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Creating a Herbarium for Plant Conservation

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Executive Summary

Plants, lichens and fungi, have been an integral part of the ecology and culture of Tsay Keh Dene Nation (TKDN) since time immemorial. Disturbances resulting from climate change, anthropogenic activities, and natural causes pose risks to flora, including medicinal and cultural plants. Flora in northern climates, such as in high mountain alpine habitats, are particularly vulnerable to extinction (Dullinger et al., 2012). As Tsay Keh Dene (TKD) elders and botanical knowledge holders age, there is an urgency to gather and formally document important cultural botanical information before habitats, flora, and TKD knowledge, is lost. The project goal, to investigate and determine the feasibility of creating a community herbarium for botanical conservation in Tsay Keh Dene, BC, aligns with the following FWCP Action Plans:

- Research and Information Acquisition: PEA.RWE.SO5.RI.13 – Research culturally important species.
- Research and Information Acquisition: PEA.CRE.SO5.RI.12 – Conduct stewardship and education related to aquatic and terrestrial conservation.

We investigated the potential of establishing a herbarium in the community of Tsay Keh Dene, BC, through i) a literature review, ii) interviews with a select number of TKD citizens and elders, and Tsay Keh Dene Lands Resources and Treaty Operations (TKD LRTO), and iii) consultation with two herbaria curators.

Results from interviews indicate that creating a herbarium is important to TKD citizens. In particular, elders who would like to facilitate Indigenous Knowledge retention and education for culturally important species, as well as for land stewardship purposes within the territory. Over 16 culturally important plant, fungi, and lichen species were identified from interviews, as well as several habitat types and ecosystems where collecting botanical data was of interest to TKD citizens. This includes alpine and wetland habitats, and moose and caribou forage species. Several important cultural species have lost Indigenous Knowledge already, and these species require field validation and collection with elders to ensure the remaining Indigenous Knowledge is retained for future generations.

A herbarium based in Tsay Keh Dene, BC, will create new connections to the land, facilitate inter-generational knowledge transfer, provide educational opportunities for structured and informal learning, and formally document biological and cultural records. Within the herbarium there are physical specimens that are important for data retention, and employment and training opportunities for TKD citizens to gain skills in specimen processing and data management. The herbarium will be an important stewardship and ethnobotanical resource for TKD citizens and others interested in northern flora conservation now and in the future, including elders, researchers, TKD LRTO, and others doing land-based work in the territory.

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1 Introduction

1.1 Project Background and History of Tsay Keh Dene

Plants, as well as lichens and fungi, have been an integral part of the ecology and culture of Tsay Keh Dene Nation (TKDN) since time immemorial. Climate change, anthropogenic activities, and natural disturbances pose risks to northern flora, including medicinal and cultural plants. The creation of the Williston Reservoir flooded the Rocky Mountain Trench, including areas used for subsistence by TKD for medicine gathering and berry picking. Further, the reservoir has become a transport route, permitting the economic harvest of previously inaccessible forested areas. Many natural areas have been impacted by forest fires, pine beetle kill, and the associated salvage harvests. These factors, combined with the aging of TKD elders and botanical knowledge holders, creates an urgency to gather and formally document important cultural botanical information before important habitats, flora, and TKD knowledge held by individuals, is lost.

The study area is TKDN territory, located within the Finlay Arm Watershed. The community engagement occurred in the village of Tsay Keh Dene, British Columbia, located at the northernmost tip of the Williston Reservoir in northern British Columbia, Canada (56.902, -124.953) (Figure 1).

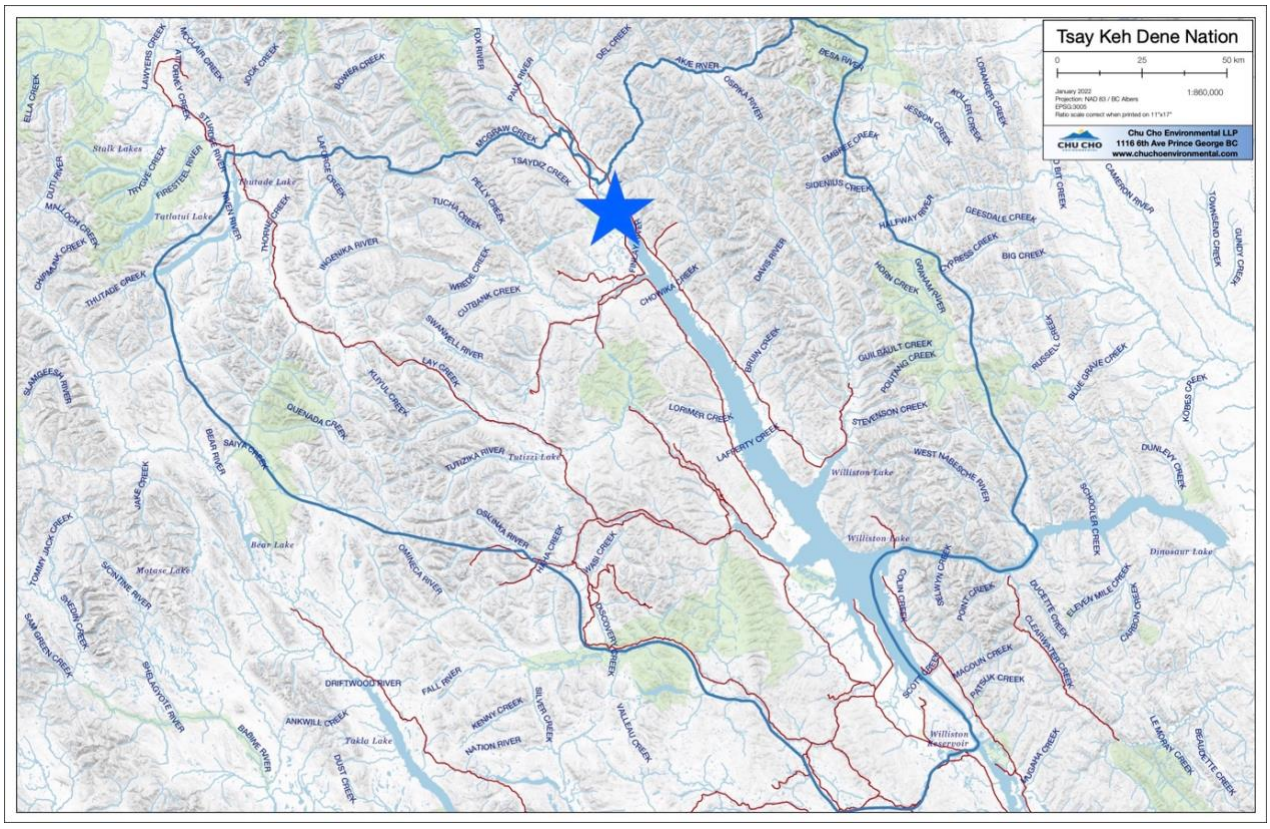

Figure 1. Map of Tsay Keh Dene Nation territory, location of community of Tsay Keh Dene indicated with blue star.

To date, there have been several comprehensive surveys for vegetation in the territory (e.g., baseline studies for Kemess Mine, FWCP Wetland Surveys for Predictive Ecosystem Mapping); however, these occurred in a small subset of ecosystem types and there has been no concerted effort to organize and collect botanical data for community purposes in the territory, including to retain Indigenous Knowledge and collect specimens for long-term data and educational use. However, botanical data are collected in the territory as a component of many projects, for example baseline studies for mineral exploration projects. This is an opportunity. The botanical data collected during these projects could become an important input to a community managed herbarium.

Creating a community herbarium in TKD to preserve important data on cultural plant, lichen, and fungi species falls under the following priority actions: PEA.RWE.SO5.RI.13, PEA.CRE.SO5.RI.12, and PEA.CRE.SO4.RI.10.

The primary source for contemporary Tsay Keh Dene ethnobotanical information is the book entitled *Sekani Ethnobotany: Traditional Role of Plants and Amongst the Sekani People* (Tsay Tay Forestry Ltd, 2008) or through discussions with elders. Sekani Ethnobotany is an important but out of print resource that includes details on medicinal plants and how to use them. However, it does not include accounts of habitat or detailed illustrations to assist with field identifications. Additionally, there are no physical specimens to assist with this knowledge retention and transfer. Conversations with TKD elders indicate that there are culturally important plants that are not documented in the book. Field collection and validation is required to retain Indigenous Knowledge as it relates to species identify, use, habitat, and locality information *Sekani Ethnobotany* will be useful in conjunction with physical herbarium specimens and collections data to assist with knowledge retention and knowledge integration of culturally important flora in TKD.

This project used seed grant funding to conduct community engagement a literature review, and consult with existing herbaria including the Arkansas State University (STAR) herbarium curator and the National Herbarium of Canada (CNM) curator. The project outcomes are rooted in researching culturally important botanical species based on interviews with elders and TKD LRTO, using Indigenous Knowledge to inform activities associated with a herbarium including field collection, herbarium setup, workshop and trainings, and knowledge integration with existing sources. Creating a community herbarium provides an accessible repository for biological and cultural data in addition to providing a framework and environment for all botanical data in the territory.

1.2 A review of the literature on herbaria

A herbarium (plural herbaria) is a collection of dried and preserved botanical specimens, such as plants, fungi, and lichens, that are a critical resource for biodiversity, ecological, and evolutionary studies (Chapman 2005). Herbaria are irreplicable sources of botanical information about species themselves as well as the land they inhabit. Globally, there are over 3,522 active herbaria containing 397,598,253 specimens (Thiers 2022). These herbaria range from large institutions such as the Kew Gardens to small, locally run herbaria. The oldest herbarium is believed to be a collection from an Italian herbalist and artist from 1532, Gherardo Cibo. In 2021, there were 95 newly registered herbaria (Thiers 2022), indicating there is clear continued support for herbaria and the data they collect. In Canada, there are 92 herbaria

with 9,315,350 specimens from data reported in 2021 (Thiers 2022). The Royal Botanic Gardens in the United Kingdom is the largest herbarium in the world, established in 1852 and housing over 8 million specimens.

The Smithsonian Institute (Funk 2004) compiled a list of 72 modern uses of herbaria. For example, herbaria are increasingly used for understanding climate change impacts on the landscape (Hovenden et al., 2018) as well as documenting biodiversity shifts over time and space (Chapman, 2009). Herbarium records have also been used to detect and respond to threats of invasive plant species (Baird, 2010) and can be used to support current and future conservation actions, i.e., herbaria serve as a means of locating rare or possibly extinct species via recollecting areas listed on label data, or by providing spatial or morphological information on rare species to support conservation work (Funk 2004).

There is currently global interest to inform natural history collections with Indigenous Knowledge. The Nez Perce Tribe Herbarium in Idaho, USA, has a vascular plants collection focussing on native plants and canyon grassland flora. The Navajo Nation Herbarium (NAVA) was created in 1997 and was listed with the Index Herbariorum in 2003. This herbarium is now housed at the Northern Arizona University and has over 10,000 specimens of ecological and cultural importance and is digitally databased. The University of California at Berkeley collaborated with Klamath and Yurok Tribes to create the Karuk Herbarium, focussing on cultural food, fiber, and medicinal flora found in their territory. Timiskaming First Nation in Ontario, Canada, created the Ni Dakinan virtual herbarium, showcasing cultural and medicinal flora. Additionally, the University of Calgary Herbarium has also developed an online resource to share ethnobotanical knowledge about specimens with Kainai First Nation in Alberta, Canada.

Herbaria can document information about plant associations, the medicinal use of specific botanical species, how to process medicinal plants, identities of species used for fibre and construction materials, information about traditional food crops, and other traditional processes associated with these plants. Cultural plant data can also describe stories and historical accounts, retrace ethnobotanical histories, locate ancestral crops, and identify seed and plant remains from archeological sites. Herbaria can include notes and personal anecdotes from those using the plants and their connections to them and the land. More uses and information regarding cultural plants and cultural uses of herbaria are likely to surface when engaged with an Indigenous Knowledge perspective during implementation.

The biological and ecological value of herbaria is immense. Herbarium specimens and data are used to identify and document plant communities for and spread of weeds for invasive species management, used to locate habitat and forage for insects, locate habitat and forage for mammals, document pollination ecology, provide QAQC for rare plant data, and retrace historic plant ranges, amongst others. Tracking ecological trends in population occurrences and phenology is critical to support the health and security of culturally important flora and conservation in the territory across taxa.

1.3 Statement of need

The cultural, spiritual, and ecological knowledge of plants is important to conserve and share with future generations of the TKD community. Building a repository of culturally and ecologically important botanical data to preserve knowledge is time sensitive – elders and knowledge holders are aging, and landscape changes are occurring at a rapid pace due to both industrial land use and climate change. Understanding and tracking ecological trends in population occurrences and phenology is critical to support the health and security of culturally important plants and conservation in the territory across taxa. Creating a herbarium to preserve culturally important species ensures Indigenous Knowledge is retained and that continued access to documented botanical data exists for forest stewardship, conservation initiatives, educational purposes, and more. A repository of botanical data collected in this format would be valuable to TKDN as well as proponents, government or interested parties that might conduct work in the territory.

1.4 Project Goals

The goal of the Seed Grant is to investigate and determine the feasibility of creating a herbarium informed by Indigenous Knowledge in Tsay Keh Dene, BC.

1.5 Project Objectives

To investigate and determine the feasibility of creating a herbarium in TKD, BC, the following objectives were developed:

1. Conduct a literature review
    a. To understand the value of herbaria for cultural and ecological purposes.
2. Conduct feasibility research
    a. To understand space and facility requirements including operational and start-up costs, database options, personnel, accessibility options, and educational opportunities.

3. Investigate community interest through interviews with TKD Citizens
    a. Discuss the perceived need for botanical conservation with TKD citizens.
    b. Determine if TKD Citizens are interested in implementing a herbarium and what it could look like.
    c. Understand community needs for data collection, including specific species of interest or areas or habitats of concern that should be documented.
    d. Other topics brought up by community members through semi-structured interviews.

4. Synthesize and disseminate results
    a. Provide results from steps 1 – 3.
    b. Explore how data generated could be used by other interested parties such as TKD LRTO, and the TKDN Forest Stewardship Framework (which is a document developed by TKDN to

guide forest practises), and other research and conservation programs in the territory.

2 Community Engagement: Methods and Outcomes

2.1 Community Engagement

2.1.1 Community Engagement Methods

Prior to community engagement, a letter was sent to TKDN members who were noted by Sabrina Dulude (TKD Citizen and Chu Cho Environmental employee) as having interest in ethnobotany (0). Approximately 20 TKD citizens were contacted in advance. During a formal engagement session in April 2022 in the TKD community, the project was discussed with citizens. Interviews regarding the herbarium project occurred with six community members, including four elders, between April 26 and 28.

Interviews were structured but were allowed to evolve organically with the goal of understanding the interest and value of creating a community herbarium for TKDN. Other topics included understanding the participants' relationship is to plants, lichens, and fungi in the territory, what species participants were interested in monitoring for ecological and cultural purposes, and ways to collect and share knowledge for research and educational purposes.

Interviews were structured around three key questions:

1. *Tell me about yourself and your relationship to plants in the territory.*
    a. *Do you have concerns about plant knowledge retention, conservation, or education in the community?*
2. *What would you like to see done to explore plant conservation and knowledge retention?*
3. *Would creating a community herbarium (plant collection) be a tool you would be interested in creating for plant conservation and education in TKD?*

Participants were shown materials to assist in understanding and visualizing what a plant collection and herbarium storage might look like, as well as a map of the territory to help guide interviews and explain and visualize concepts (Appendix 2:). Casual conversations where support was provided for the project also occurred through conversations at a TKD Language and Culture Committee meeting in the fall of 2022, and by connecting and working with community members on other projects throughout the summer of 2022 in the territory.

2.1.2 Community Engagement Results

A total of nine community members discussed the project. Six were formally interviewed with an additional three TKD citizens providing interest and support outside of this engagement.

- All participants expressed interest in conducting plant collections work for themselves and for educational purposes with youth and the community.
- All participants were interested in creating a herbarium and storing physical specimens in the treaty office where other historical information including books, photographs, and maps are accessible. This office is staffed and is a central location for the collection to reside and be shown to community members and visitors.
- Participant B wanted to collect medicinal plants and store them in jars and bags so that the medicine, as it looks in the processed form, can be visualized. Participant B also wants to have traditionally pressed herbarium specimens that feature flowers, fruits, stems, and leaves of the plant for research and identification purposes.
- Participant C brought to the engagement session jars of different medicines to show the project lead and noted that they have a plant press to do some collecting work. Participant C also expressed wanting to educate the younger generation in plant medicine and collecting, as they were now aging and finding it difficult to get out and collect specimens on her own.
- Participant D explained how they used to do plant pressing workshops with kids at the school. Participant D would like to do school visits and plant pressing workshops in the future as part of the herbarium.

All community members interviewed expressed interest in plant collections work and having a community herbarium for cultural, ecological, and educational purposes. Other organizations that expressed interest in pursuing the project include the Language and Culture Department, and TKDN LRTO, including community members staffed at the LRTO, and the Canadian Nature Museum.

2.1.2.1 Specific botanical species and habitats

Community members expressed particular interest in monitoring and looking for certain botanical species (Table 1). Species identified were noted as being less abundant than they have been in the past, culturally important to retain record of locations and population health and tied to important to ecological processes. All participants expressed interest in monitoring and collecting lowbush cranberry (*Vaccinium vitis-idaea*) and most participants mentioned alpine plants and monitoring alpine areas to be of interest as there are concerns over climate changes and warming. Specific reasons of interest for collecting botanical information and specimens were discussed but are not included in the FWCP report as they have not undergone review by TKDN LRTO.

Table 1. Plants of interest for data and specimen collecting in Tsay Keh Dene based on interviews with community members in April 2022.

Plant of interest (Sekani names)	Plant of interest (English name(s), Latin name)	Participants expressing interest in collecting and monitoring
unLhut, Een'clud	Lingonberry, Lowbush cranberry *Vaccinium vitis idaea*	All participants
K'ehmi-ehe	Saskatoon *Amelanchier sp.*	A, B, C, D
Whush Cho	Devil's club *Oploplanax horridus*	A, C, D
Caah'chel'lay	Cottonwood *Populus balsamifera*	All participants
Unknown	Unknown	B, C, D, E
Niswhush	Soapberry *Shepherdia canadensis*	B, C, D
Mye'cho, Mi-cho	Huckleberries *Vaccinium membranaceum*	All participants
utsisutLha	Blueberry *Vaccinium caespitosum*	E
Ch'eh'tahz'zee	Yellow water lilies *Nuphar lutea spp. polysepala*	B, C, D
Unknown	Chaga	B, D
Txahns	Grizzly bear roots *Hedysarum alpinum*	B, C, D
Unknown	Water cress? Unknown	C
Suzziullie	Wild onions *Allium cernuum*	B, C, D
Doh'gaze'zaa	Lady slipper *Calypso bulbosa var. americanum*	B, C, D
Luddee'mass'gate, Meldimesghid	Muskeg Tea, Labrador tea *Rhododendron groenlandicum*	E, F
Ein'jooh	Freckle pelt lichen, Caribou lichen *Peltigera apthosa*	F
Unknown	Invasive plants (generally)	A

In addition to the above specific plants, lichens, and fungi identified, the following general habitat features and areas were of interest to collect cultural botanical information and specimens in as part of a herbarium collections trip:

- Wetlands, lake edges, and swamps
- Alpine areas
- Damp, mossy forests
- A specific mountain
- A specific culturally significant area

Outcomes from the interviews in Table 1 indicate several culturally important plants with unknown Sekani, Latin, or common name identities. These species were also not found in *Sekani Ethnobotany*. These species require field validation with elders and specimen collection to retain the remaining Indigenous Knowledge for future generations and to create knowledge integration with ecological studies in the territory.

3 Operations and Feasibility: Methods and Outcomes

Herbarium establishment activities and costs, as well as and operational activities and costs, were discussed with the curator of CNM Herbarium (J. Doubt, personal communication, July 12, 2022) curator of the STAR Herbarium (T. Marisco, personal communication, October 24, 2022), and through the literature. These activities are outlined in Table 2 and Table 3. The low cost options for digitization are outlined in Harris and Marsico 2017.

Start-up/establishment cost for a kick-off collections trip, mounting workshop, data management, research, community engagement and herbarium supplies is estimated to be $43,228.86 (includes all costs of labour, materials, etc.), with $28,399.00 of this being In-Kind time and disbursements. A full budget for year one of the TKD herbarium was completed in the Large Grant application (Appendix 3:).

Ongoing operational costs include those associated with management and specimen insertion, curatorial training, capacity building, consumable supplies, and educational workshops and collection trips. Therefore, variability exists for ongoing costs; however, the operating costs at a yearly minimum for basic data management curation would be approximately $6,500. Costs will increase based on how many collection trips are planned, if mounting workshops are given, the number of specimens requiring insertion and digitization into the collection, additional consumable supplies, number of staff working and if additional training is pursued.

Table 2. Resources and activities associated with herbarium establishment.

Item	Purpose
Facility	Location to house the collection, provide information to TKD citizens and visitors

Specimen storage cabinets	Proper specimen storage to prevent damage (2-4 cabinets)
Plant Identification Resources – Books, Literature, Microscope	Education, Training
Fieldwork and Specimen Mounting Supplies – non-consumable	Education, Training, Data management
Digitization Equipment – camera, lights	Data management, Education
Plant dryer	Dry botanical specimens for quality and longevity in the collection
Digitization and curation training time	Training, Data management, Capacity Building for 1 TKD citizen to learn how to digitize specimens.
Collection kick-off field survey and collection in TKDN	Collect important species for the herbarium based on community input for cultural plants and location to conduct fieldwork in.

Table 3. Resources and activities associated with herbarium operations.

Item or Activity	Purpose
Consumable Fieldwork supplies – consumables (Cardboard, plastic and paper bags, labelling materials)	For continued data collections.
Mounting supplies – paper, glue, folders, mounting tools, printer ink, cardboard	For continued specimen management.
Curation Time, 1-2 people	Manage collections, insert new specimens from other projects, data management including digitization, providing support to elders and those interested in visiting and using the herbarium. Curation work will prioritize training and hiring a TKD citizen.
Specimen collection trip with elders, TKD community	For continued data collection and IK preservation in TKD, education, and land stewardship. Field work will prioritize training and hiring TKDN LRTO Environmental Monitor, if available.
Education, Knowledge Sharing and Engagement (e.g., Workshops, Learning Sessions)	For continued knowledge dissemination and training on how to use the herbarium, specimen management, etc. for those interested in the community. Engagement work will prioritize training and hiring a TKD citizen.
Ongoing training and capacity building for personnel	For continued training in curation and management of the collection.

4 Funding Opportunities

There is support from TKD LRTO, the TKD Language and Culture Department, and Chu Cho Environmental to continue to support the use of the herbarium once it has been installed to address the long term sustainability. This is further discussed in Section 6.

Since application of the Large Grant to FWCP in 2022, the project has also been sent to the TKD LRTO and TKD Language and Culture Department to acquire additional funds. A submission for additional funds will also be submitted to the Climate Change and Health Adaptation Program.

5 Training, Capacity Building, and Data Ownership and Digitization

5.1 Employment and Training Opportunities

Training opportunities will be provided as part of any future project through field collection, curation, data entry, management, and digitization (see Table 2 and Table 3). Digitization would occur as the herbarium progresses in subsequent phases providing employment and training for TKD community members to complete this work. The project will prioritize the provision of training and capacity building opportunities for TKDN citizens, which would include employing environmental technicians to assist in plant collections and data management.

5.2 Educational opportunities for the community

Herbaria, by design, are an educational tool and plant database to assist in learning plant morphology and biogeography, as well as facilitate stewardship with the land. Creating a herbarium in TKD, BC, that is rooted in documenting northern flora and is informed through Indigenous Knowledge will provide many educational opportunities. The herbarium will be a resource for both formal and informal training and learning.

Formal educational opportunities include identification workshops, specimen care and mounting workshops, training for inputting data, and curation and data management. Formal workshops could also be led by TKD community members on cultural plant use, including medicine processing workshops. Seed collection workshops would also benefit from being run in collaboration with the herbarium. The herbarium could also offer tours and workshops to youth at the school and to visitors in the community when feasible.

Informal learning opportunities will also be available, as the herbarium will be open to the public and available as a resource online once digitized. Informal learning is endless, and each person can tailor their educational

experience with the data generated from the herbarium to suit their needs, i.e., learn about medicinal plant uses, identification and morphology, understand range and habitat, etc.

Data generated could also be accessed as part of educational studies or formal research on botanical species and associated habitats including morphology and phenology studies, forage studies, cultural use studies, climate change studies, and more.

5.3 Digitization process

Many herbaria are digitizing their collections to be more publicly available online for both the public and scientific community over the past few decades (Owen, 1990; Allen, 1993; Lane, 1996; Network Integrated Biocollections Alliance, 2010; Nelson et al., 2015). Digitization expands the use of the information to disseminate knowledge and research to the broader botanical community. In the digitization process, botanical specimens that have been collected are updated with new nomenclature, if required, and annotated. Specimens are then imaged, and those images are uploaded to a database. The herbarium described herein would use Specify, a commonly used free software for herbaria. Label information is then databased and uploaded. All components are combined into a virtual herbarium accessible online. The process is described specifically as a low cost option for herbaria with limited resources by Harris and Marsico 2017. The community herbarium would have logistical In-Kind support from CNM for digitizing.

5.4 Data collection, sharing, and management

Data collection, sharing, and management will be directed by TKDN and will follow the First Nation Information Governance Centre Principles of Ownership, Control, Access, and Possession (OCAP).

Data management of physical specimens will occur as part of workshops to mount specimens and prep them for herbarium insertion. Physical specimen data will be available in TKD, BC, in the herbarium. Data will be entered into the herbarium database, Symbiota, as directed by TKDN.

5.5 TKD Herbarium value to other projects

The herbarium provides specific guidance to inform collections for cultural plants to retain important Indigenous Knowledge; however, additional botanical data and collections work is a component of existing and ongoing projects in TKD territory. A herbarium will provide an established venue for this data to be housed, and will enhance the value that those projects provide to TKDN and the scientific community. By creating a repository for botanical data and specimens, all future projects can contribute to the herbarium, providing educational material for TKD citizens and others through more data deposits. For example, TKD citizens expressed interest in collecting invasive plant specimens as part of an established monitoring program with TKD LRTO in the territory. These specimens would be used to educate others on the invasive plant species and their traits that are known to occur in TKD territory. The specimen data will also be useful

for forage studies of focal wildlife species such as caribou and moose (e.g., to determine areas of high-quality habitat).

The specimen data will also be of use to TKDN's businesses, including Chu Cho Environmental, whereby TKDN employees can use the herbarium for training and education to support projects in the territory.

6 Funding Conditions

FWCP provided the following funding conditions,

"Final report to include review of existing information sources, address long term sustainability of herbarium in terms of funding, and include plan on how project could be expanded beyond Tsay Keh Dene area if results are positive."

Existing information sources on herbaria and plants

Existing information sources on establishing herbaria and operations have been outlined throughout the report, including but not limited to sources used in the literature review, and consultation with herbaria curators. The National Herbarium of Canada (CNM) is willing to provide long-term support for the project as an information source (J. Doubt, personal communication, July 12, 2022). There are books, articles, and research that provide guidance on data management of herbaria that can be used through the establishment phase and into the operational phase, including a detailed bibliography for plant collection and curation (Hicks and Hicks 1978). *Sekani Ethnobotany* is an important resource for the herbarium project; however, there are culturally important plants and information that are not included that require specimen collection to retain this important Indigenous Knowledge (noted in 2.1.2, Table 1).

Long-term sustainability of the TKD herbarium

Research results indicate an operational pathway to creating the herbarium, including prioritizing materials under limited budgets and funding, operational aspects of maintenance and setup, and materials required (Table 2, Table 3). Viable workflows have been created to optimize herbarium specimen processing and digitization, specifically for those with limited resources (Harris and Marsico 2017; T. Marisco, personal communication, October 24, 2022). Herbaria can use free, online databases such as Symbiota to curate and store information and is recommended for use with the community herbarium (J. Doubt, personal communication, July 12, 2022; T. Marisco, personal communication, October 24, 2022). Small herbaria typically operate on low budgets and once initially installed, can function for some time before requiring additional supplies (J. Doubt, personal communication, July 12, 2022). In this case, we have support from TKD LRTO, TKD Language and Culture Department, and Chu Cho Environmental continue to support the use of the herbarium once it has been installed, addressing the long term sustainability of items identified in 3.

Expanding the TKD herbarium

The community herbarium will physically reside in TKD where citizens can utilize the data and specimens. Therefore, the program is currently being developed in close collaboration with TKDN; however, the project can be expanded beyond TKD area through providing educational material, data submissions and specimen donation, use of the herbarium, online digitization, training, and more based on specific interest. We also have logistical support from CNM's curator and expect to send duplicate specimens to larger herbaria to ensure the data is of provincial and national importance, increasing the value and utility of the information collected in TKD territory.

7 Summary of Outcomes and Recommendations

Specific Recommendations

We recommend funding a large project to achieve the following objectives:

1. Collect botanical data and Indigenous Knowledge in TKDN, as directed by elders and those interviewed in section 5.
    a. Field collection trips, as outlined by TKD elders and those interviewed, will be conducted to collect important cultural plant data and specimens in the territory to enhance existing information such as Sekani Ethnobotany. Documenting this data is time sensitive as elders are aging.

2. Process and create cultural and biological data for long term storage.
    a. Deliver a specimen processing training and workshop for those involved in collections work, as well as formal training for a TKDN citizen to curate and manage collections with support from CCE.
    b. Duplicate specimens with permitted sharable data will be sent to larger herbaria such as CNM as a data back-up for preservation in a climate-controlled environment and established institution.

3. Create a herbarium in TKD, BC – a repository for all data on plants, lichens, and fungi in the territory, both by physically installing storage for specimens in a prominent and secure building in the community where they will be accessible to community members, as well as in an online database where permitted data can be shared.
    a. Provide training and mentorship to the broader TKD community on how to use the herbarium and how to process specimens for insertion.
    b. Provide curation and data management training on how to enter and manage the data so it is usable with support from CCE and TKDN's LRTO and Language and Culture Departments for long term sustainability of the herbarium. In-Kind support from CNM is provided to this project to continue as a resource for establishing and maintaining the herbarium, as identified in the Large Grant submission.

   c. Deposit existing botanical data into the herbarium from other projects in the territory, as appropriate.
   d. Digitize collection.

4. Work with TKDN to disseminate project and data findings, provide educational opportunities, and determine future collection locations and information the community desires.
   a. This includes outreach at events such as Science Week and Environmental Outreach Week, events hosted by CCE with youth and the community.
   b. Develop herbarium data collection processes that coincide with community interest and values. In particular, elders may provide recommendations areas and species for collection.
5. Disseminate research and findings to project funders and partners, as appropriate based on data sharing agreements.
   a. For example, presentations in TKD to youth and elders, to funders, etc.

Ownership will be governed by the principles of OCAP, and funding details will be refined as the project concept is developed with TKD LRTO. Through creation of a herbarium in TKD, BC, educational opportunities and cultural knowledge sharing and retention through permanent specimen records are provided immediately and in the future to TKD citizens and others wishing to better understand northern flora. A community herbarium informed by Indigenous Knowledge and as envisioned by the community and plant knowledge holders is an important and unique data repository that will be an educational and land stewardship resource for the community and others for generations to come.

8 Acknowledgements

We thank the FWCP for providing financial support for investigating creating a herbarium with the community in Tsay Keh Dene. We thank Sabrina Dulude and Luke Gleeson for their time and work to support and organize the engagement in April 2022. We thank Jennifer Doubt, curator of the National Herbarium of Canada, for providing important guidance and logistical information, as well as a supportive interest in continuing a collaboration on this project in the future. Finally, we are grateful to each community member who participated in the engagement to share their valuable knowledge and great ideas that have helped shape the project into something tangible and meaningful to pursue.

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Appendix 1: Letter to Tsay Keh Dene Nation citizens

Hello, 8 April 2022

My name is Brianna Collis, and I work as a plant ecologist with Chu Cho Environmental.
I worked with Morgan Husereau at the Tobin Lake plant trip last year in June 2021 where I enjoyed going on plant walks with community members. I was also in the community for Science Week in March 2022.

I am hoping to chat with anyone who has plant knowledge in Tsay Keh Dene. I am looking to discuss plants and their importance in the territory. I would like to know if working on plant conservation, education and collections work would be of interest to the community.

I will be in the community **April 26 (Tuesday) – April 29 (Friday), 2022**. Are you interested in chatting? If so, please indicate below what date and time(s) you would be available:

Day: _____

Time: _____

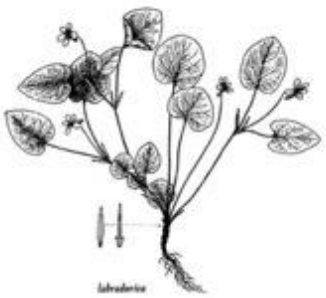
If you are interested in talking with me but not available in April, please indicate below if you would like to connect some other time:

Yes, I want to connect later. ☐

No, thank you. I'm not interested. ☐

Please let Sabrina know if you are interested in talking with me in April, or some other time by April 20th if possible. You can contact Sabrina in the TK treaty office at 993-2127 from Monday-Friday, 8:30am-4:30pm.

Thank you for your time!



Brianna Collis brianna@chuchoenvironmental.com

Appendix 2: Engagement Materials from session in April 2022

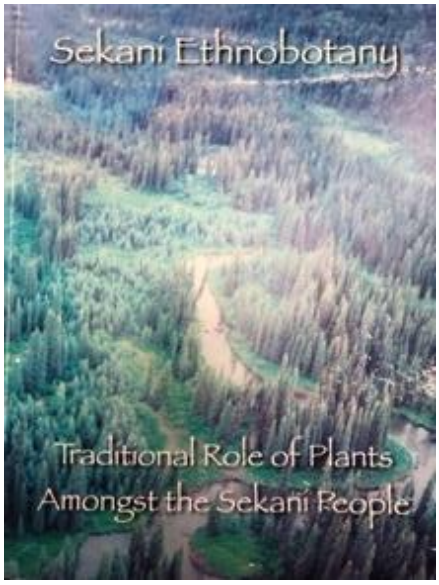


Figure 2. The *Sekani Ethnobotany* book was brought to interviews as a tool to engage and to confirm identities of plants.

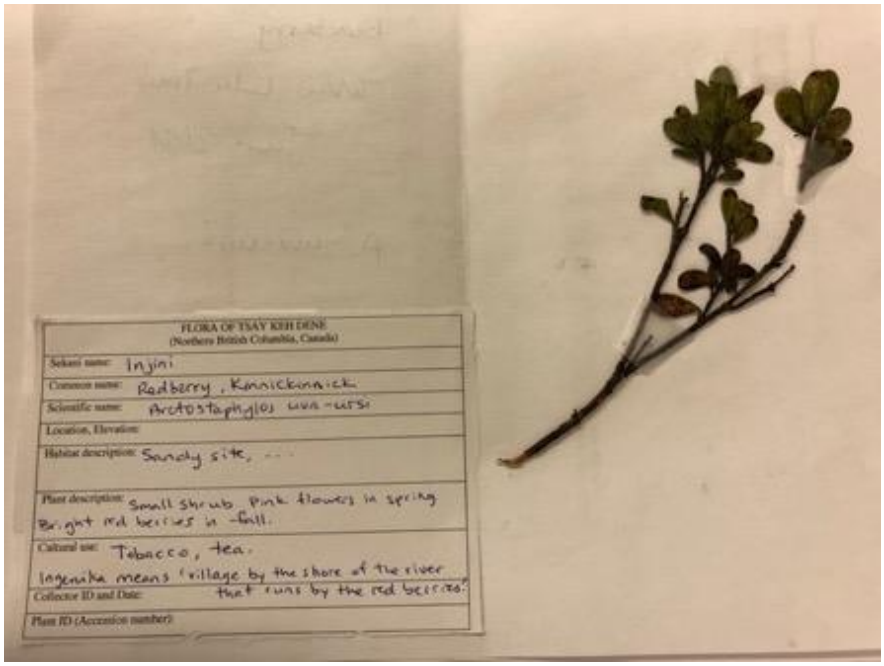


Figure 3. An example of a herbarium sample with a culturally appropriate label was brought to interviews to assist community members' understanding of what herbarium samples could look like.

To store plant specimens to prevent damage:

For display purposes, for example, treaty office, or the school:

Figure 4. Handout indicating examples of how pressed plants look, how to store them, and how to display them for community engagement purposes.

Appendix 3: FWCP Large Grant Submission Budget

FWCP Fish & Wildlife COMPENSATION PROGRAM

Budget Info

Project Budget

A) Labour Expenses (i.e. Salaries/Wages)

Service	Daily Rate	Total Days	Total Cost	FWCP Contribution
CCE - Senior Project Manager	$776.00	28.00	$21,728.00	$21,728.00
CCE - Level 1	$624.00	9.75	$6,084.00	$6,084.00
IN KIND - Canadian Museum of Nature Herbarium Curator	$250.00	6.00	$1,500.00	$0.00
IN KIND - CCE Senior PM	$776.00	1.00	$776.00	$0.00
IN KIND - TKDN LRTO	$624.00	14.50	$9,048.00	$0.00
Sub-Total(A)			**$39,136.00**	**$27,812.00**

B) Materials, Equipment, Transportation and Field Expenses

Item	Number Units	Unit Cost	Total Cost	FWCP Contribution
Per Diems - Fieldwork and Community Engagement	35	$51.00	$1,785.00	$1,785.00
Honorariums	20	$250.00	$5,000.00	$5,000.00
Fieldwork Supplies - Community Collection Consumables: Plant pressing materials, cardboard, plastic and paper bags, cleaning tools, labelling materials [Lot]	1	$500.00	$500.00	$500.00
Fieldwork Supplies - Plant Dryer Rental	10	$25.00	$250.00	$250.00
Specimen Community Workshop Supplies - Paper, cardboard, glue, mounting tools[Lot]	1	$400.00	$400.00	$400.00
Herbarium Installation Supplies, Consumables: Cardboard, Mounting Paper, Envelopes, Ink, ID Resources	1	$1,300.00	$1,300.00	$1,300.00
IN KIND - Herbarium Cabinets, Supplies	5	$1,200.00	$6,000.00	$0.00
IN KIND - Kilometers - Paved	700	$0.55	$385.00	$0.00
IN KIND - Kilometers - Gravel	1600	$0.77	$1,232.00	$0.00
IN KIND - Accommodations	16	$200.00	$3,200.00	$0.00
Herbarium Installation Engagement - Food [lot]	1	$200.00	$200.00	$200.00
IN KIND - Specimen Donation	60	$50.00	$3,000.00	$0.00
Herbarium Cabinet Transportation from In-Kind Canadian Museum of Nature Equipment Donation	1	$3,800.00	$3,800.00	$3,800.00
Kilometers - Gravel	350	$0.55	$192.50	$192.50
Kilometers - Pavement	1500	$0.77	$1,155.00	$1,155.00
Sub-Total(B)			**$28,399.50**	**$14,582.50**

Goods and Services Tax

GST-Number	Estimated GST
711378323	$2,161.44

Revenue

Source	Cash	In-kind	Volunteer	Total
Canadian Museum of Nature	$1,500.00	$6,000.00	$0.00	$7,500.00
TKDN LRTO	$0.00	$9,048.00	$0.00	$9,048.00
CCE	$7,817.00	$776.00	$0.00	$8,593.00
Non-FWCP Total	**$9,317.00**	**$15,824.00**	**$0.00**	**$25,141.00**

Total FWCP Funding Request	**$43,228.86**
Total Revenue (should equal Total Expenses)	**$68,369.86**

C)Project Administration Costs

Item	Number Units	Unit Cost	Total Cost	FWCP Contribution
Admin 3% on Labour	1	$834.36	$834.36	$834.36

Sub-Total(C)	**$834.36**	**$834.36**
Total Expenses	**$68,369.86**	**$43,228.86**