A complete summary of Cordilleran Sucker (*Pantosteus bondi;* Catostomidae) occurrence data in British Columbia, Canada

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ABSTRACT

Gilmore, S., Abbott, C., Castaneda, R.A., Stenhouse, L., Van Nynatten, A., Wade, J., and Grant, P. 2026. A complete summary of Cordilleran Sucker (*Pantosteus bondi*; Catostomidae) occurrence data in British Columbia, Canada. Can. Tech. Rep. Fish. Aquat. Sci. 3759: vii + 22 p. https://doi.org/10.60825/ws7v-b487

Cordilleran Sucker (*Pantosteus bondi*) is a freshwater fish species known to occur in parts of the North Thompson, Similkameen, and Fraser rivers in British Columbia, Canada, that is assessed as threatened by COSEWIC. Geographic range information is vital for the conservation management of imperilled species. Cordilleran Sucker has undergone substantial taxonomic revisions through time and is morphologically similar to other species, thus historical records of its occurrence may not be based on correct taxonomic identification. It is possible that museum specimens currently relied on for this information were misidentified at the time of collection or reflect out of date taxonomic identifications. Indeed, there are inconsistencies in geographic distribution reports among data sources, including among COSEWIC documents, that require investigation. We comprehensively examined museum specimens and reviewed historical records of occurrence of Cordilleran Sucker in BC from available literature and databases to verify the accuracy of the species identification. Erroneous, misidentified records previously associated with this species and confirmed here to represent other species were found and marked for removal from the public record. Limited survey effort may also contribute to an incomplete understanding of the current distribution of Cordilleran Sucker in British Columbia, thus we tested eDNA metabarcoding as a possible survey method. This was done at three locations where Cordilleran Sucker was historically reported (two in the North Thompson River and one in the Fraser River), and positive detections were found at all three locations. This report summarizes the currently known distribution of Cordilleran Sucker based on all available data.

RÉSUMÉ

Gilmore, S., Abbott, C., Castaneda, R.A., Stenhouse, L., Van Nynatten, A., Wade, J., and Grant, P. 2026. A complete summary of Cordilleran Sucker (*Pantosteus bondi*; Catostomidae) occurrence data in British Columbia, Canada. Can. Tech. Rep. Fish. Aquat. Sci. 3759: vii + 22 p. https://doi.org/10.60825/ws7v-b487

Le meunier des Cordillères (*Pantosteus bondi*) est une espèce de poisson d'eau douce présente dans certaines parties des rivières North Thompson, Similkameen et Fraser, en Colombie-Britannique (Canada), et considérée comme menacée par le COSEPAC. Les données sur son aire de répartition géographique sont essentielles à la gestion de la conservation des espèces en péril. Le meunier des Cordillères a fait l'objet d'importantes révisions taxonomiques au fil du temps et présente des similitudes morphologiques avec d'autres espèces ; par conséquent, les données historiques relatives à sa présence pourraient ne pas reposer sur une identification taxonomique correcte. Il est possible que les spécimens de musée actuellement utilisés pour ces informations aient été mal identifiés au moment de leur collecte ou qu'ils reflètent des identifications taxonomiques obsolètes. En effet, des incohérences existent dans les rapports de répartition géographique provenant de diverses sources de données, y compris les documents du COSEPAC, et nécessitent une investigation. Nous avons examiné de manière exhaustive les spécimens de musée et passé en revue les données historiques relatives à la présence du meunier des Cordillères en Colombie-Britannique, issues de la littérature et des bases de données disponibles, afin de vérifier l'exactitude de l'identification de l'espèce. Des données erronées, précédemment attribuées à cette espèce et confirmées ici comme appartenant à d'autres espèces, ont été découvertes et marquées pour être retirées des registres publics. Le faible volume des relevés effectués peut également expliquer la connaissance incomplète de la répartition actuelle du Meunier des Cordillères en Colombie-Britannique ; nous avons donc testé le métabarcoding de l'ADN environnemental comme méthode de recensement potentielle. Cette méthode a été appliquée à trois sites où la présence du Meunier des Cordillères avait été historiquement signalée (deux sur la rivière Thompson Nord et un sur le fleuve Fraser), et des détections positives ont été obtenues aux trois endroits. Ce rapport résume la répartition actuellement connue du Meunier des Cordillères d'après toutes les données disponibles.

INTRODUCTION

The Cordilleran Sucker (*Pantosteus bondi*) is one of several extant species previously known as the Mountain Sucker or Northern Mountain Sucker (*P. jordani*). Mountain Sucker was a species known in Canada from British Columbia (BC), Alberta, and Saskatchewan (Scott and Crossman 1973). The taxonomy of the group has changed as the understanding of species boundaries within the Catostomidae family has evolved. Cordilleran Sucker was first reported in BC in 1955 under the name *Pantosteus jordani* Evermann, 1893, and commonly called the Mountain Sucker (Lindsey 1956, 1957). Smith (1966) combined *Pantosteus jordani* with *Pantosteus platyrhynchus* (and others) and transferred the species to *Catostomus*, making it *Catostomus platyrhynchus* (Cope 1874). Recently Smith, Stewart and Carpenter (2013) split *C. platyrhynchus* into multiple species. In BC, this resulted in the newly described *C. bondi* placed into the subgenus *Pantosteus.* More recently, Unmack et al. (2014) used mitochondrial DNA data to separate *Pantosteus* from *Catostomus,* resulting in *P. bondi*. Hence the currently accepted scientific name is *Pantosteus bondi* (Smith *et al*. 2013) and the common name is Cordilleran Sucker (COSEWIC 2022, Page et al. 2023).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first assessed the Mountain Sucker (*Catostomus platyrhynchus*) in April, 1991, as Not at Risk (Campbell 1992). It was then split into three Designatable Units (DUs) in November 2010 (COSEWIC 2010), after which the Pacific population was assessed and subsequently listed under the *Species at Risk Act* (SARA) as Special Concern. In December, 2022, the Pacific population was revised and renamed Cordilleran Sucker (*Pantosteus bondi*) and assessed as Threatened (COSEWIC 2022).

Due to changes in taxonomy and revisions to COSEWIC's DU structure, not all databases have updated records based on the new taxonomy and maintain records under the previous nomenclature. Museum collections have not been examined to confirm species identifications amidst these extensive taxonomic changes; thus there is a risk of erroneous records being used in COSEWIC and Fisheries and Oceans Canada (DFO) publications and potentially perpetuating misinformation. Indeed, there are inconsistencies in geographic distribution reports among data sources, including COSEWIC assessments, status reports, and recovery documents (COSEWIC 2010, 2022, Fisheries and Oceans Canada 2020) that require investigation. Furthermore, limited survey effort, particularly in the last 20 years, contributes to an incomplete understanding of the current distribution of Cordilleran Sucker in BC.

The purpose of this work was to verify the accuracy of published distribution data for the currently recognized Cordilleran Sucker by assessing available literature and database records and confirming the identification of specimens from BC housed in museum collections. We also tested eDNA metabarcoding as a possible survey method for this species by applying it at several sites in BC. The revised baseline data generated here on species occurrence will better inform the conservation management of the species, which relies on accurate geographic distribution data.

METHODS

MUSEUM COLLECTIONS SEARCH

Specimen records of Cordilleran Sucker collected in BC and housed in museums were comprehensively collated by searching ichthyology databases of collections from North America and other biodiversity specimen depositories (Table 1). These specimens were searched for using the various names attributed to this species in BC since it was first discovered including *Pantosteus bondi*, *P. jordani*, *Catostomus bondi,* and *C. platyrhynchus*. Photographic records were also searched for on iNaturalist (iNaturalist.org). All searches were completed in July 2024, and from them a preliminary list of specimens to be verified was compiled. Three institutions were found to house Cordilleran Sucker specimens: the Beaty Biodiversity Museum at the University British Columbia (UBC); the Royal BC Museum (RBCM); and the Museum of Zoology at the University of Michigan (UMMZ). There were no photographic records found on iNaturalist.

To examine and confirm the identification of the museum specimens, we visited the Beaty Biodiversity Museum and the RBCM in the autumn of 2024. All specimens collected in BC named as *C. platyrhynchus*, *C. bondi*, *P. jordani, P. bondi*, as well as those named only to genus (*Catostomus* or *Pantosteus*) were examined using a stereo microscope (see next section). Bridgelip Sucker (*P. columbianus*) specimen collected from locations known to have Cordilleran Sucker were also examined to check for misidentifications, as this species can be difficult to differentiate from Cordilleran Sucker (McPhail 2007). To asses the one specimen of *P. bondi* housed at UMMZ, photographs of identifying features were obtained.

MUSEUM SPECIMEN EXAMINATION

Keys in McPhail & Carveth (1993) and McPhail (2007) as well as descriptions in McPhail (2007), Smith (1966), and Smith et al. (2013) facilitated the morphological distinction among the different sucker species in BC that were examined here. For preserved specimens, features of the mouth are critical for identification. Cordilleran Sucker has a deep notch between the upper and lower lips, a shallow cleft in the lower lip, with the posterior margin typically appearing close to horizontal and with the outer angles more angular (approaching ninety degrees) than round (Figure 1a). The upper lip is free from papillae on the outer surface (Figure 1a), and the pelvic fin has membranous stay and a pelvic axillary process (Figure 1b). Juvenile specimens are incredibly hard or impossible to distinguish between Cordilleran and Bridgelip suckers despite a supposed difference in fin ray counts (see Cannings and Ptolemy 1998).

DATABASE AND LITERATURE SURVEY

All historical records of Cordilleran Sucker in BC from the primary and secondary literature as well as catch data were assembled to be critically reviewed. All searches were done with a combination of current and past common and scientific names. Searches included: EcoCat (Aquatic Report Catalogue); CLIR (Cross-linked Information Resources) (Basic Search); Known BC Fish Observations and BC Fish Distributions, Open Government page (acknowledge licence), which is the same as our BC Conservation Data Centre (BC Conservation Data Centre; B.C. Conservation Data Centre - Province of British Columbia); Federal Science Library Network (Fisheries and Oceans Canada Library - Canada.ca); and the primary scientific literature. In order for records from databases and literature without voucher specimens to be considered accurate, one of the following criteria needed to be met: (1) the record was found at or near a location with previously confirmed specimens; (2) the specimen was identified by a recognized expert; or (3) the method used for identification was clearly indicated and valid, such as listing keys used for the identification, describing distinguishing features seen, or sharing photographs. Records that did not meet one of these three criteria underwent additional scrutiny by examining all details of the record to determine if it could be accurate or why a misidentification is the likely origin.

eDNA METHODS

Sample Collection

eDNA metabarcoding surveys targeting freshwater fish were conducted at historical sites with Cordilleran Sucker reports and other potential sites as an initial step to acquire additional distributional data. Shore-based water samples for eDNA analysis were taken at or near sites of historical Cordilleran Sucker records of occurrence (Table 2). Samples in and near the Fraser River were collected on March 11, 2024; samples in or near the North Thompson River were collected on September 13 – 14, 2024; and samples at Shesta Lake were taken on September 16, 2024.

All samples were collected with an eDNA Backpack Sampler (Smith-Root, Inc) using 5 µm self-preserving filters (Smith-Root, Inc.). Either six or seven field samples were collected per site, consisting of approximately 1.0 L of water. Before field samples were collected at each site, one field blank was collected by opening a 1.0 L bottle of Millipore water for approximately one minute and then filtering it.

The backpack sampler, hoses, and equipment were all disinfected upon arrival at each site by running a 2% v/v sodium hypochlorite (NaOCl) solution through the machine for 10 mins, followed by rinsing with tap water for one min and wiping with Eliminase (Decon Laboratories, Inc.) using paper towel. Similarly, at the end of each sampling day, sampling equipment was disassembled, cleaned and disinfected using methods just described.

eDNA extraction and amplification

eDNA was extracted from filters using the DNeasy Blood & Tissue Kit (Qiagen, Cat. No. 69504). Based on in-house optimization experiments and to ensure the whole filter was submerged during digestion, the following modifications to the manufacturer's protocol were made: (1) 720 µL of Buffer ATL was added to each filter at the lysis step followed by two cycles of high-speed vortexing for 10 min and incubation on a rotator at 56 °C for 30 min; (2) 80 µL of Proteinase K was added and incubation with rotation continued for another 2 h; (3) 200 µL each of Buffer AL and ethanol were added to the lysate; and (4) two elutions were done using buffer AE pre-warmed to 56 °C. The first elution was with 60 µL and the second with 40 µL; spin columns were incubated at room temperature for 3-5 min and then centrifuged at 6000 x g for 1 min. One eDNA extraction control, comprised of a sample with no filter added, was included in each eDNA extraction batch to monitor for potential contamination.

Two metabarcoding markers were used, *12S rRNA* and *16S rRNA*. The 12S marker was amplified using forward primer 12S_248F (He et al. 2022) and reverse primer MiFish-U-R (Miya et al. 2015). The 16S marker was amplified using Vert-16S-eDNA primers (Vences et al. 2016) but with a modified forward primer (Vert-16S-eDNA-F1m: 5’- AGACGAGAAGACCCTDTGGAGCTT-3’).

The twin-tagging Tagsteady protocol was used (Carøe & Bohmann, 2020). Mirrored septamer tags with 0 to 4 additional nucleotides (for positional diversity) were attached to the 5’ end of each PCR primer. All tags had at least 3 nucleotide mismatches with other tags. Triplicate PCR reactions, each with a final volume of 25 µL, were done per marker for each sample and contained 1x Qiagen HotStarTaq MasterMix, 0.2 mg/mL BSA, and 0.3 mM each primer. Thermocycling conditions for 12S were: 15 min at 95°C; 40 cycles of 90s at 94°C, 90s at 58°C, 60 s at 72°C; and 10 min at 72°C. Thermocycling conditions for 16S were: 15 min at 95°C; 40 cycles of 30 s at 94°C, 90 s at 60°C, 60 s at 72°C; and 10 min at 72°C. Triplicate PCR products were pooled and run on 3% agarose gels. PCR products were then combined into amplicon pools in approximate equimolar ratios, as estimated visually by gel band strength. Each amplicon pool was purified using a 1.5X SPRI bead solution and quantified using a Qubit Fluorometer.

Library Construction and Sequencing

2 pmol of each amplicon pool was end-repaired in 30 µL using 0.1875 U/µL Klenow fragment, 0.5 U/µL T4 PNK, 0.125 mM dATP, 1x T4 DNA ligase buffer, and a reaction booster (1.25% PEG, 20 mM NaCl, 0.1 mg/mL BSA) at 37°C for 30 min, followed by 65°C for 30 min. Amplicon pools were ligated with Y-adapters with 3’ dT overhangs (xGen™ UDI-UMI Adapters from IDT) that had the Illumina TruSeq backbone and dual matching indices, as follows: 3 µL of adapter solution (15 µM), 1x T4 DNA ligase buffer, 6.25% PEG-4000, and 8 U/µL T4 DNA ligase were combined and incubated for 20°C for 30 min, then 65°C for 10 min. Each library was purified using 2x volume SPRI beads and quantified using the NEBNext™ Library Quant Kit for Illumina. All libraries, containing a total of 184 indexed samples, were then pooled into a single library in equimolar amounts to a final molarity of 7 nM. The final library underwent a quality

control check at Genome Quebec before being sequenced there on the Illumina NovaSeq using 150 bp paired-end read (target depth 1500M reads).

Bioinformatics

Demultiplexing was performed using *seqkit grep* (Shen et al. 2016). Output FASTQ files with the same orientation (forward or reverse) were merged, and unpaired reads were removed using the *seqkit pair* function with default parameters.

Amplicon Sequence Variants (ASVs) were generated from the demultiplexed reads using the *QIIME 2* bioinformatics platform (Bolyen et al. 2019). Forward and reverse 16S reads were processed as single-end reads because amplicon sequences were too long to merge. Sequence reads generated for 12S were analyzed as paired reads. Primer and index sequences were trimmed from the raw reads using the *cutadapt* plugin (Martin 2011) with an error rate of 0.2. Reads that could not be trimmed were discarded. Trimmed reads were dereplicated and denoised using the *dada2* plugin (Callahan et al. 2016) with default parameters. One ASV table per marker was generated, and ASVs were curated post-clustering using the LULU algorithm (Frøslev et al. 2017). The minimum match parameter was set to 90 to avoid removal of closely related, co-occurring species; all other parameters were left at default values.

Taxonomy Assignment and Data Analysis

LULU-filtered ASVs were taxonomically classified using the BLAST algorithm (Camacho et al. 2009) and two reference sequence databases, then results compared. The first database was NAMERS (Westfall et al. 2024; namers.ca), a high-quality mitogenome sequence database for fishes of BC. The second database was the NCBI Genomic Mitochondrial Reference Sequence Database (Version 5, accessed: Jul 4, 2025). A 98% percent identity (PID) threshold was set for ASV classification. To avoid misclassifying sequences due to database gaps, ASVs classified as bony fishes using the NCBI database and not classified to any fish species with > 98% PID were recorded as unclassified fish sequence. When the top species-level match for an ASV differed between the two databases, the classification with the higher PID was retained. If both matches had identical PIDs, the classification from the NAMERS database was used. If an ASV could not be unambiguously assigned to a single species, all species classifications were retained. ASVs not classified as bony fishes and those with relative read abundances under 0.0001 were removed from analysis. No *P. bondi* ASVs were detected above this threshold in any negative controls, hence no further corrections were needed.

MAPPING VERIFIED DISTRIBUTION

Extent of Occurrence (EOO) was calculated by forming the smallest total geographic area which encompassed all known records, using Google Earth and following COSEWIC methods (COSEWIC 2017).

RESULTS

MUSEUM SPECIMEN EXAMINATION

Confirmed specimens of *P. bondi* based on the positive identification of species from each museum are presented in Table 3. First discovered in BC in 1955 (Carl et al. 1959), the earliest known collected specimen of this species is from 1948 but not identified until 1959. This specimen is labelled as collected in Taylor Lake; however, a label inside the jar states "*Location inaccurate*" and writing on the field record also bring into question where this specimen was actually collected (https://open.library.ubc.ca/collections/fisheries/items/1.0207073?o=0). While the specimen is clearly *P. bondi*, we agree the collection location for this record should be changed to unknown; we have labelled it as such in Table 3. Photographs of the specimen at the UMMZ clearly showed all features required to confirm the specimen was a Cordilleran Sucker.

Several museum specimen jars labelled as Cordilleran Sucker were, upon examination, found to be Bridgelip Sucker or, on occasion, to be a mix of the two species. Specimen jars where all individuals were misidentified are listed in Table 4. A selection of the records from Appendix 3 of COSEWIC (2010), which are stated as ‘collection records’ and list RBCM or UBC as the sampling organization, were not associated with museum collections or catch records housed in museum databases and, as such, were classified here as erroneous (Table 4). All specimen of Bridgelip Sucker collected at known Cordilleran Sucker locations were also examined, and none were misidentified Cordilleran Suckers.

DATABASE AND LITERATURE RECORDS

Literature and database searches resulted in many records of Cordilleran Sucker from BC that were not found in other sources. The majority of these were in the BC Conservation Data Centre (CDC) database. Each of these records was carefully considered and those that met the criteria (see methods) are listed in Table 5. Records that were aberrant in their location and or identification and deemed here to be erroneous (or highly uncertain) are listed in Table 4. Some of these records were used in past documents as evidence of Cordilleran Sucker presence, others have been rightfully rejected, each of which is discussed below.

<u>Lakes near Prince George</u>

Two early records of Mountain Sucker were from lake survey data on 16 and 22 July, 1969, at Shesta Lake and Pelican Lake near Prince George. Both Longnose Sucker and Northern Mountain Sucker were reported at these locations (Table 5). Two later lake stocking reports for Shesta Lake (conducted on July 15–16, 1991, and July 20–22,

1994) recorded Longnose Sucker and Largescale Sucker (Barry & Van Schubert 1992, 1995), whereas surveys in Pelican Lake on June 22, 1972, only recorded Longnose Sucker (Klein & Heathman 1972). Our eDNA results from Shesta Lake indicated the presence of Longnose, White and Largescale Suckers, but not Cordilleran Sucker. Given no eDNA detection, that Cordilleran Sucker is known only from swift running rivers; and that Shesta Lake is filled with marsh grasses and lily pads (Harding and Offin 1969a), we suspect these original reports of Cordilleran Sucker are misidentifications. Importantly, past records of Mountain Sucker from lakes come from records in Nevada, Wyoming and Idaho (references in McPhail 2007), none of which are Cordilleran Suckers following the revision by Smith et al. (2013). Thus there are no confirmed records of Cordilleran Suckers in lakes.

Mouth of the Fraser River

The CDC has three records linked to a publication on at-risk fish (Haas 1998). The dates are all April 1, 1998, and the record locations are linked to the mouth of the Fraser River, North Thompson River at Kamloops, and the Columbia River at the US border. This appears to be an interpretation error by the CDC as Haas (1998) only lists general fisheries branch regions where Cordilleran Sucker has been found and not exact locations.

A record at the mouth of the Fraser River appears in the latest EOO estimate (COSEWIC 2022) but was not used for the COSEWIC 2010 report. This point is not linked to Haas (1998) but is instead linked to a UBC catch record from April 12, 2000. The locality is listed as "*Herrling Island, lower end, Fraser River, BC*" but the associated latitude and longitude in the CDC database is erroneously at the mouth of the Fraser river, which is seen as an error. The written location is within the known range of Cordilleran Sucker.

Columbia River

Along with the CDC record from the Columbia River from Haas (1998), McPhail (2007) reported on an unconfirmed record of Cordilleran Sucker in the Columbia river system near the Salmo and Pend d'Oreille river confluence sighting by Baxter et al. (2003). This record is believed to be erroneous as Baxter et al. (1998) reported catching one Cordilleran Sucker with a fork length of 37.4 cm. This measurement is well beyond the maximum standard length of Cordilleran Sucker, which is 17.5 cm (Smith et al. 2013). Note that McPhail (2007) and COSEWIC (2022) list the maximum fork length as <250 mm; however, records near this length are from *Pantosteus jordani* in Alberta and not *P. bondi* in BC (Campbell 1992).

Rayfield River

A CDC record from Mountain Sucker in the Rayfield River is challenging to trace. The final report associated to this data point lists White Sucker and Mountain Whitefish but not Mountain Sucker (Smith 2000). Given that the documentation does not include Mountain Sucker, we considered this CDC record to be an error and excluded it from further analysis.

Euchinko River

McPhail et al. (1998) mapped locations of fish in the Fraser River drainage. On the map for Mountain Sucker there is a record at what appears to be the Euchinko River, a tributary of Blackwater River. We were unable to find any historical documentation or specimen for this record, and this location was not reproduced in later maps by McPhail (2007). Thus we determined it here to be erroneous and excluded it from further analyses.

eDNA RESULTS

All eDNA sample locations that had confirmed records or specimens of Cordilleran Sucker returned positive eDNA results, which we defined as the detection of sequence reads (ASVs) confidently assigned to the species. These sites included one in the Fraser River and three in the North Thompson River (Table 5, Figure 2). The species was detected with the 12S marker at all four sites and with the 16S marker at the three North Thompsons River sites only. eDNA samples were taken at some sites (n = 5) neighbouring the four sites where the Cordilleran Sucker were detected, including one further upstream in the North Thompson River, and no further detections were found (Figure 2). No detections of *P. bondi* occurred in negative controls above cutoffs.

This study provides field validation of an eDNA metabarcoding tool for surveying for Cordilleran Sucker, as positive results were obtained at sites with confirmed presence. Thus the method is confirmed to be a valid option for surveying for the presence of Cordilleran Sucker. As such, more thorough eDNA sampling could be undertaken to assess the extent to which the species is still found throughout its documented range (and beyond). It is noteworthy that there have been no records in the Tulameen and Similkameen River upstream of Hedley for almost 50 years (since 1978); the eDNA metabarcoding tool used here is recommended as an efficient option for screening level assessment of whether Cordilleran Sucker still occur at any of these locations.

CURRENT KNOWLEDGE OF CORDILLERAN SUCKER RANGE IN BC AND ESTIMATE OF EOO

McPhail (2007) states that the historical distribution of Cordilleran Sucker includes: the Fraser River from near Hope to the mouth of the Sumas River; the North Thompson River near Heffley; and the Similkameen River and the Tulameen River from near Princeton to the US border. Our in-depth assessment of the validity of occurrence records for this species found (and corrected) several errors, and we gained new information from eDNA metabarcoding. Nonetheless, the previously described range of Cordilleran Sucker was reasonably accurate, warranting only slight changes. In the Fraser River, the distribution is centred around Chilliwack and goes from the junction with Sumas River north to near Laidlaw (Figure 2a). In the Similkameen River and Tulameen River, the species occurs from Princeton downstream to just past Cawston (Figure 2b), and in the North Thompson from Heffley Creek north to Clearwater (Figure 2c). All previous records of Cordilleran Sucker located south of the distributions just described in the Similkameen were erroneous; they were actually Bridgelip Sucker. Until eDNA surveys can be undertaken in the Similkameen and Tulameen rivers the current distribution of Cordilleran Sucker as it relates to the historical distribution is unknown.

Based on results from all data sources including museum specimens, literature, databases, and eDNA results that were generated here, the EOO of Cordilleran Sucker is 24410 km^2 (Figure 3), which is slightly lower than that previously reported at 29267 km^2 (COSEWIC 2022).

CONCLUSION

Our examination of museum specimen and historical occurrence data for Cordilleran Sucker revealed significant and pervasive issues with specimen misidentification through time. This not only undermines the reliability of historical records but also underscores the critical need for rigorous validation of existing specimens and collections for all species at risk. A particularly alarming consequence of misidentification is the downstream propagation of errors throughout the scientific literature that could conceivably give rise to an erroneous understanding of a species' range. Publications frequently cite occurrence records from peer-reviewed sources or authoritative databases (e.g. reputable museums), reasonably assuming they are accurate; however, results reported here clearly show this assumption may often be violated.

In the context of species at risk, freshwater assessments in BC rely heavily on existing distribution records to inform status determinations, making the validation of records used in status reports especially critical. It further highlights the importance of voucher specimens, both for retrospective verification and as a recommended (or required) component of future studies, including as a condition in permitting to work on species at risk. While a specimen submitted to a museum allows the greatest confidence and ease of validation of identifications, a tiered systems of recommendations of vouchering via photographs and a clear description of how a species was identified and congeners refuted could suffice when dealing with the most sensitive species.

Despite errors in specimen identification and mixed use of historical data in reports, Cordilleran Sucker were confirmed as occurring within three regions of BC. eDNA successfully distinguished Cordilleran Sucker from other species, at all four locations tested where specimens or reports of the species were found. No additional positive eDNA results were found in nearby locations. eDNA is an effective tool to use for confirming the current distribution of the species in BC. As abundance is likely low, sampling methods can be adapted to reduce the likelihood of false negatives.

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REFERENCES

Barry, S. and Van Schubert R.M. 1992. Report: A Stocking Assessment of Shesta Lake 01025LCHL https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=9670.

Barry, S. and Van Schubert R.M. 1995. Report: A Stocking Assessment of Shesta Lake 01025LCHL https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=9671.

Baxter, J.S., G.J. Birch, and W.R. Olmsted. 2003. Assessment of a constructed fish migration barrier using radio telemetry and floy tagging. North American Journal of Fisheries Management 23:1030-1035.

Bolyen, E., Rideout, J.R., Dillon, M.R. et al. 2019. Reproducible, interactive, scalable and extensible microbiome data science using QIIME 2. Nature Biotechnology 37: 852–857 https://doi.org/10.1038/s41587-019-0209-9.

Callahan, B. J., McMurdie, P. J., Rosen, M. J., Han, A. W., Johnson, A. J. A., & Holmes, S. P. 2016. DADA2: High-resolution sample inference from Illumina amplicon data. Nature Methods, 13(7), 581-583.

Campbell, R.E. 1992. Status of the Mountain Sucker, *Catostomus platyrhynchus,* in Canada. Canadian Field Naturalist 106: 27-35.

Cannings, S.G., and Ptolmey, J. 1998. Rare freshwater fish of British Columbia. B.C. Minist. Environ., Lands and Parks, Conserv. Data Centre, Victoria, B.C. 214pp.

Carl, G.C., W.A. Clemens and C.C. Lindsey, 1959. The fresh-water fishes of British Columbia (3rd edition revised). Victoria (British Columbia, Canada): British Columbia Provincial Museum. Department of Education, Handbook 5: 192 p.

Carøe, C, Bohmann, K. 2020. Tagsteady: A metabarcoding library preparation protocol to avoid false assignment of sequences to samples. Molecular Ecology Resources 620:1620-1631. doi: 10.1111/1755-0998.13227. Epub 2020 Aug 6. PMID: 32663358.

COSEWIC. 2010. COSEWIC assessment and status report on the Mountain Sucker *Catostomus platyrhynchus* (Saskatchewan - Nelson River populations, Milk River populations and Pacific populations) in Canada. Comm. Status Endanger. Wildlife Can. Ottawa. xvii + 54 pp.

COSEWIC. 2017. Instructions for the Preparation of COSEWIC Status Reports. 39pp https://cosewic.ca/images/cosewic/pdf/instructions_e.pdf

COSEWIC. 2022. COSEWIC assessment and status report on the Plains Sucker *Pantosteus jordani*, Saskatchewan-Nelson River population and Missouri population and the Cordilleran Sucker *Pantosteus bondi* in Canada. Comm. Status Endanger. Wildlife Can. Ottawa. xxii + 68 pp.

Fisheries and Oceans Canada. 2020. Management Plan for the Mountain Sucker (*Catostomus platyrhynchus*), Pacific populations, in Canada. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada, Ottawa. iii + 18 pp.

Frøslev, T. G., Kjøller, R., Bruun, H. H., Ejrnæs, R., Brunbjerg, A. K., Pietroni, C., & Hansen, A. J. 2017. Algorithm for post-clustering curation of DNA amplicon data yields reliable biodiversity estimates. Nature Communications 8: 1188. https://doi.org/10.1038/s41467-017-01312-x

Harding and Offin. 1969a. Report: A Reconnaissance Survey of Shesta Lake 01025LCHL https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=13719.

Harding and Offin. 1969b. Report: A Reconnaissance Survey of Pelican Lake, 1969 00724EUCH https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=32350.

Haas, G.R. 1998. Indigenous fish species potentially at risk in BC with recommendations and prioritizations for conservation forestry/resource use, inventory and research. Fisheries Management Report 105.

He, X., Stanley, R.R.E., Rubidge, E.M., Jeffery, N.W., Hamilton, L. C., Westfall, K.M., Gilmore, S.R., Roux, L-M., Gale, K.S..P., Heaslip, S.G., Steeves, R., Abbott, C.L.. 2022. Fish community surveys in eelgrass beds using both eDNA metabarcoding and seining: implications for biodiversity monitoring in the coastal zone. Canadian Journal of Fisheries and Aquatic Sciences 79: 1335–1346.

Klein and Heathman. 1972. Report: A Reconnaissance Survey of Pelican Lake 1972 01210UDEN https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=12510).

Lindsey C. C. I956. Recommended common and scientific names of British Columbia freshwater fishes. British Columbia Game Commission, Fisheries Management Division. 26 pp.

Lindsay, C.C. 1957. Possible Effects of Water Diversions on Fish Distribution in British Columbia. Journal of the Fisheries Research Board of Canada 14: 651-668.

Martin, M. 2011. Cut adapt removes adapter sequences from high-throughput sequencing reads. EMBnet. journal 17: 10-12.

McPhail, J.D. and Carveth, R. 1993. Field Key to the Freshwater Fishes of British Columbia. Government Publications Centre https://www.zoology.ubc.ca/~etaylor/nfrg/fresh.pdf.

McPhail, J.D., Szenasy, E.B. and Watson, B. 1998. An Atlas of Fraser River Fishes: Fish Distribution and Assemblages in the Fraser Basin. DOE FRAP 1998-13.

McPhail, J.D. 2007. The Freshwater Fishes of British Columbia. University of Alberta Press 620pp.

Miya, M., Sato, Y., Fukunaga, T., Sado, T., Poulsen, J.Y., Sato, K., et al. 2015. MiFish, a set of universal PCR primers for metabarcoding environmental DNA from fishes: detection of more than 230 subtropical marine species. Royal Society Open Science. 2: 150088. doi:10.1098/rsos.150088. PMID:26587265.

Ramsay, I. 2017. Report: Fish Salvage Similkameen River – 2017; PE17-273660a. https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=54053.

Page, L. M., K. E. Bemis, T. E. Dowling, H. Espinosa-Pérez, L. T. Findley, C. R. Gilbert, K. E. Hartel, R. N. Lea, N. E. Mandrak, M. A. Neighbors, J. J. Schmitter-Soto, and H. J. Walker, Jr. 2023. Common and scientific names of fishes from the United States, Canada, and Mexico, 8th edition. American Fisheries Society, Special Publication 37, Bethesda, Maryland.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184, Ottawa.

Shen, W., Le, S., Li, Y., & Hu, F. 2016. SeqKit: a cross-platform and ultrafast toolkit for FASTA/Q file manipulation. PLOS One, 11(10), e0163962.

Smith, G.R. 1966. Distribution and Evolution of the North American Catostomid Fishes of the *Subgenus Pantosteus,* Genus *Catosomtus.* Miscellaneous Publications Museum of Zoology, University of Michigan, 129: 1-132.

Smith, G.R., Stewart, J.D., & Carpenter, N.E. 2013. Fossil and Recent Mountain Suckers, *Pantosteus*, and Significance of Introgression in Catostomin Fishes of Western United States. Occasional Papers of the Museum of Zoology, University of Michigan 743. 1-59.

Smith, S. 2000. Upper Bonaparte River Watershed Reconnaissance (1:20000) Fish and Fish Habitat Inventory https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=295.

Taylor, E. 2011. Report: Mountain Sucker Phylogeography in the North Thompson River, fish collection permit SUKA10-64612. https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=23123.

Unmack, P.J., Dowling, T.E., Laitinen, N.J., Secor, C.L., Mayden, R.L., Shiozawa, D.K., and Smith, G.R. 2014. Influence of Introgression and Geological Processes on Phylogenetic Relationships of Western North American Mountain Suckers (*Pantosteus*, Catostomidae). PLOS One 9(3): e90061. doi:10.1371/journal.pone.0090061.

Vences, M., Lyra, M.L., Bina Perl, R.G., Bletz, M.C., Stankovic, D., Lopes, C.M., Jarek, M., Bhuju, S., Geffers, R., Haddad, C.F.B., Steinfartz, S. 2016. Freshwater vertebrate metabarcoding on Illumina platforms using double-indexed primers of the mitochondrial 16S rRNA gene. Conservation Genetics Resources 8: 323–327. https://doi.org/10.1007/s12686-016-0550-y.

Westfall, K. M., Singer, G. A. C., Kaushal, M., Gilmore, S. R., Fahner, N., Hajibabaei, M., & Abbott, C. L. 2024. NAMERS: A purpose-built reference DNA sequence database to support applied eDNA metabarcoding. Metabarcoding and Metagenomics 8: e125095. https://doi.org/10.3897/mbmg.8.125095.

Table 1. Museum and online databases searched for Cordilleran Sucker (*P. bondi*) museum records in this study.

Name	Weblink
BOLD	https://www.boldsystems.org/index.php/databases
GBIF	https://www.gbif.org/
iDigBio	https://www.idigbio.org/
Royal British Columbia Museum (RBCM)	https://search-collections.royalbcmuseum.bc.ca/Ichthyology
Burke Museum	https://webportal.specifycloud.org/uwfc/
Beaty Collection at UBC (UBC-BBM)	https://open.library.ubc.ca/collections/fisheries
Smithsonian	https://naturalhistory.si.edu/research/vertebrate-zoology/fishes
American Museum of Natural History (AMNH)	https://emu-prod.amnh.org/db/emuwebamnh/Query.php
Ohio State University Museum of Biological Diversity (OSUMBD)	https://mbd.osu.edu/collections/fish-division
Yale Peabody Museum	https://peabody.yale.edu/
Florida Museum	https://www.floridamuseum.ufl.edu/fish/collection/holdings/
Field Museum	https://www.fieldmuseum.org/collection/fishes-collection
University of Alberta Museums (UAM)	https://search.museums.ualberta.ca/
VertNet	http://www.vertnet.org/index.html

Table 2. Location of water samples collected and analyzed here using eDNA metabarcoding. The number (#) of samples indicates the number of field replicates.

Location	Watercourse	Latitude	Longitude	# of samples
Chehalis- Harrison Wildlife Management Area	Chehalis/Harrison River	49.2771	-121.95	6
Ballam Road, Chilliwack	Fraser River	49.2098	-121.93	6
Keith Wilson Bridge	Chilliwack River	49.1034	-122.08	6
Near Heffley Creek	North Thompson River	50.8534	-120.29	7
McClure	North Thompson River	51.0322	-120.24	7
Near Swanson Road	Clearwater River	51.6420	-120.08	7
Near Dunn Lake Road	North Thompson River	51.6398	-120.03	7
Near Raft River Road	Raft River	51.6366	-119.97	7
Mad River Bridge	North Thompson River	51.6728	-119.61	7
Shesta Lake Recreation Site Campground	Shesta Lake	53.6352	-122.99	7

Table 3. Museum specimens of Cordilleran Sucker examined here and confirmed to be correctly identified. The locality description is as written on the specimen labels, the notes column gives comments made by current authors upon specimen examination.

Waterbody	Collection	Catalogue no	Date Collected	Locality description	Lat	Long	Notes
Unknown	UBC	59-417	27-Jul-48	Labelled as: Taylor Lake, north of Allison Lake near Princeton, southern BC			Paper in jar "locality inaccurate". See comments in results
Fraser River	UBC*	59-605	31-Aug-59	Mouth of Vedder R., at Fraser River, Lower Main.	49.144	-122.119	
Fraser River	UBC	06-0087	12-Apr-00	Herrling Island, Lower end, Fraser River, BC	49.216	-121.712	
North Thompson River	UBC*	58-321	24-Aug-58	North Thompson River, 1 mile from Heffley, Kamloops area, southern BC			Mixed species 3 Cordilleran and 1 larger Bridgelip Sucker moved to new jar
North Thompson River	RBCM*	994-00254-007	24-Sep-94	Thompson River; Heffley Creek townsite; main river as well as adjacent pond; access through 'Ranchland' trailer park	50.852	-120.291	
North Thompson River	RBCM*£	994-00263-003	26-Sep-94	North Thompson River; McClure; Isolated pools; downstream of ferry crossing	51.033	-120.238	"???" on label
Similkameen River	UBC*	56-0488	30-Jul-56	Similkameen River c. 1.6km W of Wolfe Creek	49.438	-120.284	Mix of Cordilleran and Bridgelip suckers.
Similkameen River	RBCM	992-00222-005	21-22 Oct 92	Similkameen River dyke "Ern's place" (near Cawston)	49.150	-119.761	
Similkameen River	RBCM*	992-00225-002	25-Oct-92	Similkameen River, east of Ashnola IR			
Similkameen River	RBCM*	009-00006-001	19-Jul-05	Similkameen River, Karemeos	49.204	-119.890	Mixed species 1 Cordilleran and 14 Bridgelip
Similkameen River	UBC	06-0060	5-Sep-92	Cawston, Similkameen R., at Coulthand Rd.	49.176	-119.776	
Similkameen River	UBC	10-0037	31-Aug-78	British Columbia, Similkameen River below Princeton			
Similkameen River	RBCM	992-00192-003	27-Aug-92	Similkameen River; about 1km downstream of Keremeos near P-92-33; along boulders of dyke; south bank	49.196	-119.786	
Similkameen River	UMMZ Δ	179424	19-Jul-55	Similkameen River, 6 Hwy miles SE Princeton	49.455	-120.380	

Table 3. Museum specimens of Cordilleran Sucker examined here and confirmed to be correctly identified. The locality description is as written on the specimen labels, the notes column gives comments made by current authors upon specimen examination.

Waterbody	Collection	Catalogue no	Date Collected	Locality description	Lat	Long	Notes
Similkameen River	RBCM*£	977-00129-001	18-Jun-77	Similkameen River, Keremeos, BC	49.199	-119.828	
Similkameen River	RBCM*£	992-00221-006	21-Oct-92	Similkameen River below "Ern's place"	49.150	-119.761	"?" on identification label
Similkameen River	UBC	55-398	6-Aug-55	Southern British Columbia, Similkameen River, near where Wolfe Creek enters Similkameen River	49.436	-120.305	At least one Cordilleran Sucker. Smaller specimen not confirmed.
Tulameen River	UBC*	59-477	19-Jul-58	Tulameen river at Princeton	49.463	-120.512	
Wolfe Creek	UBC*	56-413	16-May-56	Wolfe creek, trib. of Similkameen river, Princeton area, southern British Columbia	49.436	-120.305	Mixed species 2x Cordilleran Suckers and one Bridgelip Sucker (moved to new jar)
Wolfe Creek	UBC	56-89	2-Apr-56	Wolfe Creek, tributary of Similkameen River near Princeton, southern British Columbia	49.436	-120.305	

Δ Species identification confirmed from specimen photographs. £ Specimen too immature/ small to confidently confirm identification. *listed in Appendix 3 of COSEWIC (2010)

Table 4. Specimen and catch records associated with Cordilleran Sucker found here to either not exist in collections or databases or to have been incorrectly identified. Data found to be erroneous that were used in COSEWIC (2010) (Appendix 3) are indicated by an asterisks (*); these data had no associated specimen or record in musuem databases apart from the specimen in the North Thompson River collected in 1997.

Watershed/ site	Collection	Catalogue no	Date collected	Locality description	Notes
Fraser River	RBCM*	-	30-Oct-92		
North Thompson River	RBCM*	-	27-Aug-92		Specimen with this date is from the Similkameen; see Table 1
North Thompson River	RBCM*	-	25-Sep-94		
North Thompson River	RBCM*	-	27-Sep-94		
North Thompson River	UBC*	-	29-Nov-97	?	This is a catch record at UBC without a specimen, no collector or identifier is mentioned
North Thompson River	RBCM*	-	30-Aug-16		
Blind Creek	RBCM*	-	30-Aug-06		
Similkameen River	RBCM*	-	13-Sep-90		
Similkameen River	RBCM*	-	26-Oct-04		
Similkameen River	RBCM*	007-00108-007	19-Jul-05	Similkameen River, Kobau Park	All specimen are Bridgelip suckers
Similkameen River	RBCM*	-	19-Jul-05		
Similkameen River	RBCM*	-	29-Aug-06		
Similkameen River	RBCM*	007-00057-006	29-Aug-06	Similkameen, Cawston	All specimen are Bridgelip suckers
Similkameen River	RBCM*	009-00014-008	29-Aug-06	Similkameen, Karemeos	All specimen are Bridgelip suckers
Similkameen River	UBC*	-	9-Aug-09		
Wolfe Creek?	UBC*	-	9-Aug-09		
Similkameen River	RBCM	009-00018-003	30-Aug-06	Similkameen, upstream of lowest bridge across river; E shore; rocky cover upstream of bridge	All specimen are Bridgelip suckers
Similkameen River	RBCM	009-00002-003	26-Oct-04	at partially covered red- wooden bridge, western shore	All specimen are Bridgelip suckers

Table 4. Specimen and catch records associated with Cordilleran Sucker found here to either not exist in collections or databases or to have been incorrectly identified. Data found to be erroneous that were used in COSEWIC (2010) (Appendix 3) are indicated by an asterisks (*); these data had no associated specimen or record in musuem databases apart from the specimen in the North Thompson River collected in 1997.

Watershed/ site	Collection	Catalogue no	Date collected	Locality description	Notes
Similkameen River	RBCM	009-00005-002	19-Jul-05	South of Karemoes, just upstream of open-framed Bridge that leads to IR8 (Skemoskuakin)	All specimen are Bridgelip suckers
Similkameen River	RBCM	009-00011-002	29-Aug-06	Cawston, at Kobau Park	All specimen are Bridgelip suckers
Similkameen River	RBCM	009-00016-003	30-Aug-06	narrows just north of International Border; E side of river. 1.2km from junction with Hwy 3	All specimen are Bridgelip suckers
Otter Creek	UBC	56-374	7-Jun-56	Princeton Area, Tulameen river near junction of Otter river	All specimen are Bridgelip suckers
Euchinko River	Literature			Euchinko River	McPhail et al. 1998
Salmo River	Literature		22-Jun-05	Salmo River	Baxter, Birch & Olmsted 2003
Pelican Lake	CDC		22-Jul-69	Pelican Lake	Harding and Offin 1969b
Shesta Lake	CDC		16-Jul-69	Shesta Lake	Harding and Offin 1969a
Columbia River	CDC		1-Apr-98	Columbia River at US border	Haas 1998
Fraser River	CDC		1-Apr-98	Mouth of Fraser River	Haas 1998
North Thompson River	CDC		1-Apr-98	North Thompson River at Kamloops	Haas 1998
Rayfield River	CDC		1-Feb-00	Rayfield River	

Table 5. Cordilleran Sucker records from databases that met one of the three criteria for confirmation of identification along with positive eDNA metabarcoding results from this study.

Waterbody	Source	Catalogue no	Date	Locality description	Lat	Long	Notes
Fraser River	CDC/ FDIS	fshclctn_id 110445	13-Sep-07	adjacent to F.H. Barber Provincial Park	49.293	-121.667	
Fraser River	CDC/ FISS	survey_id 135258	1-Feb-00	Near Herrling Island	49.229	-121.713	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135107	1-Feb-00	Fraser River Ecological reserve	49.182	-122.001	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135218	1-Feb-00	Carey Island	49.223	-121.881	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135228	1-Feb-00	Just west of Agassiz	49.219	-121.811	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135245	1-Feb-00	South of Agassiz	49.213	-121.757	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135159	1-Feb-00	Minto Island	49.225	-121.924	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135176	1-Feb-00	Minto Island	49.217	-121.949	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135189	1-Feb-00	Minto Island	49.225	-121.924	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135121	1-Feb-00	Minto Island	49.209	-121.971	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135206	1-Feb-00	East of Minto Island	49.223	-121.896	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135135	1-Feb-00	Minto Island	49.204	-121.946	Fraser R fish study - UBC
Fraser River	CDC/ FISS	survey_id 135147	1-Feb-00	Minto Island	49.209	-121.932	Fraser R fish study - UBC
North Thompson River	CDC/ FDIS	fshclctn_id 117330	6-Aug-10	Clearwater	51.648	-120.049	Taylor 2011
Similkameen River	CDC/ FISS	survey_id 106627	1-Feb-98	Located in Similkameen at Ashnola River mouth	49.225	-119.973	
Similkameen River	CDC/ FDIS	fshclctn_id 223223	12-Sep-17	Similkameen River at Hedley	49.350	-120.083	Ramsay 2017
Similkameen River	CDC/ FDIS	fshclctn_id 223225	24-Sep-17	Similkameen River at Hedley	49.350	-120.083	Ramsay 2017
North Thompson River	eDNA/ this study		13-Sep-24	Near Heffley Creek	50.853	-120.290	Positive eDNA result

Table 5. Cordilleran Sucker records from databases that met one of the three criteria for confirmation of identification along with positive eDNA metabarcoding results from this study.

Waterbody	Source	Catalogue no	Date	Locality description	Lat	Long	Notes
North Thompson River	eDNA/ this study		13-Sep-24	McClure	51.032	-120.236	Positive eDNA result
North Thompson River	eDNA/ this study		14-Sep-24	Clearwater, near Dunn Lake Rd	51.640	-120.031	Positive eDNA result
Fraser River	eDNA/ this study		11-Mar-24	Ballam Road, Chilliwack	49.210	-121.929	Positive eDNA result

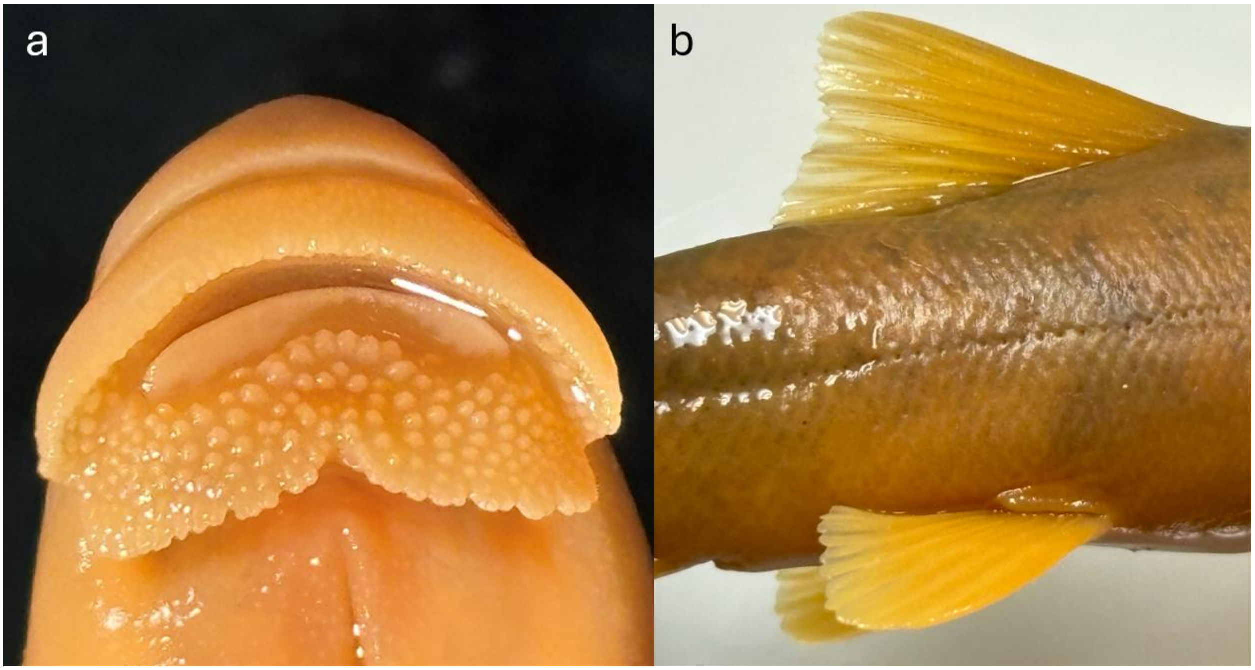

Figure 1. Images of Cordilleran Sucker specimens showing the mouth with an upper lip lacking papillae, and distinctive shape of the lower lip showing nearly horizontal posterior margin with a small central notch and the outer corners of the lower lip more angular (approaching 90 degrees) than round (a) and the presence of a pelvic axillary process on the pelvic fin (b). Photos by Scott Gilmore.

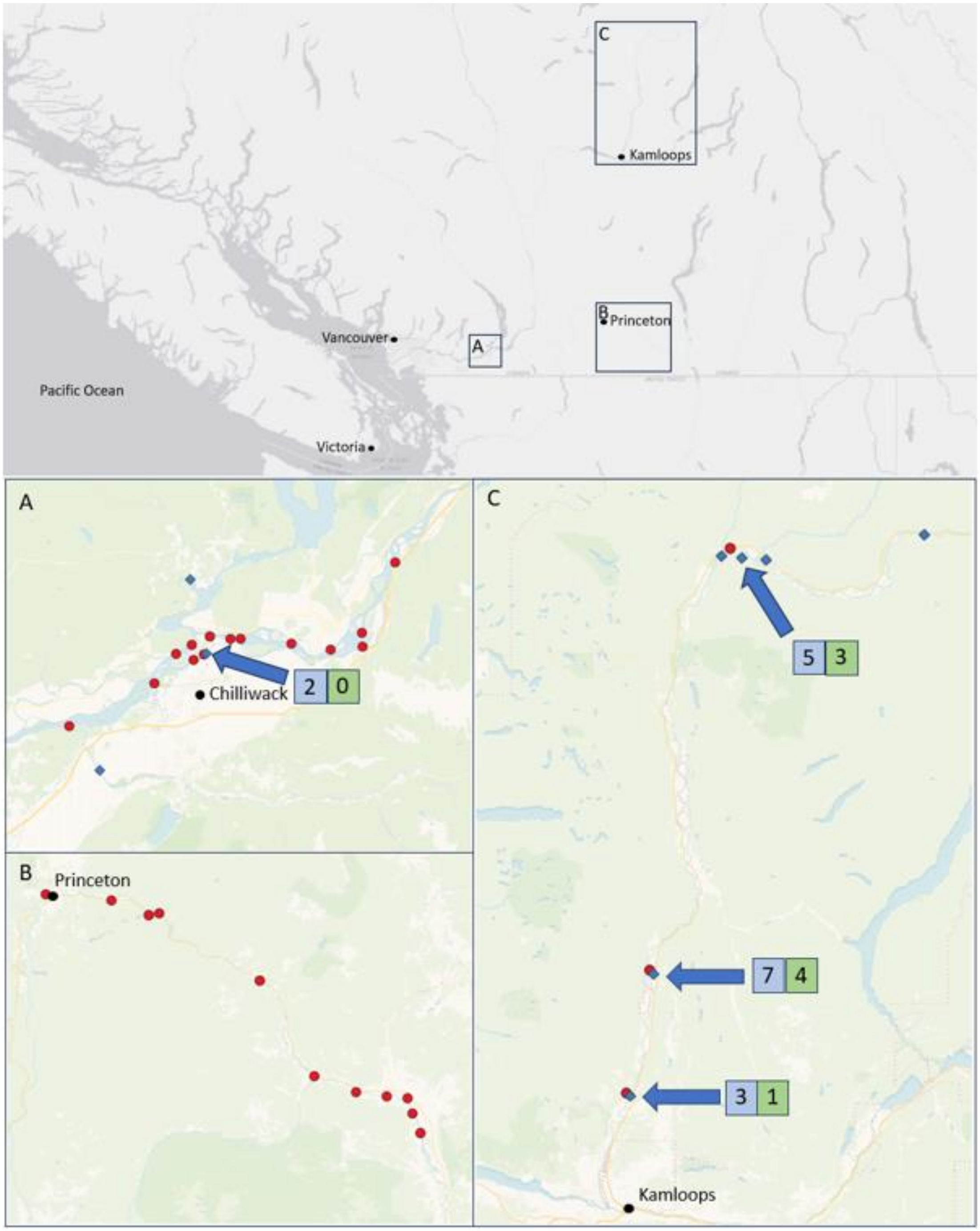

Figure 2. Overall Cordilleran Sucker distribution in British Columbia; as follows: Fraser River (panel A); Similkameen/Tulameen Rivers (panel B); and North Thompson River (panel C). Red dots are specimen or verifed database occurrence records; blue diamonds are eDNA sample sites; and large arrows show positive eDNA sites. Boxes show the number of field replicates in which the species was detected by 12S (blue) and 16S (green) at each positive eDNA site.

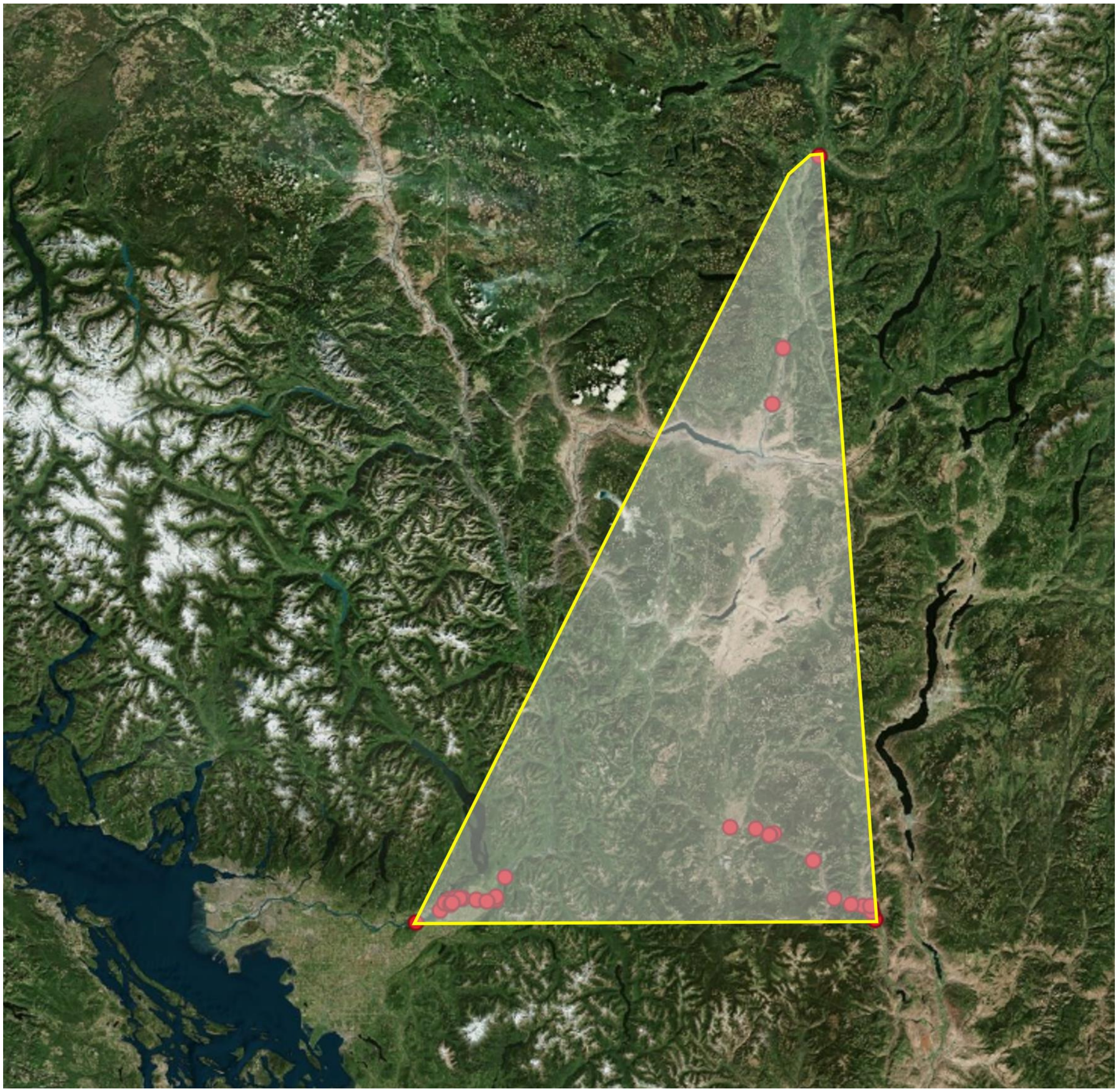

Figure 3. Map showing the Extent of Occurrence (EOO) of Cordilleran Sucker in British Columbia covering 24410 km^2. Red circles indicate confirmed locations of the species based on verifications done in this study.