull movement ecology and nutrient cycling. Even informal observations from neighbouring water bodies (ie: Harrison Lake, Nicomen Slough, Vedder Canal, etc) would help establish whether displacement is local or regional in scale.

### *Drone protocol*

Future drone surveys should implement a pre-planned nadir grid protocol at a consistent altitude sufficient to resolve individual birds, with overlapping frames designed to tile into a whole-roost mosaic. Surveys should be timed to coincide with peak arrival before full darkness and ideally under flat or overcast light conditions and on evenings with calm water. The computational counting tools developed during this project are available for continued use.

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# 8 LIMITATIONS

The 2025/26 surveys were conducted from Jade Bay and Maple Bay rather than the elevated waterslide tower used during the 2012–2014 baseline surveys. The lower elevation may have reduced the ability to resolve individual birds within dense passage flocks and to track multiple simultaneous groups. The magnitude of any resulting undercount is not quantifiable but is considered a source of additional uncertainty when comparing results with the baseline.

Five survey events were completed across the overwintering season, with several sessions limited in duration by light conditions or flock fragmentation. The absence of systematic counts in October and early November means the onset of the roosting season is not well characterised for 2025, and the occupation start date remains an assumption rather than an observation.

On multiple occasions the roosting flock divided into two or three groups distributed across different areas of the lake, making simultaneous counts from a single vantage point impractical. The January 23, 2026 count of 2,320 birds likely reflects incomplete coverage of a fragmented flock rather than a true population total and should be interpreted accordingly.

The 2025/26 surveys represent one season of data. Year-to-year variability in roosting numbers is expected given natural fluctuations in population dynamics, Fraser Valley foraging conditions, weather, and disturbance. Peak counts should be interpreted as estimates specific to this season rather than a long-term average, and multiple seasons of data would be required to characterise inter-annual variability robustly.

Bald Eagle harassment during surveys caused the roosting raft to periodically flush and redistribute, complicating count efforts on affected evenings. Later-season counts, particularly January 23 and February 15, reflect a population actively responding to predator disturbance rather than stable roosting conditions and should be interpreted in that context.

Drone imagery was collected opportunistically on a single date under dusk conditions rather than as part of a pre-planned systematic protocol. No single image captured the full roost extent, and variable lighting, low-contrast immature birds, and oblique angles on some images all contributed to counting uncertainty. The computational analysis methods have been validated against the manual count for this site and date but have not been independently verified across a range of conditions.

Nutrient loading commentary in this report is qualitative and indicative only. No formal loading calculations have been performed, and comparisons with Putt et al. (2019) should not be treated as a revised nutrient budget. Any formal update to the Cultus Lake nutrient budget should be undertaken as a separate analytical exercise drawing on multi-year survey data.

All birds counted during passage surveys were assumed to be Glaucous-winged Gulls based on the known composition of the Cultus Lake roost. No systematic species verification was undertaken, and small numbers of other large gull species or hybrids may have been included in totals. This is considered a minor source of uncertainty given the strongly Glaucous-winged Gull-dominated nature of the roost.

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# APPENDIX A FIGURES

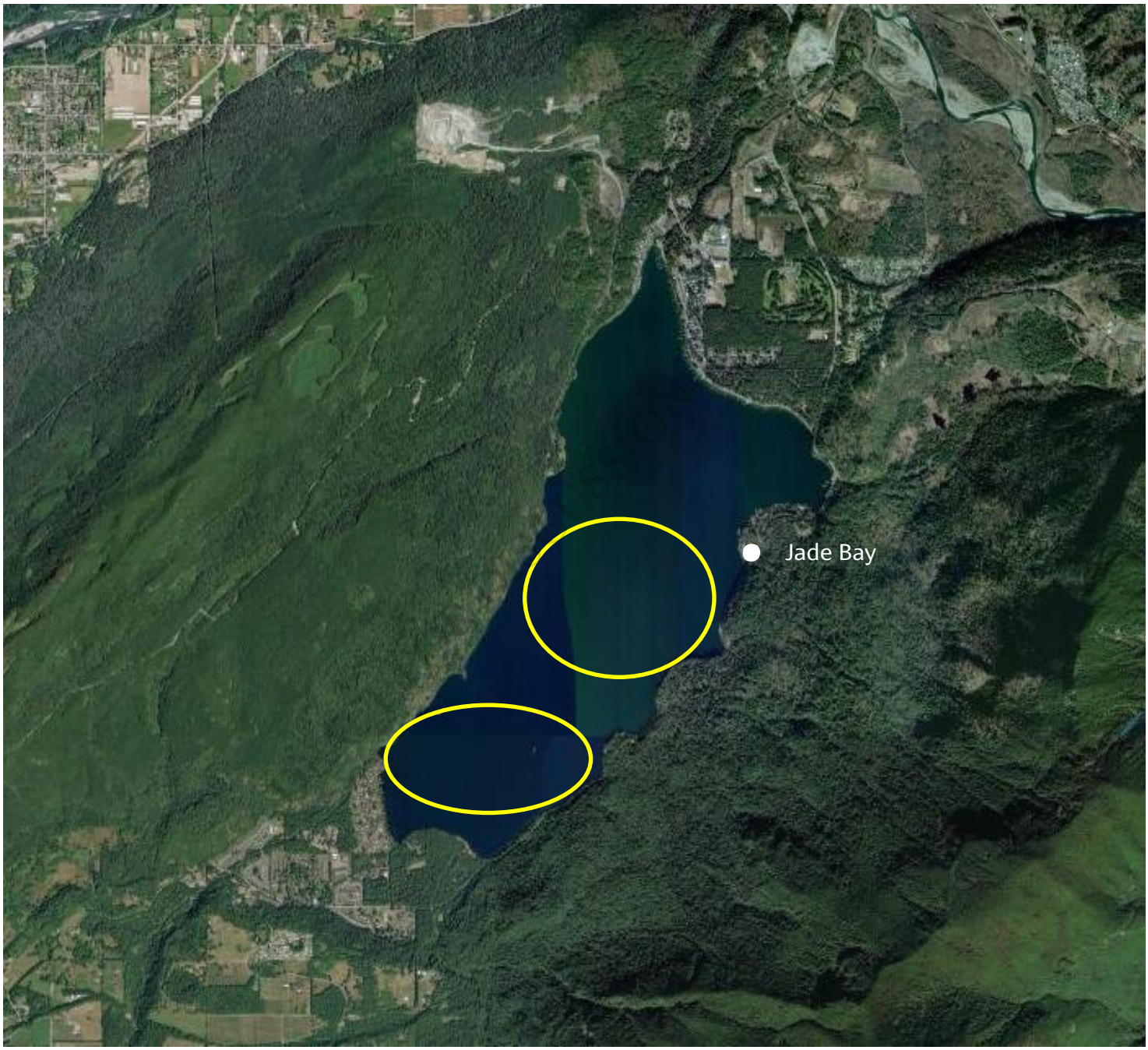



**Figure 1- Map of study area showing survey station locations and generale roosting areas used by gulls during surveys (yellow).**

# APPENDIX B PHOTOGRAPHS

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# Appendix B



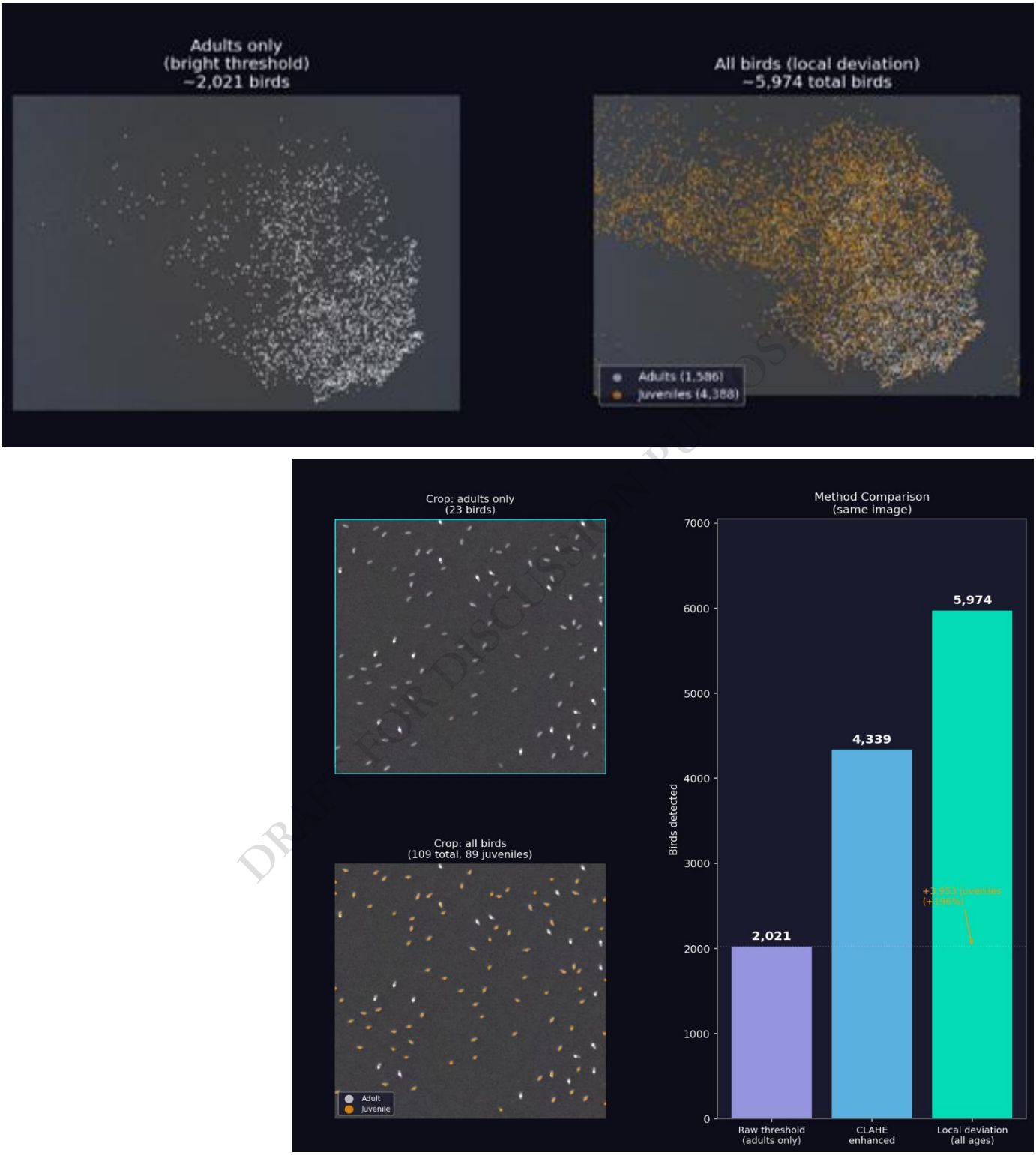
**Appendix Photo B-1. Flock of gulls after lifting off the surface due to disturbance by eagles. Photo looking west from Jade Bay. Photo taken 31 December 2025.**



**Appendix Photo B-2. Drone photo showing partial flock on 31 December 2025.**

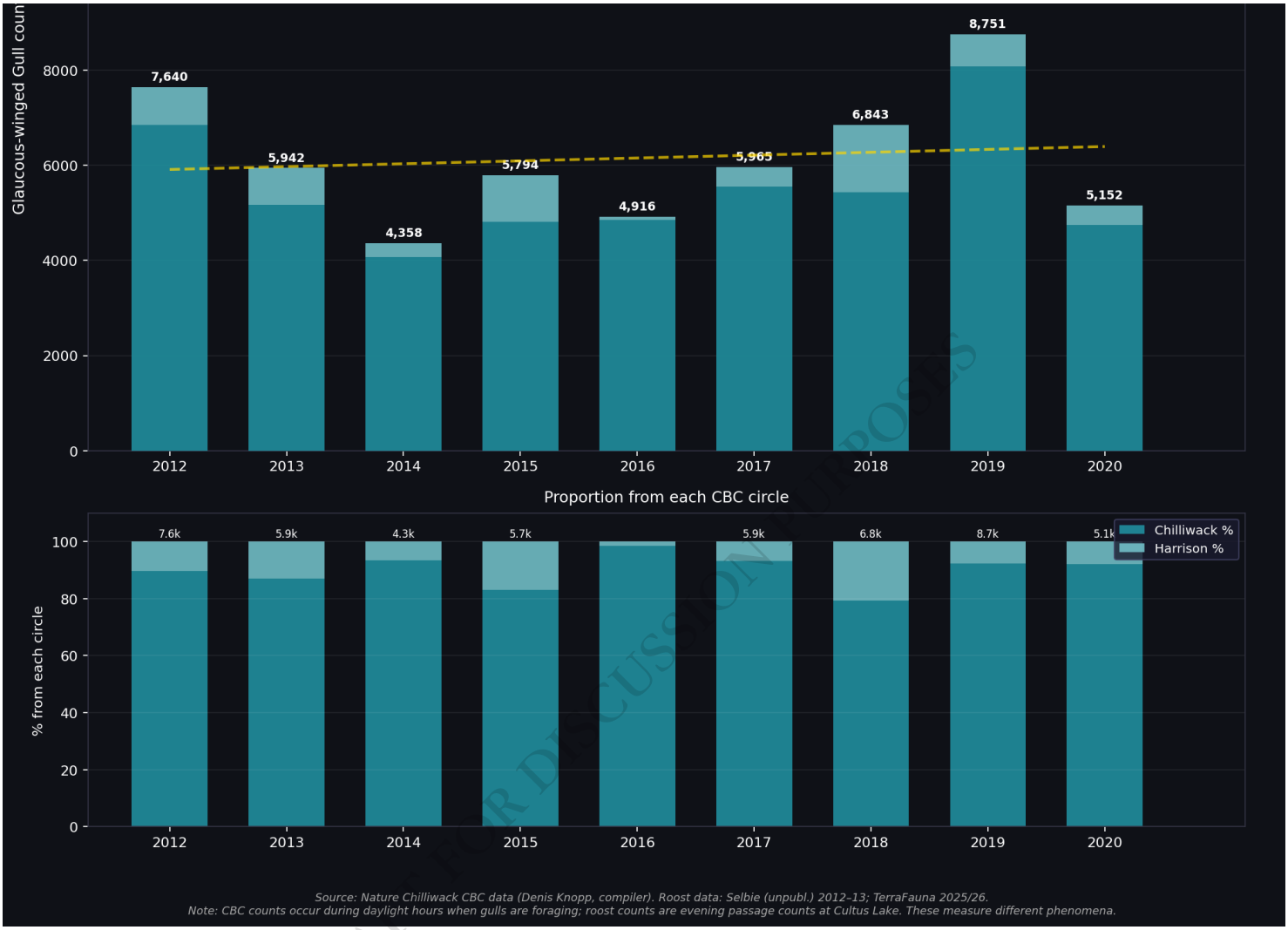
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# Appendix B




**Appendix Photo B-3. Sample of image analysis showing adult gulls (white) versus juvenile gulls (orange) demonstrating differences in detection thresholds based on brightness.**

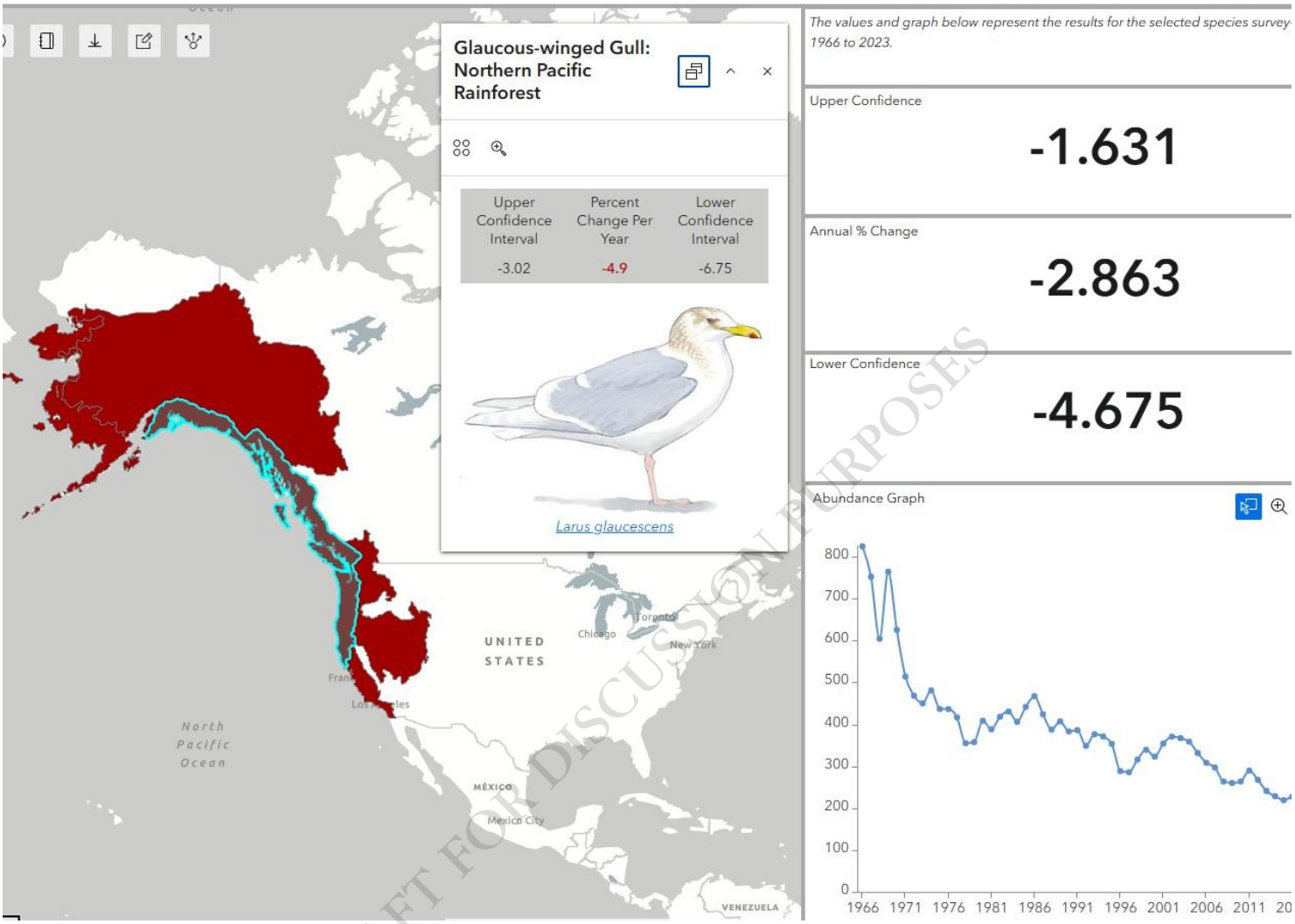
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**Appendix Photo B-4. Population estimates from Christmas Bird Count data (2012-2020) from Chilliwack (dark blue) and Harrison (light blue) showing near flat trend.**

# Appendix B




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**Appendix Photo B-5. Population trends for Glaucous Gulls from the Northern Pacific region from the Audubon Society from 2013-2023 showing decline of 2.8% annually.**