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Socio-ecological Resilience in the Heart of Hutsulshchyna:
Centering Traditional Ecological Knowledge (TEK)
through Translational Ecology

By

NINA MARIA FONTANA
DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Ecology

in the

OFFICE OF GRADUATE STUDIES

of the

UNIVERSITY OF CALIFORNIA

DAVIS

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Committee in Charge

2021

Подяки:

“Карпати, Карпати, чарівні Карпати”

Головними натхненниками моєї дисертаційної роботи стали мої батьки, які подарували мені можливість досліджувати наш світ, нескінченно мене підтримували. Мій батько запалив у мені вогонь наполегливості, стійкості, постійної підтримки та ясності поглядів. Моя мати дала мені усвідомлення самобутності та відчуття дому завдяки своїй історії, мові та прихильності до людей, прагненню підтримати та нагадати кожному, кого вона зустріла, що важливо пишатися власним корінням. Саме ці подарунки стали основою мого дисертаційного дослідження.

Я висловлюю вдячність родині в Україні – теті Ларисі та Ігорю, Оксані та бабусі Ганні. Вони стали для мене другим домом – постійно забирали мене з аеропорту, авто- та залізничного вокзалу, зберігали мої валізи та одяг (навіть зараз). Я хочу подякувати їм за опіку, за розмови про політику, життєві цілі, сім'ю та любов. Стільки чудових бесід ми мали на кухні.

Я б хотіла подякувати всім людям, у яких зупинялася впродовж моїх досліджень… кожному гуцульському дому. Багато з них нагадували другу домівку (смачною їжею, живими балачками, теплотою прийняття і затишним притулком). Здається, що гостинність та щедрість перебувала скрізь, куди б я не ступала, і я не можу не підкреслити, що без цієї привітності, яку я отримала, ця дисертація була б, напевно, лиш вигадкою моєї уяви.

Хочу подякувати Богданові та Люді Прокопишиним з Верхнього Ясенова - з якими познайомилась під час свого першого візиту на Гуцульщину у жовтні 2017 року. Любов Богдана до історії відчулась щойно він почав оповідь. Я дуже вдячна йому та Люді за глибокі знання, якими вони поділилися зі мною. Я також хотіла б подякувати Миколі Костюку за його велику доброту та відкритість у розповідях про рослинний світ та Чорногору. Також складаю подяку Паші [ii] ьмесі, яка познайомила мене з багатьма жителями села Криворівня, яка провела багато зимових ночей, розмовляючи зі мною про землю, яку вона любить, і про тонкощі місцевої історії та мови. Дякую Андріані Бельмесі за те, що вона брала мене в походи! Глибока вдячність пані Василині з Верхнього Ясенова за те, що вона провела зі мною цілий день, і поділилася неймовірними думками та своєю мудрістю. Я глибоко вдячний Каті Юрнюк, освіченій бібліотекарці з Криворівні, яка люб'язно запрошувала мене у дослідницькі експедиції зі своїми друзями Любою Цвілюнюк, Василиною Плиткою та Надією Піпінчик-Кравців. Кожна з цих жінок є силою природи, присутність якої стала для мене чудовим прикладом для наслідування. Дякую Надії Перепелиці та всій її родині за тепло та доброту. Хотіла б подякувати пану Сусаку за палкі дискусії в нього вдома на різноманітні теми: від Карпатських гір до філософії. Я хотіла б подякувати бабусі Ганні зі Старої Косова за те, що прийняла мене у своєму домі, і за її пустотливу усмішку. Вона поділилася не лише своїми знаннями, але й перспективою бачення речей, життєвою мудрістю. Я хотіла б подякувати всім чудовим спеціалістам Музею Івана Франка у Криворівні: Іванові Зеленчуку, Ганусі Люцик, Василині Кутищик і Галині Кутищик з Музею Гуцульщини. Також дякую Марії Потяк, Василині Павлюк, Василині Чарик, Ірині Мойстевич та Миколі Мойсечику, Павлові Рибаруку, Ісусу Сеговії та Арсену Мартищуку за те, що вони поділилися своїми знаннями.

Хочу подякувати Любомирові Держипільському, Василеві Лосюку, Любі Глодовій, Олегові Погрібному, Лідії Погрібній, Стеллі Фокшей, Марії Пасайлюк та Юрію Стефураку з Національного природного парку «Гуцульщина» за спільні візії та підтримку в цьому проєкті. Дякую Іванові Зеленчуку, Ярославові Зеленчуку, Михайлу Нечаю, Івану Колоджану, Дмитрові Стефлику, Наді Заєч, Миколі, Ярославу, Івану, Віталіні та Алі Зітенюкам з Національного природного пар iii ерховина» за те, що вони поділилися своїм досвідом та відкрились на співпрацю.

Також хотіла б подякувати професорам Національному лісотехнічному університету України (НЛТУ), зокрема Василеві Заячуку (за його безперервне кураторство та віру в цей проєкт), Людмилі Загвойській (за підтримку та захопливі дискусії), Ігореві Соловію (за допомогу з перекладом у ті перші місяці). Велика подяка Романові Лисюку з Львівського національного медичного університету імені Данила Галицького (за спільний досвід у систематиці рослин та щедрості ділення досвідом), Ігорю Круглову з Львівського Національного університету імені Івана Франка (за багато дискусій щодо мети проєкту) та Дмитрові Карабчуку від WWF Україна (за його щедре ділення знаннями та прихильність до Гуцульських Карпат).

Я хотіла б подякувати спільноті в UC Davis та GGE. Спасибі моєму головному професору, Бет Роуз Міддлтон Меннінг (за її нескінченну підтримку, сприяння у творенні нових перспектив та гумор), а також моєму комітету з дисертацій Комітету дисертацій UC-Davis, а саме Кет Андерсон (за її підтримку, заохочення та конструктивне керівництво у всіх аспектах дослідження), і Дену Поттеру (за його нескінченне терпіння та керівництво у процесі написання). Окрім того, я хотіла б подякувати Еміліо Лаца (за його незліченну кількість знань про методи), Соні Бродт та Тому Томічу (за все, що стосувалося сільського господарства), Марку Любеллу та Хайді Баллард (за кураторство під час процесу кваліфікаційного іспиту), Метт Малапеай (за багато дискусій, що надихали), Джоанна Льюїс (за її логістичну магію), Роберто Дельгаділло (за його неймовірну здатність отримувати найезотеричніші книги, дисертації за темою короткий термін та його доброту), Мішель Тобіас (за її вказівки щодо того, як створити читабельну карту), та всім людям з Центру ефективності освіти (за підтримку та віру в мене впродовж мого першого року аспірантури).

Нарешті – найважливіше, я хотіла б подякувати своєму «фонду» - моїй родині та друзям. Ця подорож була натхненна та підживлена вашою любов’ю. Я хотіла б подякувати своїм братам і сестрам (Дону (та Ерін), Роману, Тамарі та Адріану Фонтанам), за їхню підтримку та мудрість. Крім того, я хотіла б подякувати дядьку Джону, Юрію Бігуну, Ентоні Амато, Наталії Кормелюк, Оксані Маланчук, Ніку Кулібабі, Пітеру Бейджеру, Джорджу Зайдану, Оленці Добош, Іану Бейтсону, Райану Найту, Сарі Стінсон, Браяну Кліфтону, Метту Вільямсону, Елісон Тернер, Кріс Банч, Кендрі Дерні, Мішель Россі, Дуейн Вомак, Павлу Арданов, Емі Ромні, Россу Бреннану, Клаудії Габріель, Джу Ґу, Колін Россьє, Кріс Адлам, Наді Тарнавській (за багато поїздок машиною в гори та чудову дружбу), Александрі Гаврилишин. Велика подяка Івану Галамасюку та його родині за те, що вони відкрили двері своїх помешкань та поділилися зі мною своїм світом. Я хотіла б висловити особливу подяку моєму дорогому наставнику Коркі Лоґсдону за нескінченні прогулянки та розмови вздовж

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“Karpaty, karpaty, charivni, Karpaty” – Carpathians, Carpathians, oh magical, Carpathians

The inspiration behind my dissertation work is born from the gift my parents have given me - the opportunity to explore the world and their never-ending support. My father has given me the fire of perseverance, fortitude, continual support, and clarity of vision. My mother has given me a sense of identity and the meaning of home, through her story, her language, and her commitment to supporting and reminding anyone she met the importance of celebrating of their own roots. It is these gifts that have framed my dissertation research.

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Соціально-Екологічна відновлюваність у серці Гуцульщини:
Центрування традиційних екологічних знань (ТЕЗ) через
трансляційну екологію

Ніна Марія Фонтана

Анотація

Дисертація досліджує соціально-екологічну стійкість Гуцульщини, де проживають гуцульські громади південно-східного хребта Карпатських гір на теренах України та Румунії. Гуцули – гірська етнографічна група українців, що традиційно займаються скотарством, мають довгу обширну історію, глибоко обізнані у сфері етноботанічних знань, у результаті ТЕЗ їх культура розвивається, будучи глибоко вкоріненою у ландшафті, що їх оточує. Беручи до уваги екосистемні, кліматичні та культурні виклики, враховуючи незаконну вирубку лісів, забруднення вод та збільшення частоти повеней та паводків, гуцули стикаються з численними викликами щодо підтримки соціально-екологічної стійкості в регіоні; моє питання звучить: наскільки традиційні екологічні знання (ТЕЗ) у залежних від лісу гуцульських громадах сприяють культурним зв'язкам з ландшафтом та збереженню здоров'я громад, а також інформують про адаптивний потенціал у підтримці регіональної продовольчої самостійності. Використовуючи трансляційний підхід у співпраці з гуцульськими науковцями і членами громад, зосереджую увагу на особливо-важливих видах (108 таксонів) та середовищах проживання в межах просторих ландшафтів (толоках, лісах, пасовищах, високогірних районах, полонинах, полях, дорогах, садах, лугах та лісах). Враховуючи значну кількість пов'язаних між собою екологічних проблем, що впливають на наш загальний клімат, екологам необхідно негайно розглянути прямі впливові наслідки своїх досліджень, розглянувши трансляційну екологію, як методологічний підхід.

У першому розділі досліджуються п’ять вимірів у формуванні стійкості в напрямі трансляційного підходу цього дисертаційного дослідження, які можна окреслити як: 1) спілкування та залучення, 2) політика, 3) освіта, 4) формування знань та 5) особиста діяльність. У другому розділі ми[1] контекстуалізуємо роль і важливість етноботаніки (особливо медичного застосування) у повсякденному житті однойменних громад Гуцульщини, визначивши 108 таксонів та кількісно оцінивши різноманітні етноботанічні показники культивованих та диких культурно-важливих видів (рослин, грибів та лишайників). Завдяки якісним методологіям ми виявляємо, що екологічні виклики критично впливають на доступність землі, наявність видів і ТЕЗ, а це в кінцевому підсумку впливає на екологічну спадщину та збір практик збереження культурно важливих видів, місця проживання яких є різноманітні. У третьому розділі ми досліджуємо короткострокові (механізми подолання) та довгострокові (адаптивні стратегії) відповіді на існуючі виклики, які можуть зменшити порушення та підтримати адаптаційні можливості Гуцульщини. ТЕЗ інформує про ці відповіді, забезпечуючи важливу основу для підтримки продовольчої самостійності, як це видно – через традиційні продукти харчування.

В цілому, ця робота підкреслює критичну необхідність застосування трансляційного підходу до міждисциплінарних екологічних досліджень, які об’єднують гуцульські голоси, вибори та ТЕЗ для інформування щодо регіональної політики.

[1] Хоча я (Ніна Фонтана) є автором цієї наукової роботи, варто зазначити, що вона була розроблена та написана за підтримки членів гуцульської громади. Ця дисертація робота не існувала б без їхньої співпраці.

Socio-ecological Resilience in the Heart of Hutsulshchyna:
Centering Traditional Ecological Knowledge (TEK) through
Translational Ecology

By Nina Maria Fontana

Abstract

This dissertation explores socio-ecological resilience in Hutsulshchyna, the home of Hutsul communities in the southeastern ridge of Carpathian Mountains of Ukraine and Romania. Hutsuls are an ethnographic group of traditional, pastoral highlanders, who share a deep, extensive history of ethnobotanical knowledge and resulting TEK, grounding culture to place within the landscape. Given ecosystem, climatic, and cultural challenges, including illegal logging, pollution, and increased frequencies of flooding, Hutsuls face extensive challenges to maintaining socio-ecological resilience in the region; I ask: To what extent does traditional ecological knowledge (TEK) in forest-dependent, Hutsul communities in Ukraine nurture cultural ties to landscape, maintain health of communities, and inform adaptive capacity in supporting regional food sovereignty? I take a translational approach in collaboration with Hutsul scientists and community members, focusing on specific culturally important species (108 taxa), and their habitats within larger landscapes (*toloka*, forest, pasture, alpine area, *polonyna*, field, road, garden, meadow, and woodland). Given the abundance of socially linked environmental problems governing our global climate, it is urgent that ecologists consider the direct policy impacts of their research and consider translational ecology, as a methodological approach.

The first chapter explores five dimensions of resilience-building inherent in the translational approach of my dissertation research, which include: 1) communication and engagement, 2) policy, 3) education, 4) knowledge creation, and 5) personal actions. In the second chapter, we[1]

[2]contextualize the role and importance of ethnobotany (specifically medicinal use) in the day-to-day lives of Hutsul communities in Hutsulshchyna by identifying 108 taxa and quantifying various ethnobotanical indices of cultivated and wild culturally important species (plants, fungi, and lichens). Through qualitative methodologies, we find that accessibility to land, availability of species and TEK are critically impacted by environmental challenges, ultimately influencing ecological succession, and gathering practices of culturally important species found in a diversity of habitats. In the third chapter, we explore short-term (coping mechanisms), and long-term (adaptive strategies) responses that mitigate disturbances and support adaptive capacity in Hutsulshchyna. TEK informs these responses, providing a critical foundation for supporting food sovereignty as seen through traditional foods. Overall, this collaborative work underlines the critical necessity of employing a translational approach to interdisciplinary, ecological research that center Hutsul voices, choices, and TEK to inform regional policymaking.

[1] While I (Nina Fontana) am the author of this dissertation, this entire dissertation was developed with, supported by, and included Hutsul community members. It would not exist without their collaboration.

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Chapter 1: Translational Ecology in Action: Centering Community Voices and Choices in Hutsulshchyna

1. Introduction

The rise of epidemiological crises, resource extraction and depletion, pollution (of water, air, soil), extreme weather events (floods, droughts, fires) exacerbated by climate change, biodiversity loss and land degradation among many other intensifying ecological threats demand resilient solutions that are grounded in communication and engagement, policy, education, community-driven knowledge creation, and personal action (Rubert-Nason et al., 2021). Scientific research and discovery drive innovative solutions to environmental problems; however, public engagement and policy remain one of the main hurdles in addressing today's global ecosystem threats. The disconnect between discoveries made and implementation of these discoveries into policies remains one of the main issues in ecological and environmental science.

One source of disconnect is an issue of science communication; scientists have not consistently made discoveries accessible or understandable to the public and policy makers. Additionally, scientists often research a specific phenomenon without necessarily relating it back to policy implementation (i.e., scientific questions asked are not explicitly linked to answers needed by policy makers) (Brunson and Baker, 2015; Hallet et al., 2017). Most importantly, scientists don't necessarily know what research questions are relevant to communities or ecosystems of concern and what types of solutions will work in practice. In the last 20 years, the intellectual and practical gaps seen between research and policy have spurred discussion of how to integrate scientific findings into effective collaborative, community-based solutions, leading to a more relatable, and equitable approach to ecological research called translational ecology. The heart of translational ecology is apparent in its bidirectional learning process – to collaboratively co-produce knowledge that is informed by empathetic, equitable, transparent partnerships (Milkoreit et al., 2019), among all individuals within the ecosystem of impact.

1.1 What is translational ecology?

Translational ecology, as a term, was taken from the field of 'translational medicine,' which is dedicated to demystifying and communicating new research findings to medical patients. Like 'translational medicine', translational ecology connects "end-users of environmental science to field research conducted by scientists" (Schlensinger, 2010). Brunson and Baker (2015) name competencies and skill sets needed to conduct translational work in addition to providing learning processes that would be suitable for acquiring these skill sets. Enquist et al. (2017) further expand on the definition by highlighting six principles that typify translational ecology including: 1) collaboration, 2) engagement, 3) commitment, 4) communication, 5) process, and 6) decision-framing. They stress that translational ecology consists of a transparent participatory process involving long-term capacity-building and engagement between all stakeholders at all stages of the science-to-management process (Lemos et al., 2012). Researchers further highlight the need for translational ecology to identify shared stakeholder goals, acknowledging that effective problem-solving is based on relationship-building, which demands time investment (Lawson et al., 2017; Hallet et al., 2017). Translational ecology actively acknowledges the common dissociation of ecological research from policy outcomes by attempting to resolve it through a framework of collaboration and co-productive partnerships upheld by transparent, effective methods (Merson et al., 2018; Firestone et al., 2020) to create informed policies (Rubert-Nason et al., 2021).

1.2 What is the benefit of employing a translational approach to research?

Translational ecology addresses an apparent need in society to make science applicable and understandable to all, not just to researchers generating results through data-driven methodologies. There are numerous reasons to employ translational ecological methodologies. By building partnerships and long-term relationships, scientific research can become more effective since multiple stakeholders are part of the decision-making process. Effective research is accessible research. For example, research can become more accessible to communities and applicable to policy decisions through fact sheets and interdisciplinary articles (Enquist et al., 2017). Accessibility in today's world implies downloadability from the internet, which includes the ability to easily access and obtain policy briefs, short papers, web-based applications of case studies, stories, and maps, as well as incorporating the use of social media which allows for multi-modalities of dialogue. The result of translational approach is ultimately more resilient than other approaches because it provides actionable scientific results with more informed policymaking along with increased investment in science-driven partnerships (Lawson et al., 2017).

1.3 What does translational ecology look like in action?

A powerful example of translational ecology was seen in the spring of 2014, when the Colorado River ran from the Rocky Mountains to the California Gulf for the first time in 16 years. Approximately 105,392-acre feet of water (130 million cubic meters) were released into a parched waterbed below the Morelos Dam, on the U.S.-Mexico border. Karl Flessa, a geoscience professor from the University of Arizona, along with an international team of government and non-governmental agencies, started this pivotal work in the 1980s (Zamora-Arroyo and Flessa, 2009). Flessa, seeing the Colorado River flow again, stated, "It doesn't get any better than this" (Robbins, 2014). Over three decades of collaboration, community engagement, and co-partnerships, and discussions with various stakeholders (Hallet et al., 2017) resulted in a momentous ecological occasion, restoring the river's parched delta, with the hopes of also restoring the river's riparian habitat and communities' water tables.

The Colorado River running again is one of most powerful examples of translational ecology in action; it is a result of a time-intensive, interdisciplinary, and transboundary ecological restoration project. The Minute 319 Science Team behind this transboundary restoration project, includes more than 21 scientists from nongovernmental agencies, government agencies, universities from both the U.S. and Mexico including the Nature Conservancy, the U.S. Bureau of Reclamation, U.S. Geological Survey, the Universidad Autónoma de Baja California, the Sonoran Institute and Pronatura Noroeste (Jensen, 2014). The science team will continue to environmentally monitor the Colorado River Delta's hydrologic pulse response and vegetation as a part of a five-year program, under the auspices of the International Boundary and Water Commission.

Other researchers have highlighted translational ecological approaches in climate-change adaptation planning project for Navy and Marine Corps installations in Southern California (Clemesha et al., 2016), fire science and management efforts seen in addressing changes in fire ignition patterns (Lawson et al., 2017), and improvement of aquatic ecosystem health through agricultural conservation methods (Fales et al., 2016; Christopher et al., 2017), among many others. All of these research projects encountered similar challenges including difficulties in measuring 'success' since progress is seen incrementally, as well as the time investment needed to build long-term individual and institutional relationships through trust.

2. Background

The focus of this dissertation is the Eastern Carpathian Mountains of Ukraine, specifically in a region called Hutsulshchyna with Hutsul communities, an ethnographic group of traditional, pastoral highlanders, who live with a deep, extensive history of ethnobotanical knowledge and TEK, grounding culture to relationships with landscape. Additionally, this region is facing rapid socio-economic development, with factors such as cultural, climatic and ecosystem changes. The integrated relationship between cultural and biological diversity is apparent here; This multidirectional feedback loop of changes will impact TEK loss, which will drive biodiversity loss and vice versa.

This beginning chapter focuses on the time-intensive process of collaborative work and the dimensions of resilience-building seen in the translational approach to interdisciplinary ecological research. Using a translational ecology framework outlined in Rubert-Nason et al. (2021) and adapted from the Climate Center (2019), I will be exploring the five essential dimensions present in the translational approach undertaken in my dissertation research: 1) communication and engagement, 2) policy, 3) education, 4) knowledge creation, and 5) personal actions (Table 1.2). My methodologies, built upon concepts from community-based participatory action research (CBPAR) were interdisciplinary and collaborative due to the nature of the research questions, and as a result employed a translational approach. CBPR can be broadly defined as research methods that are action-oriented, community-driven, collaborative, and democratic (Ballard and Belsky, 2010) and are very much in line with the translational approach. The links of these questions to policy were explicit. The role of ethnobotany and access to land is critically linked to political and ecological challenges in the region including impacts of illegal logging, tourism, and climate change which ultimately impacts ecological successions of culturally important species found in a diversity of habitats. Collaborations with the Verkhovyna National Nature Park, the Hutsulshchyna National Nature Park, and the Ukrainian National Forestry University were foundational in the development of these research questions. My three main research questions were: 1) What is the role of traditional ecological knowledge (TEK) in Hutsulshchyna? 2) How has TEK been impacted by ecosystem, climatic and cultural changes seen in the region? and 3) What does the path to food sovereignty look like in Hutsulshchyna?

The second chapter of my dissertation contextualizes the role and importance of ethnobotany in the day-to-day lives of communities in Hutsulshchyna by identifying 108 taxa and quantifying various ethnobotanical indices of cultivated and wild culturally important species of plants, fungi, and lichens. The most cited ethnobotanical uses of species are medicine (30.8%) and food (30.6%). Traditional ecological knowledge (TEK) is impacted by ecosystem, cultural, and climatic changes in terms of access to landscape and supports gathering practices of culturally important species in a diversity of habitats. In my final chapter, I collaborate with Hutsul scientists from the Hutsulshchyna National Nature Park to explore various coping mechanisms (short-term responses) and adaptive strategies (long-term responses) present in Hutsul communities that support food sovereignty through the lens of traditional ecological knowledge (TEK). The results and discussion of this co-created third chapter will be supported by official Hutsulshchyna National Nature Park documents and implemented under policy strategies titled, "Territorial Community Development Strategy."

2.1 Personal Background (Positionality statement)

My dissertation work formally began in the summer of 2016 where I connected with collaborators, when I went back to Ukraine with both of my parents, to my mom's homeland, as her final trip. My mom's Alzheimer's had taken a progressive turn and it was that summer trip that was deeply difficult, moving, and important for my family.

However, I could say my dissertation work started long before 2016. My mother's journey to the U.S. is like that of many refugee immigrants after World War II. She, along with her parents, made their way through Poland, were smuggled to an internment camp in Austria where they finally made their way on a ship to Ellis Island, New York in 1950. Growing up in a multi-lingual and multi-cultural diaspora household, my exposure to Ukraine began with my mom only speaking Ukrainian to us and going to Ukrainian Language School and church. Holidays at the Ukrainian church revealed a rich blur of deep reds and black, oranges, yellows, and blues, of embroidered shirts, dresses, ties, and hats that gave hints to the region of people's origin. As a young child, I remember our close family friend, a talented sculptor and painter, Pan Paliczuk who dressed especially vibrantly with maroon, orange, yellow, green, black, blue stitching on his feather-adorned pom-pom hat, along his keptar (brightly embroidered and decorated sheepskin vest).

Pan Paliczuk's artwork hung in all the prominent areas of our house and many of his paintings displayed the Carpathian Mountains. I loved staring at his paintings as a kid (Figure 1.1). Pan Paliczuk was Hutsul and came from these same mountains. His story was similar, an immigrant refugee, who spent time in an internment camp in Germany, and made his way to New York in 1950 alone as a 15-year-old, where he lived with other refugee boys on the second floor of a Bronx synagogue. He made his way to Baltimore where he eventually graduated from Baltimore City College with a B.A. and M.A. at the University of Maryland as the school's first sculpture candidate. He credits the United States with saving his life, "I was born in Ukraine, and she is my mother, but America accepted me, and she is my love. This is my home." My mom also had a similar and deep love for her homeland, leveraging her positionality and privilege in the United States to lobby, demonstrate and serve as an ardent activist and community organizer for Ukraine's freedoms and democratic society throughout most of her life (Kebalo 2011, pg. 178).

Figurę 1.1. Painting by Wasyl Paliczuk. This painting is over our fireplace mantle and as a kid, I loved staring at it every day.

Due to the social aspect of my ecological research, it is true to say that this research is personal to me on a certain level. My mom's immigration story to the U.S. impacted me growing up and continues to impact me. My mom speaking Ukrainian to me and my four siblings served as a way to impart language to us. She invested in sharing Ukrainian culture through food, song, language, embroidery, holidays, and history. Each of my siblings has integrated her imparting of culture on a continuum from ambivalence to celebration. With this in mind, I come to the subject matter with my own implicit bias due to my own biography although I strive to maintain "empathetic neutrality." This means that I "strive to avoid conscious and systematic bias in the collection, interpretation and presentation of data" (Ormston et al., 2014), while acknowledging that there is no such thing as completely "neutral" knowledge. I want to acknowledge that it is also this same bias that also inspires my research, imparts a love and respect for the relationships that I have gained and the mountains I was privileged enough to live in briefly.

My first glimpse to the beauty of the Hutsul Carpathian Mountains began with seeing Pan Paliczuk's art in my home as a small child. I made my first trip to Ukraine at the age of 18, where I met my mom's relatives in Lviv, Ukraine (western Ukraine). Even though I grew up in a politically active, diverse, Ukrainian diaspora community in the metropolitan Washington D.C. area, it was both an exciting and nerve-racking experience to utilize a language learned outside of its native context and connect with family members I had never met. It was the first time that I realized that I spoke Ukrainian with an accent (which to native Ukrainians sounded like I had a Polish accent), that there were many words I did not know, and I used words that many grandparents used (I spoke an older language - the language my mother's parents brought with them to the U.S.) It was also my first time that I felt that the Carpathian Mountains were indeed a real place. In these mountains, I spent a summer, volunteering at a university summer camp, teaching English to college students. I remember one afternoon when I went out to pick wild strawberries and I met a middle-aged woman doing the same. We began talking and she asked if I was from Poland (due to my accent) and I said, "No, I am from the U.S." She looked at me in an astonished way and said, "How do you know Ukrainian?" I stated that my mom taught us and that she was from Ukraine but fled with her parents after WWII. The woman's eyes welled up with tears and she smiled saying, "Oh my goodness! Please thank your mother for me for continuing to speak Ukrainian and teaching you." This early formative experience was particularly impactful and moving for me.

Growing up, my mom would make it a point to distinguish between Ukrainian and Russian words. Having fled the persecution of both Nazi and Soviet regimes, language became a pivotal weapon of autonomy and resistance from colonizers. During the Soviet Union, people were thrown in jail or sent to Siberia for speaking Ukrainian or practicing their religion. During my childhood, I would hear: “We speak Ukrainian.” “Ukrainian is a different language from Russian.” “Ukraine is a separate country, a separate culture.” These phrases were common in our house, given the fact that most people in my day-to-day life outside of the Ukrainian-American community really didn’t know that there was a difference between the two countries. As a kid, I didn’t really understand why this distinction was so important. It was through that interaction with that woman, while picking strawberries, that I realized that language is powerful in its ability to connect people and ground identity with history. Throughout the next 10 years, I would visit Ukraine three more times before formally beginning my dissertation research in 2016.

My own biography is linked to the nature of this work, and it has provided me an opportunity to use a reflexive approach to inform my own positionality throughout this manuscript, where I can describe my worldview a little bit and the position I adopted (Rowe, 2014) or the position that was sometimes given to me during my research. Note that there are blind spots in my interpretations, and my background will impact my understanding. Familiar with the Carpathian Mountain region, I chose to center and develop my general research topic based on my exposure to Hutsul diaspora growing up in the Washington D.C. area. My research questions changed and morphed once I settled in the mountains when I was able to meet and talk to community members. My identity was blurry most of the time - sometimes with a clear distinction between insider versus outsider and other times less so (Herod, 1999). My positionality shifted and probably existed more on a continuum with conceptual rather than true endpoints (Chistensen and Dahl, 1997), depending upon location, time, topic, or people in the room (Mercer, 2007). Most of the time - I would consider myself an outsider with frequent insider moments. U.S. citizen with Ukrainian-Italian ancestry and family in Ukraine. Woman living alone in the mountains. Researcher. Unmarried woman without children. A lot of my identities were wound up in cultural norms in the place that I was in, mostly tied to gender role or citizenship or both and sometimes neither. My status as a U.S. citizen may have absolved me of some of the cultural norms present but at times, they were placed on me in an empathetic, almost familial way, "But of course, you will get married and have children!" I felt shifts in my point along the continuum with language use. My linguistic capabilities anchored me and at times, my knowledge and unknowing use of old Ukrainian words brought exclamations of surprise and warm reception among the young and old. It was in those moments, that I shifted to the insider edge of the continuum, with the link of a shared history through the learned, spoken word of my mother's lineage. My mom's gift of language was the gateway into my dissertation research, and throughout my dissertation research, my goals were to engage with Hutsul communities, to listen and learn from elders, and lastly to facilitate connections and center Hutsul voices and priorities in my research.

2.2 Regional Background

My research, based in the Carpathian Mountains of Ukraine, is centered in the traditional historical land of Hutsuls called Hutsulshchyna, with Hutsul communities, an ethnographic group of pastoral, traditional highlanders (Figure 1.2). The Carpathian Mountains span across countries including Poland, Czech Republic, Slovakia, Hungary, Serbia, Romania, and Ukraine. Containing Europe's largest remaining old-growth forest ecosystems outside of Russia, it is a biodiversity hotspot, harboring one-third of all European vascular plant species. Considered the "Amazon of Europe," this region is one of Europe's last fully undeveloped landscapes, a rich refuge for large carnivores and a principal source of subsistence to 16 million people (Gurung et al., 2009). Hutulshchyna, the land of Hutsuls, transects the Carpathian Mountains and falls within the country boundaries of both Romania and Ukraine. This area is characterized by its high elevation and small villages that dot the valleys between the peaks. Zhab'ye (renamed Verkhovyna by the Soviets in the 1962) is considered the historical, cultural, and geographic center of Hutsulshchyna, as it lies along the Black Cheremosh River at an elevation of 600 meters, at the base of the Black Mountain range (Velyoha, 2006).

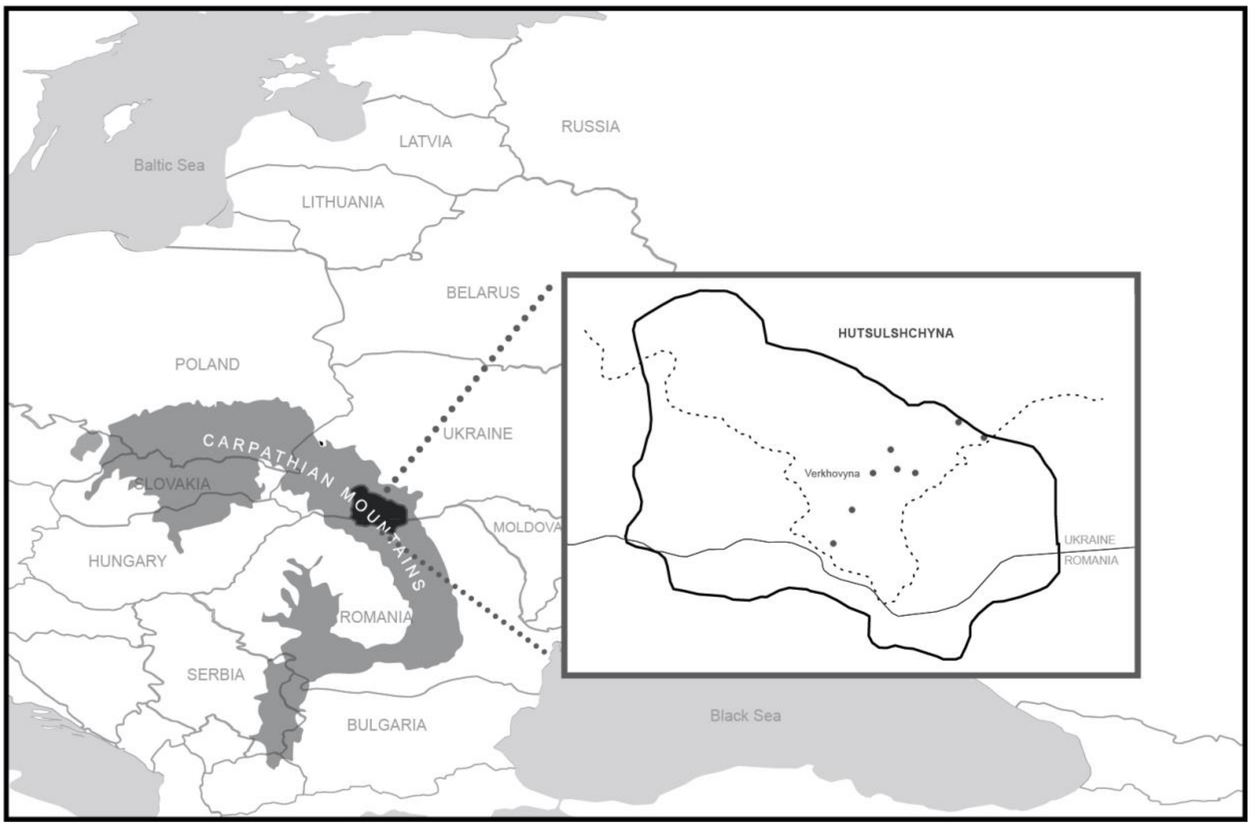

Figure 1.2. Hutsulshchyna is denoted by the dark polygon centered in the Carpathian Mountain region bordering both Ukraine and Romania (Adapted from Figlus, 2009). Verkhovyna is the historical, Hutsul heart of Hutsulschyna where field work was centered. The dots represent the 8 villages that interviewing took place.

In the Ukrainian Carpathians, 59-91% of the population lives in rural areas (Bosch et al. 2008); this broad range is due to the socioeconomic inequality between rural and urban areas in the region (UNEP 2007). The interdependence between nature and need is explicit. Communities are self-sufficient in terms of their nutritional needs. Food is grown, gathered, and stored (dried, pickled, canned, fermented). Many households in this region rely on subsistence-based agriculture with homes surrounded by chickens, pigs, cows, and goats, and with additional income derived from family members going abroad for work. Low salaries demand multiple avenues of revenue from subsistence farming, gathering, and selling of culturally important wild species, as well as opening one's home to tourist stays (ecotourism). The foundation of Hutsul lifeways in the Carpathian Mountains is driven by traditional ecological knowledge (TEK). Lived and experienced by local and Indigenous communities worldwide, TEK is cultural, spiritual, intergenerational, dynamic, place-based, environmental wisdom for survival and interconnection that is revisited, reinterpreted, and re-evaluated consistently (Berkes, 2012; Molnár et al., 2008). TEK, the scientific method brought to life through culture, plays a significant role in meeting community needs, while adapting with ecosystem, climatic and cultural changes.

The environmental threats present in Hutsulshchyna are recognized by forest-dependent community members and many of these threats are also cited in an extensive literature review of the region (Appendix B, Table B1). Table 1.1 includes a column titled, "Descriptions cited in literature" in which specific threats mentioned in the literature review are listed because they were also mentioned by Hutsul community members under the column titled, "Converging Hutsul community observations." Ecosystem change observed by community members include illegal logging and pollution with major impacts seen on culturally important species. Effects of climatic change include increased frequency of invasive species (like bark beetle), shifts of plant habitats, and uptick of extreme weather events impacting plant phenological cycles. Thirdly, cultural change is seen through the synergistic interactions of both ecosystem and climatic changes in the region. Specifically, historical colonial logging policies have impacted the cultural use of an ecologically important and endangered species, *Pinus cembra* and restructuring of grass plant communities. It is important to note that cultural changes, including commercial harvesting and the legacy of colonial practices stated by community members, are not captured in earlier literature, and serve as critical drivers impacting both ecosystem and climatic changes. Ecosystem, climatic, and cultural changes create challenges to maintaining socio-ecological resilience in the region. A resilience-based approach to addressing environmental threats within ecosystems applies to the collaborative translational research process as well. These approaches strive to mitigate disturbances and challenges through direct action by supporting and strengthening existing relationships.

Table 1.1. Local manifestations of changes in Hutsul socio-ecological system as convergently stated by local Hutsul community members and scientific literature.

Main Change	**Descriptions cited in literature**	**Converging Hutsul Community Observations**	**Predicted Effects (Based on Hutsul community observations)**
Ecosystem Change	• Illegal logging	• Legal/illegal logging practices on mountainsides (1)	• Impacts succession of species (berries and mushrooms) (1)
	• Pollution	• Rivers are impacted by plastic pollution (1)	• Increase of regional flooding (1) • Impacts river health, flow, and availability of fish (1)
Climatic Change	• Increase in mean temperatures • Warmer winters	• First mowing of hayfields occurring earlier in the season (2) - Plants of importance are being cut down before reseeding occurs (*Carum carvi*, *Centaurium erythraea*)	• Dysregulated phenological cycles of plant communities (1)
	• Extreme hydrological events (i.e., flooding) • Extreme events (pests i.e., bark beetle, windstorms, invasive species)	• Extreme weather conditions (shortened time frames between flooding events) (1)	• Increased incidence of pests (*Leptinotarsa decemlineata*) on cultivated crops (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)
	• Advancing upper tree line	• Elevation shifts of endangered plant habitats and plant habitats (*Arnica montana*, *Rhodiola rosea*, *Veratrum album*) (1)	• Stay at endangered status (*Gentiana spp.*, *Allium ursinum*, *Orchis mascula*, *Platanthera bifolia*) (1)

Cultural Change	• Poaching	**<u>Commercial harvesting</u>** • Improper harvesting techniques (*Arnica montana*) (1) - Not leaving root behind - Gather flower before seed release • Mass harvesting (*Cetraria islandica*) (2) No recovery growth of slow-growing lichen	• Culturally important plants become rarer; less accessible to local Hutsul populations (1)
	• Erosion of TEK	**<u>Colonial Policies</u>** • Soviet policies (1939-1991) • Mass aerial fertilizing of land changed structure of grass cover (*Trifolium pratens* dominates) (3)	• Slow recovery of grass plant communities (Example: *Thymus serpyllum* has recovered; *Matricaria chamomila* still recovering) (E)
		<u>Colonial Policies</u> • Austrian-Hungarian empire (1772-1918) • Excessively logging of culturally and ecologically important, endangered species (*Pinus cembra*) • Planting of monoculture pine species (E)	• Impacts cultural use of species (weddings) (1) • Limits ecosystem functioning of forests (2) • *Pinus cembra* stays endangered status/reaches extinction (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)

Observation rankings: 1 = widely shared (many observations and expert generalizations across villages), 2 = place specific (well-accepted within a particular community), 3= somewhat common (various participants), 4=less common (one or a few local experts), E=observation mainly reported by elders.

3. Five Dimensions present in Translational Ecology

The five dimensions of resilience-building present in translational process and explored in my collaborative dissertation research include 1) communication and engagement, 2) policy, 3) education, 4) knowledge creation, and 5) personal action (Table 1.2). The essence of translational ecology is in its approach - to co-create knowledge that is grounded in equitable, empathetic, transparent partnerships (Milkoreit et al., 2019) among all individuals within the ecosystem of impact (Rubert-Nason et al., 2021). The dire need of this approach is driven by the multi-layered changes needed on social, political, and ecological levels to address the intensifying global threats.

3.1 Communication and Engagement

The first dimension, communication and engagement, is pivotal in creating trust-based relationships and networks. Continuous and transparent communication takes place through trusted channels and includes a diversity of voices and interests in discussing outcomes (Bidwell, 2016; Dietz et al., 2020; Rubert-Nason et al., 2021). Traditional, local, and Indigenous knowledge systems must be prioritized and valued (David-Chavez and Gavin, 2018); according to the World Bank (2019), communities that rely on traditional, local, and Indigenous knowledge systems, steward an estimated 80% of the world's remaining biodiversity (2019). Institutions, ranging from non-governmental organizations, government institutions and universities should also be included in the diversity of voices at the proverbial table of translational ecology. The components structuring the communication and engagement dimension of my research was rooted in network building and linguistic competency.

Table 1.2. Five dimensions of building resilience that are present in translational ecology and explored in my collaborative research process. Each of these dimensions presents thematic challenges that were addressed through actions to reach desired outcomes.

Dimension	Challenges	Actions Taken	Desired Outcomes
Communication and Engagement	• Language learning • Time needed to develop connections and trust, inclusion, motivation, and representation of community members • Unclear expectations of why researcher is present in community	1) Take Ukrainian language classes to strengthen linguistic skills and learn Hutsul 2) Develop trusting relationships with community members and leaders in Hutsulshchyna as well as universities, national parks, and NGOs to identify community needs/interests 3) Share my personal story, connection to the country and region	*Specific*: Relationships and networks are built across various organizational levels to identify community needs and contextually driven limitations *Broader*: Dialogue is established and continued to address challenges beyond the scope of the project
Policy	• Policies are written without incorporating community voice • Country policies are not enforced due to lack of funding, corruption, bureaucracy	1) Co-author and publish findings in English, and Ukrainian 2) Collaboratively evaluate policies and their greater impacts 3) Offer policy recommendations if asked	*Specific:* Small policy changes that uphold civil society and community voices *Broader:* Policy impacts are equitable, community-based, evidence-informed, and are re-evaluated to address intended and unintended impacts, relevance, and outcomes along the way
Education	• Lack of understanding of worldview and day-to-day challenges • Lack of information on the relevance of research to community	1) Spend significant amount of time in villages; get to know people and spend time in landscape to understand worldview (before research begins) 2) Ask questions and listen to elder community members and organizations 3) Educate myself and think reflexively on the role and impact of my research on a local level 4) Reach out to mentors at local Ukrainian universities to learn about culturally-relevant collaborative processes	*Specific:* Incorporates different ways of knowing (TEK) into research process by: 1) Encouraging participation of all people in decision-making and knowledge creation and curation 2) Addressing causes and consequences of various socio-ecological changes in the region (ecosystem, climatic, cultural)

Dimension	Challenges	Actions Taken	Desired Outcomes
			Broader: Collaborative and culturally-relevant processes are supportive of all community members and local organizations, accurately reflecting knowledge and worldviews
Knowledge creation	• 'Parachute science' • Culturally relevant practices are not implemented • Inadequate support (funding or capacity) for knowledge creation and curation	1) Collaborative process in the development of a phenological calendar with the Women's Collective 2) Dissertation research will be translated and housed as an ethnobotanical reservoir following CARE Principles (2019)	*Specific:* Communities at various organizational levels have ownership over the creation and curation of ecological knowledge collaboratively shared *Broader:* Collaborative knowledge creation and curation are supported through grants, fellowships, and gain traction through various organizational levels within government, local, and non-governmental agencies
Personal actions	• Lack of resources • Lack of sense of empowerment, or direction on actions to support translational ecology in research	1) Secure funding for collaboratively, co-created research proposals for communities (Fulbright, National Geographic) 2) Support and facilitate community members to identify credible information, and access relevant research 3) Support and participate in democratic actions that support civil society 4) Commit to clear, consistent, transparent communication with communities	*Specific:* Reflexive methodologies are employed by ecologists in their research, to include, acknowledge advocate, lead, and serve as role models *Broader:* Personal actions create collective actions that create a culture of equity, inclusion, compassion in research

Framework adapted from Rubert-Nason et al., 2021.

My research evolved from communication and direct engagement with various entities, which began from my own network - the Ukrainian-American community in Washington D.C. It was through this network that I was put into contact with a friend of a friend who was as Fulbright scholar, Yurij Bihun. His guidance and mentorship connected me to individuals at the Ukrainian National Forestry University (UNFU) which later served as my host institution during my Fulbright student award (2017-2018). Once in Ukraine, I spent 4 months grounding myself in this new context, meeting new people, and establishing key contacts. I met the head of the World Wildlife Fund Ukraine (WWF), Dmytro Karabchuk. He invited me to attend various conferences sponsored by WWF-Ukraine and I had an opportunity to edit WWF-Ukraine's illegal logging assessments. It was also during this time that I had an opportunity to travel extensively throughout the Hutsul and Zakarpattia regions with the facilitation and guidance of Yurij Bihun to meet with NGOs, like FORZA, and key scientists at the Carpathian Biosphere Reserve before the start of my research process. Many professors at UNFU (especially Vasyl Zayachuk) connected me with his own contacts in the Hutsul Carpathian Mountains. It was through these various contacts that I found a place to live in the Carpathian Mountains, providing a base point to build relationships with other community members throughout the region as well as park at the Verkhovyna National Nature Park and the Hutsulshchyna National Nature Park. Those first four months were pivotal, where I relied on previously built networks (Ukrainian-American network in Washington D.C.), to expand and make new networks (Fulbright community, World Wildlife Fund (WWF), Ukrainian National Forestry University, Verkhovyna National Nature Park, Hutsulshchyna National Nature Park) which greatly aided in the research process and connecting with village community members.

The building of these relationships was in many ways contingent on my linguistic fluency of Ukrainian and my understanding of worldview, culture, and day-to-day life. It is through language that culturally distinctive values, knowledge, meanings, and world views emerge (Simpson 2004). My ability to speak and understand Ukrainian was a starting point to many discussions with new colleagues and collaborators, which created an opening and opportunity to share my personal story. In many ways, engagement and collaboration was the first step in trust-building, and this was brokered by linguistic competency. However, when I first arrived in Ukraine, the shift to my daily routine to speaking primarily in Ukrainian presented its own set of challenges. I had to learn how to distinguish the type of vocabulary I knew versus the one I would need to learn (science-based for university settings, and modern Ukrainian words). This learning curve extended its way to living in Hutsul villages for over the course of a year, where elder generations spoke a mix of Hutsul and Ukrainian. Hutsul is a unique dialect that is endangered due to socio-economic pressures (Coyne, 2014, pg. 218). In many instances, Hutsul is indistinguishable from Contemporary Standard Ukrainian (CSU) (Hrabec, 1950). This mutual intelligibility created an opportunity to learn Hutsul vocabulary and connect with community members in their language, grounded in their place.

My goal was to amend my research questions and methodologies to address and include Hutsul TEK as a central part of the process. Engagement occurred at multiple levels - from community members from various villages, national parks (Verkhovyna National Nature Park, Hutsulshchyna National Nature Park), educational institutions (Ukrainian National Forestry University), and international institutions (Fulbright program). I lived with families in Hutsul villages, where I was able to spend time talking to families that I was living with, asking about their community needs and day-to-day life. Additionally, I spent time speaking to a range of scientists at the

Hutsulshchyna National Nature Park and Verkhovyna National Nature Park about illegal logging issues and community development goals. This would include formal meetings, but mostly hiking trips, discussions over tea, and various field trips. This engagement continued throughout the interviewing process. Before beginning interviews, I worked with key Hutsul experts to refine specific interview topics and improve question framing. I gathered over 70 interviews throughout two field seasons, and in the field season of 2019, Hutsul mycologist, Mariia Pasailiuk, greatly aided me, actively interviewing prominent community members with me. Various trips with scientists at the Hutsulshchyna National Nature Park occurred throughout 2017-2018, assessing old growth forests. Maintaining continual dialogue with people included visiting their homes, making phone calls, and providing open avenues of discussion and availability. These connections and continual active engagement were pivotal in the research and collaboration process (Table 1.2).

3.2 Policy

The main goal behind the translational approach is to produce policies based on transparent co-production of knowledge by all stakeholders impacted by those same policies (Fitzgibbons and Mitchell, 2019; Adler, 2020). Language plays a role in the development and understanding of policy to broader audiences. The term 'translation' in translational ecology refers to the interpretation of meaning from one language to another, with the goal of conserving the integrity of information in addition to being open to possibilities of varying interpretations (Jackson et al., 2017). The ability to translate science into understandable terms to various stakeholders is imperative to generating communicable policy grounded in mutual understanding. Additionally, careful attention and understanding to multi-cultural, real-world contexts in which ecological science is applied, are essential to the framing and designing of research questions, and successful implementation of policy decisions and management. For example, ecologists can advocate for science-informed policies and, depending on their research scope, follow the CARE principles for Indigenous Data Governance (Research Data Alliance International Indigenous Data Sovereignty Interest Group, 2019) by ethically prioritizing TEK that community partners contribute (Young et al., 2014; David-Chavez and Gavin, 2018; Rubert-Nason et al., 2021). Otherwise, there is the real possibility of generating "paper policies", which are written but are not fully integrated, followed or supported by communities.

The status of policy making in Ukraine is tenuous, given its legacy of Soviet colonialism and corruption. Environmental policies struggle to be enforced, with illegal logging being a main regional challenge. Organized criminal networks manage illegal logging operations under the guise of semi-legitimate corporations and businesses (Associação Natureza Portugal, 2020). Minimal legal and financial penalties make these unenforced activities accessible within organized crime networks. However, local national parks and World Wildlife Fund Ukraine are using multi-time satellite images, DNA, and isotope analyses of wood, along with citizen activism, to help combat illegal logging (WWF, 2017; Associação Natureza Portugal, 2020). Starting in 2020, the WWF-Ukraine is working with local communities to protect forests, while collaborating with forest enterprises to sustainably manage forests (WWF, 2020). There is an active shift within the region to include communities in the decision-making process, and prioritize their active participation in addressing social and environmental issues.

One of the ways to make meaningful policy is to form research questions that address a need or find an already existing question that needs answers. My research questions changed and morphed throughout my dissertation process, as I learned more from elders and as I built relationships with various institutions. In many cases, I had already built relationships with people before formally interviewing them later. Traditional ecological knowledge was the central theme, and conversations were open-ended. There were many days in which I spent an entire day with a community member in their home, eating, drinking, and talking about a range of topics. I conducted a few informal discussion groups both formally and informally regarding changes seen in the region as well as the specific gathering practices of culturally important species. Environmental changes came up continuously in discussions with park scientists, elders, community members, herbalists, and farmers. Reiterated continuously was the direct link between forest dependence on resources and proximity to habitats. This pattern of discussion helped to form my questions and guide my discussions with personnel at local national parks.

One of the main efforts behind my dissertation work was to co-publish with Hutsul scientists, facilitating the dissemination of knowledge on their terms, rather than on researcher terms. Currently, the last chapter of my dissertation, which was co-created by two Hutsul scientists along with myself, is under review. It synthesizes my second chapter along with in-depth analysis of TEK to explore factors contributing to Hutsul regional resilience. Additionally, it clearly identifies coping mechanisms (short-term responses) and adaptive strategies (long-term responses) that maintain food sovereignty in the region. That chapter will serve as published affirmation of the importance of Hutsul ethnobotany in regional economy building. As stated by co-author and Hutsul mycologist, Maria Pasailiuk:

> Decentralization is occurring in Ukraine and this political direction will allow communities to gain some independence both financially and economically, from the region and Ukraine's capital, Kyiv. At the same time, it will place responsibility on communities to earn money to meet their needs. Oleh Pohribnyi, another co-author, is helping develop a community development and environmental protection policy plan that will elucidate how money is made on tourism, recreation, forest, and mushroom hunting. I will be participating in the development of another community development policy, which will be based on this paper. This policy will describe the important role of plants and their use for the development of the region for production of Carpathian

teas, creation of eco-brands, collection of berries and mushrooms. In general, this publication will confirm the importance of preserving Hutsul ecocultural memory and practice of gathering culturally important species to develop the region’s economy.

The next step after publication in English would be publication of this paper in Ukrainian and Hutsul, since it would then be accessible to populations in which aided in the publication of this work. There are various levels of translation that occurred through my dissertation process - from Ukrainian/Hutsul to English and vice versa, in addition to translating scientific terminology to understandable and relatable terminologies in both languages. These non-English publications would look very different from their current English form, given the need to translate not only the data, but also to use terms, sentence structure, and images which would be accessible, relatable, and recognizable to broader populations in Ukraine. Ample time and multiple levels of translation would occur in the making of this Ukrainian and Hutsul publications. This translational approach would reseed organized information surrounding Hutsul TEK back into the communities of origin, helping build trust with communities and instill transparency in the research process.

The publication of the third chapter will serve as basis for policy development in Hutsulshchyna; a policy document is currently being written by Hutsul scientists, Maria Pasailiuk and Oleh Pohribnyi, at the Hutsulshchyna National Nature Park, highlighting the importance of gathering and selling culturally important species (as discussed in Chapter 3).

3.3 Education

Education is a process that invites an individual to explore and build upon their prior knowledge, while actively engaging and contextualizing new information into an existing framework of understanding. This dynamic process occurs both organically and intentionally through lived experiences and reflection. Education in the research process is resilience building, by creating awareness, supporting co-production of knowledge, and encouraging integration of community-driven, evidence-based practices (Rubert-Nason et al., 2021). The dimension of education is central to collaborative research processes, as a way to effectively communicate and address needs, world views, and priorities of multiple stakeholders. In order to address my own knowledge gaps of the region, and community needs, it was imperative to interact with community members and educate myself before the research process began.

I addressed my lack of practical knowledge of landscape, day-to-day challenges in Hutsulshchyna, and current institutional culture with a three-pronged approach: 1) reading and attending lectures and conferences, 2) extending my immediate network of people to include a variety of voices, and 3) living in the region. Firstly, I attended lectures, gatherings, and conferences sponsored by the Ukrainian National Forestry University, Hutsulshchyna National Nature Park and WWF-Ukraine. These opportunities allowed me to meet people and ask questions regarding specific environmental threats and policy needs and to gain a broad perspective on the institutional work being done in Ukraine. On a local level, I gathered books on history, forestry, and ecology and spent ample time at the Kryvorivnia village library with the head librarian, Katya. Additionally, I befriended a Peace Corps volunteer, Jesus Segovia, who had already spent two years as an educator in the Carpathian Mountain region, who provided great support and extended his network to me. Lastly, I addressed my lack of understanding of day-to-day challenges for Hutsul community members by engaging with community members every day while living in various villages with community members over the course of the year. Educating myself, reaching out to people, and actively listening to others was key to beginning the collaborative process with community members, in a culturally relevant way (Table 1.2).

3.3.1 Worldview and the Research Process

One of the main cultural shifts that occurred during my fieldwork season was the broadening in my understanding in how time is experienced and perceived. Within the field of anthropology, culture is noted as the learned foundation of collective and individual assumptions, beliefs, values, priorities, and behaviors within a population over time (Deal and Peterson 2010; Kuh, 1993). Cultural world views are the foundations of values, beliefs, and assumptions that guide our everyday behavior. Much of this is unnoticed unless we stumble upon a situation that interjects or presents another worldview in contrast to our own worldview. Traveling outside of the comfort of our communities is one way to encounter these interjections. I encountered many of these insightful interjections in my fieldwork experience and they were central to how I approached my research process.

Cultural world views can be viewed on a continuum from more individuated to more integrated world views. In an individuated worldview, private, compartmentalized individual, linear, mind-based, and contextually independent conception of the world is valued and common, while in a culturally integrated world view, an interconnected, reflective, cyclical or seasonal, mind/body/spirit/heart-based, contextually dependent conception of the world is valued and common (Chávez et al., 2016). Using the framework outlined in Chávez's work in education, I draw upon cultural continua seen in individuated and integrated cultural world views developed by the authors, specifically purpose of learning, ways of taking in and processing knowledge, interconnectedness of what is being learned and time.

In many ways, the academic world in U.S. culture operates in an individuated framework, where the purpose of learning (i.e., research), underpinned by individual competence, drives goals, and said betterment of humanity. The mind is seen as the primary and preferred conduit of knowledge. Additionally, U.S. college and university curricula are organized primarily in an individuated way, subjects, courses, are compartmentalized and separated. There is an assumption that learning concepts in isolation will lead to greater understanding of how these parts interact within the whole. Undergraduate education tends to be thematically siloed, without introductory seminars explicitly integrating interdisciplinary thinking; the solutions to environmental, global problems rely on knowledge and ways of thinking from a myriad of disciplines. Time is structured by linear tasks that can be measured, and punctuality is linked to respect. These elements of the individuated worldview, driven by individual competence, the mind being the conduit of knowledge, and linearity of time, was one that I brought into a highly integrated culture. Part of my education in my dissertation process was understanding and living with a more integrated view of purpose, way of taking in knowledge, seeing the interconnectedness of what is being learned and a relationship-based understanding of time. Identifying with both individuated and integrated cultures, I felt conflicted by the time constraints and individuated view of the research process, especially in regard to time. It was the moment that I incorporated a more integrated worldview that my research became more collaborative, empathetic, and community-driven.

A glimpse of an integrated worldview in Hutsulshchyna means that the purpose of learning is based on collective wisdom, for the betterment of the relationships surrounding us - family, community and beyond. The mind, spirit, and body as well as relationships and emotions are important ways of sensing the world and sources of knowledge. Context, connectedness, and belief that understanding how things impact one another within the community will facilitate further connection are central to community life.

An example of this integrated worldview, not only present in Hutsulshchyna but also present in Ukraine is *toloka*, with one of the many definitions defined as collective mutual assistance

(Appendix C). Its practice dates to the time of Kievan Rus (9^{th}-13^{th} centuries), and writings show its definitive presence between the 17^{th}-19^{th} centuries (Yevseyeva et al., 2017). *Toloka* is a customary way of providing collective mutual assistance typically seen in villages. It is a moral and ethical norm, and usually done by a voluntary group of people for a community member. Its purpose is to provide rapid implementation such as harvesting a plant, building a house, joint grazing of livestock or work for the community. Community members understand that each of them can help themselves only by helping other members of the community. As stated by a Hutsul elder and scientist, Ivan Zelenchuk:

> But *toloka* is what was before, and it almost disappeared. It is a form of community self-organization for very hard work but not only very hard work but large-scale work. It was once our duty to help one another, but it was considered a sacred duty…It is a sense of community, community of the village. It was once an old form of self-organization…Without this, we would not have survived, believe me. But they [Soviet Union] came and said, "This (*toloka*) is nothing, we will form a collective farm for you."

As seen in this example, the role of the individual is nested in connection with a larger community of aid, responsibility, duty, and organization. It is through the interconnectedness and interdependence with community members that survival is possible. Lastly, Mr. Zelenchuk alludes to the cultural, ecological, and political ramifications of Soviet-driven policy of farm collectivization in the region. In chapter 2, another definition of *toloka* is highlighted, which refers to a generationally-held pasture typically located on a nearby hillside, which ensures both connection and access to land. *Toloka* (collective assistance of cutting hay) is typically employed on *toloka*s (pastures) (Appendix C).

Lastly, time in Hutsulshchyna is experienced seasonally, and dependent upon relationships. For example, events or the start of events is dependent upon presence of everyone in the room, rather than a set time. My understanding of time was restructured during my dissertation research process, with strict timelines and meeting times thrown away; there was a need to surrender to the process of allowing events to unfold in a general, guided direction. From bus schedules to meeting people, my perceived world view (especially in regard to time) morphed to accommodate the place, time, and worldview that I was in.

3.4 Knowledge creation

Knowledge creation, in the translational approach, is an iterative process that generates methods to build resilience and practical solutions for all entities engaged in the research process. Within the broad field of ecology and environmental science, there is a rising acknowledgement of a common practice called 'parachute science' in which international scientists or researchers from high-income countries conduct scientific research in lower-income countries, without engaging with local communities or investing in local capacity (Roldan-Hernandez et al., 2020; Stefanoudis et al., 2021). Bibliographic analysis of coral reef biodiversity research of scholarly articles in Scopus from 1969-2020, showed that 40% of publications with fieldwork conducted in the Philippines or Indonesia (the top nations in terms of coral-reef habitat area) had no local scientist included (Stefanoudis et al., 2021). 'Parachute science' is driven by "outsiders" assumptions, motives, and personal needs, leading to an unfavorable power imbalance between those from the outside and those on the ground" (de Vos, 2020). A translational approach specifically within the dimension of knowledge creation attempts to remedy the negative impacts and structural imbalances of parachute science.

Throughout my dissertation process while living in the Carpathian Mountain region, I had opportunities to meet and develop relationships with local community members to aid in knowledge creation. Recalling back to the policy actions taken, co-authorship on a manuscript also serves as way to guide local knowledge creation. Its contribution will be evident in local policy actions spearheaded by co-authors, Maria Pasailiuk and Oleh Pohribnyi in Hutsulshchyna. One of the main goals as a result of this dissertation is its translation to a language and format that serves community members following the CARE principles[3] for Indigenous Data Governance (Research Data Alliance International Indigenous Data Sovereignty Interest Group, 2019).

Based on collaborative knowledge curation efforts, my goal is to co-create with Hutsul communities an ethnobotanical database within the culturally traditional Hutsul region, highlighting TEK practices of gathering and managing culturally important species (based on Chapters 2 and 3 of my dissertation). The co-created eco-cultural reservoir could be based in the Hutsulshchyna Museum in Verkhovyna, and comes at a historically important time, especially as other Indigenous groups in Ukraine (like the Tartars in Crimea) are currently facing exile, cultural loss, and religious persecution (Coynash et al., 2019) from a historically colonial neighbor, Russia. This database will serve as a critical, living knowledge base that documents the ongoing importance of culturally important species for numerous stakeholders including Hutsuls, ecologists, climate adaptation scientists, plant geneticists, linguists, anthropologists, conservationists, and community developers. It is known that the threat of biocultural diversity is impending, and the task goes beyond simply creating an inventory of species. Language plays a critical role in maintaining eco-cultural memory. We will document the Hutsul dialect not only focusing on local names but also the descriptive natural-history knowledge (including many plants and animals). My intent is to focus on endangered endemic species and species that have culturally

3 The CARE Principles assert the right to create value from scientific data management and stewardship through an Indigenous worldview lens. CARE - C-Collective benefit, A-Authority to Control, R-Responsibility, E-Ethics.

influenced abundances and distributions. Through this documentation, my hope is to engage, empower and support local communities through biodiversity documentation and stewardship through culturally driven intergenerational learning, using native language-based initiatives (Wilder et al., 2016) (Table 1.2).

Knowledge creation with community members resulted in the making of a phenological gathering calendar. One of the places where I spent a lot of time was the Kryvorivnia Village Library with head librarian, Katya Yurnyuk. It was with her kindness and guidance that I was invited to go out on gathering trips with a local Women's Collective (Figure 1.3). It was during these continual and seasonal gathering trips that I learned more about gathering practices, and various ethnobotanical uses. Additionally, it was through these gathering trips that the inception of a phenological calendar arose. This calendar, still a work in progress, will go through many iterations with community members before dissemination. With threats of climate change noted by community members, this phenological calendar would ground TEK through a community created calendar and serve as a reference point to note phenological changes over time. Facilitating local knowledge creation and curation can empower communities to direct where, in what way, and how knowledge is nested within their communities.

Figure 1.3. Katya Yurnyuk, Nadia Pipinchyk-Kravtsiv, and Nina Fontana with mushroom treasures [July 2018].

3.5 Personal action

Personal actions include lifestyle choices, advocacy, leadership, and role modeling, which can help nurture a culture of resilience (Stern and Wolske, 2017). Ecologists can provide leadership and support in areas of funding, subject matter expertise, and transparent dialogue with various stakeholders (including, policy makers, community members, media, and institutions (Rubert-Nason et al., 2021) through science outreach. These individual actions are personal and vary among individuals. For some ecologists, activism and advocacy may be important, forging community resilience to catalyze policy changes, relationship-building, and healing capacity. For others, science outreach and grant writing may be pivotal, providing accessibility of information and resources needed to implement policy changes. The goal is to ensure individual mobility and agency to promote resilience building within communities from a local to global scale.

As an interdisciplinary ecologist, I found that access to resources stand as a common barrier facing Ukrainian scientists and researchers. Having funding to implement community projects is difficult. Leveraging my positionality, I strived to secure grants as a way of supporting community-driven project ideas. Granting agencies that uphold and ask for intentional, collaborative, international work such as Fulbright scholar award and National Geographic grant have provided capabilities to partner with educational and government institutions. By securing a Fulbright scholar award (2021-2022) and a National Geographic grant, I can help fund a proposal surrounding the ecocultural restoration of the Stone Pine in the Carpathian Mountains. Both grant agencies will provide research funds that can directly go to the implementation of this project. Vasyl Zayachuk, professor at the Ukrainian National Forestry University (UNFU) and Oleh Pohribnyi, forest scientist at the Hutsulshchyna National Nature Park and head of the NGO, "The Heritage of Hutsulshchyna", proposed the idea of this ecocultural restoration project.

This ecocultural restoration project attempts to address harmful colonial legacies that impacted eco-cultural practices within Hutsulshchyna. The Austrian-Hungarian Empire, one of many historical colonizers in this region, implemented forestry practices (logging) that have negatively impacted the populations of ecologically important and vulnerable species like the Stone pine (*Pinus cembra*). Unfortunately, the result of destructive forest management practices of the Austrian-Hungarian Empire (approximately 250 years ago) is still reverberating today and negatively impacting the forests of Hutsul communities. The Stone pine serves an important ecosystem protection function on mountainsides in addition to being a culturally important species to Hutsuls. This ecocultural restoration project would: 1) expand and strengthen existing monitoring of the endangered Stone pine, 2) support the development of an ecosystem service assessment of the Stone pine habitat, and 3) provide a platform for the development of a Stone pine plantation for ecocultural use. This interdisciplinary approach interweaves both quantitative and qualitative methods that will promote resilience of this diverse socio-ecological system in the Carpathians. It was the time investment that nurtured the development of these relationships that laid the foundation for future collaborative endeavors which could lead to impactful action (Enquist et al., 2017), as seen with the Stone pine ecocultural restoration project. Securing funding is one of many direct, personal actions that ecologists can take; Others include serving as a subject expert, being an advocate and activist for resilience building within communities as well as taking leadership roles in science outreach (Table 1.2).

3.6 Challenges

In many ways, the successful completion of my dissertation work took on a translational approach due to the self-evident need for self-education, transparent communication and collaboration, application to policy, integration of community-driven knowledge creation, as well as continual self-reflection on my own individual, personal actions. Each of these dimensions presented challenges to being fully integrated in the research process. Self-education and consistent communication and engagement took on larger roles initially than the other dimensions of policy, knowledge curation and individual action. In many ways, it was those two dimensions that helped inform the other dimensions specifically policy as well as knowledge creation.

Time constraints (Whitmer et al., 2010; Singh et al., 2014) remain a common barrier for conducting translational research. The initial four months of self-education along with communication and engagement were a result of an unseen delay in obtaining my resident visa, which in many ways forced me to stay close to a major city. With that delay, I felt the time constraint of my one-year grant and an urgent necessity to begin the formal research process. Nonetheless, I was able to take short trips to the Carpathian Mountain region, reach out to various people and create networks which served valuable in the integrative process of engagement. While I was unaware at the time, this perceived delay ultimately served as a necessary part of the translational approach needed for this collaborative, time intensive work. In total, I spent a total of a year and half over the course of three years, living and engaging with community members. While this is significant, given the scope of work that is still left to do, it is also all-too-brief.

Another challenge encountered was the struggle to measure the success of this approach (Enquist et al., 2017; Lawson et al., 2017). Co-publication of an article has taken a long time, with the hope that this research is identifying knowledge gaps and resulting in actionable outcomes through regional policy development. Currently, it is preemptive to say what the actionable results will be of the publication and its impact on policy integration in the region. This is the first publication of its kind voicing Hutsul perspective and as Wall et al. (2016) suggest, intentional steps taken along the way of the translational approach may be viewed as indicators to eventual success. In terms of development of the phenological calendar at a regional park level, this serves as an accessible one-pager to ground the importance and prevalence of gathering culturally important species. Lastly, implementation of the pine ecocultural restoration project is still to come. The clear, actionable results of this research are still to be seen in many ways. These small, incremental, translational steps in the short-term, will hopefully make progress in successful outcomes in the long-term (Enquist et al., 2017).

4. Conclusion

The translational approach to interdisciplinary ecological research provides a fairly novel, yet necessary and integrated call to intentionally include diverse voices in the decision-making processes that govern policymaking. Given the abundance of socially linked environmental problems governing our global climate, it is urgent that ecologists consider the direct policy impacts of their research. Research shows that integrating strategies typically seen in the social sciences are effective in bridging the gap between research and decision-making entities (Enquist et al., 2017; McNie et al., 2016). Training future translational ecologists in practical competencies including areas such as mediation, conflict management, project management, ethics, as well as nurturing personal attributes including empathy, leadership, and a commitment to valuing multiple world views, epistemologies, non-formal knowledge, and experience. Translational ecologists, in many instances, are asked to invest their time in crossing boundaries of understanding, distinct fields, and personal comfort zones, in order to participate in a collaborative decision-making as a result of a translational process. In reflecting on various dimensions present in the translational approach and in my own dissertation research process, I provide concrete examples of challenges encountered and direct actions taken to address those challenges. In addition, I present insights into necessary areas of growth and development, as I continue along my journey in research and education. There continues to be a great need for translational researchers who can collaboratively create research objectives and methodologies that are contextually driven and culturally relevant in order to drive thoughtful decision making and proposed solutions to environmental problems.

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Chapter 2: "Medicine Under Our Feet": The Story Behind Quantitative Ethnobotanical Indices

1. Introduction

The diverse ecosystems nestled in the Carpathian Mountains are biodiversity hotspots with forests and grasslands harboring over 200 endemic plant species. Considered the "Amazon of Europe", this mountain region is one of Europe's last fully undeveloped landscapes; it serves as a rich refuge for large carnivores and principle source of subsistence to 16 million people (Gurung et al., 2009). The Carpathian region in Ukraine covers 3.5% of Ukraine's area and 10.3% of total area of the Carpathian Mountains (Elbakidze and Angelstam, 2013). The flora species composition of the Carpathian alpine forest provides a key indicator of ecosystem health in response to climate change (Geyer et al., 2010). As an ancient corridor and refuge for humans, the cultural landscape mirrors the breadth and depth of the biological landscape. Beginning over 2,000 years ago, many tribes have established cultural roots in this region (Kibych, 2010).

Ukraine is home to Indigenous, ethnographic groups ranging from various highlanders in the eastern Carpathian Mountains including Hutsuls in Hutsulshchyna (Figure 2.1), Boykos, in the Bystrytsia Solotvynska River Basin, Lemkos, in the Low and Middle Beskyd Mountains as well as Tatars in Crimea (Magocsi, 1997). Archaelogical evidence points to human existence in the region dating back to 100,000 years (Stech, 2007). This ethnobotanical study is centered in the cultural, historical center of Hutsulshchyna, which translates to "Land of Hutsuls", a mountainous area of the Carpathian Mountains in the southwestern Ukraine (Northern Bukovina) and northern Romania (Maramureș and Southern Bukovina areas). This territory covers three administrative regions (Ivano-Frankivsk, Chernivtsi and Zakarpattia) in Ukraine as well as a portion in northern Romania.

Figure 2.1. Hutsulshchyna is the historical Hutsul region shown here in a bolded outline. It lies on the border of Ukraine and Romania. Historical outline (Figlus, 2009).

At a landscape scale, for centuries, Hutsuls, traditional pastoral highlands of the Ukrainian Carpathians, have maintained alpine grasslands (*polonynas)* through mountain shepherding. Currently, there is a continuing threat of cultural loss of this shepherding practice due to its low economic competitiveness as well as increasing disinterest among younger generations (Amato, 2006). Maintenance of *polonynas* is declining quickly as newer pressures such as tourism infrastructure and emigration of younger generations to cities rise. The recent decline of grazing on secondary grasslands has led to reforestation of previously cleared areas (Elbakidze and Angelstam, 2013). However, mountain shepherding and other traditional ecological practices, such as gathering of NTFP (non-timber forest products), like wild edible plants and mushrooms, have continued to thrive despite these pressures. NTFPs, typically refer to substances, materials or non-timber species that provide economic value to rural communities (FAO, 1999). Forests and a multitude of other habitats (including gardens, roadsides, pastures, fields, woodlands, alpine meadows, meadows, forests, *polonyna*s, generationally-held pastures called *toloka*s, and alpine areas) bordering various village settlements provide an integral zone of nourishment through the gathering of wild and cultivated species (Figure 2.2). Flowers, birch sap, resin, honey, mushrooms, and berries, gathered in these diverse habitats, form an essential part of the social fabric and political economy of Ukrainian culture (Bihun, 2005; Elbakidze and Angelstam, 2007), and in forest-dependent Hutsul communities.

Figure 2.2. Common habitats seen in Hutsulshchyna. Top left: A – Toloka (Photo credit: Yurij Antamanyuk) B – Forest (Photo credit: Mariia Pasailiuk) C – Pasture (Photo credit: Nina Fontana) D – Alpine area (Photo credit: Mariia Pasailiuk) E – Polonyna (Photo credit: Oleh Pohribnyi) F – Field (Photo credit: Yurij Antamanyuk) G – Road (Photo credit: Mariia Pasailiuk) H – Garden (Photo credit: Mariia Pasailiuk) I – Meadow (Photo credit: Mariia Pasailiuk) J – Woodland (Photo credit: Mariia Pasailiuk)

Many of these gathering practices are supported by traditional ecological knowledge (TEK). Lived and experienced by local and Indigenous communities worldwide, TEK is cultural, spiritual, intergenerational, dynamic, place-based, environmental wisdom for survival and interconnection that is revisited, reinterpreted, and re-evaluated consistently (Berkes, 2012; Molnár et al., 2008). TEK, the scientific method brought to life through culture, plays a significant role in meeting community needs, while adapting to environmental changes and societal needs. In this region, TEK (mountain shepherding, subsistence hunting, and the use of wild species of plants and mushrooms) have all been impacted by deforestation and ecosystem degradation caused by various factors such as illegal logging, climate change, and ski tourism (Elbakidze and Angelstam, 2013; Geyer et al., 2010).

As Ukraine continues to face political crisis, financial insecurity, food scarcity, and increasingly expensive medical care, trade and direct consumption of NTFPs in local diets has increased in the Carpathian region (Stryamets et al., 2015). According to the Food and Agriculture Organization of the United Nations, 80% of developing countries rely on NTFPs for nutrition and health purposes (2020). NTFPs contribute to a growing local economy, diversify diets, present possibilities for genetic research and development in new domesticated crops, and provide a lens for understanding cultural identity. For centuries, local Hutsul people have creatively and effectively managed species, maintaining their productivity and availability, thus creating a socioeconomic safety net to sustain them in times of scarcity.

Hutsulshchyna has been a place of extensive ethnographic work starting in the early 1800s and continuing well into the 1930s, whereby this region was under various colonial regimes (Poland and the Austro-Hungarian Empire) (Falkowski, 1938; Kujawska et al., 2015; Łuczaj, 2008;). In the last 5 years, a group of authors have centered their ethnobotanical research in Bukovina, the southeastern corner of Hutsulschyna (which falls along the Ukrainian-Romanian border) with several studies focusing on Hutsul ethnobotany (Mattalia et al., 2020; Mattalia et al., 2021a; Mattalia et al., 2021b; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016; Stryamets et al., 2021b). Their methodologies generally consist of qualitative interviewing followed by quantitative analyses including detailed use report (DUR) and calculations of the Jaccard Similarity Index (JI) to cross-culturally compare ethnobotanical uses on either side of the border. Their studies suggest that the establishment of the border between Ukraine and Romania in 1940 and the resulting impacts of Soviet policies in Ukraine contribute to differences seen in ethnobotanical use (Mattalia et al., 2021; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016; Stryamets et al., 2021a) and knowledge transmission between Hutsuls in North Bukovina (Ukraine) and Hutsuls in South Bukovina (Romania) (Mattalia et al., 2020). Additionally, other studies analyze differences between wild and cultivated species' use between Romanians and Hutsuls in Bukovina (Mattalia et al., 2021a) as well as the revitalization of ethnobotanical practices in religious holidays of Hutsuls in Northern Bukovina (Ukraine) and Ukrainians in Roztochya, western Ukraine (Stryamets et al., 2021b).

The most recent study infers that Hutsuls in Northern Bukovina (Ukraine) exhibit greater reliance and dependence on forest habitats than Hutsuls in Southern Bukovina (Romania). The splitting of Hutsulshchyna between Ukraine and Romania in 1940 and the resulting socio-political policies implemented on each side of the border guide the narrative of these studies; differences seen in species uses, range of species as well as ethnobotanical knowledge transmission are attributed to this border creation.

What does traditional ecological knowledge (TEK) which supports ethnobotanical use look like in the center of Hutsulshchyna? How is TEK adapting to regional challenges? This study elucidates today's current traditional ecological knowledge (TEK) in the Carpathian Mountains, underpinning the practices of gathering wild and cultivated species use (including plants, lichens, and fungi), radiating out from the historical, cultural center of Hutsulshchyna, Verkhovyna, in Ukraine. Building upon previous studies, this study incorporates both the ethnobotanical, quantitative analyses (using ethnobotanical indices as metrics to determine cultural importance and prevalence of species) as well as collaborative, qualitative methodologies (community-based participatory action research and participant observation). By exploring how TEK supports gathering practices surrounding use, factors including accessibility to habitat and availability of species arise; current ecosystem, climatic and cultural changes are impacting these factors. The results of this study are interpreted through the lenses of quantitative ethnobotanical indices (what is gathered?), qualitative methods (why gather?), and TEK (how do you know how to gather? when to gather?). The answers to all these questions provide a starting point to centering TEK within a broader context of conservation policy, acknowledging the critical relationships between forest-dependent communities and their neighboring habitats.

2. Methods

2.1 Hutsulshchyna – The Land of Hutsuls

The study area of focus within Hutsulshchyna has experienced numerous battles including Tartar hordes (1000s), the Polish regime (1340), the Austrian-Hungarian Empire (1780s-1918 and 1939-1943), Poland (1919-1939), and the Soviet Union (1940-1991). During the interwar period between World War I and World War II, Hutsulshchyna was split between Poland, Romania and Czechoslovakia (Figlus 2009). In 1940, Hutsulshchyna was split between the Soviet Union and Romania. In 1991, when Ukraine became independent, Hutsulshchyna was then split between Ukraine and Romania.

The Hutsulshchyna region holds a lot of appeal for Ukrainian, Polish and European tourists today due to its natural beauty - rolling hills dot a landscape of coniferous pine forests, grazed land, gardens, mountains, *polonyna*s (traditionally-held alpine pastures), and rivers. For Hutsuls living in the region, many households manage subsistence agriculture, beekeeping, and cattle operations, with additional income derived from family members going abroad to earn income. Low salaries demand multiple avenues of revenue from subsistence farming, gathering of wild foods, selling valuable wild plants, and opening one's home to tourist stays (ecotourism). This area is characterized by its high elevation and small villages that dot the valleys between the peaks. Vekhovyna (Zhab'ye/Жаб'є), the center of this study, lies at 607 meters above sea level and has a cold and temperate climate (Velyoha, 2006). Characteristic of this region are the valley microclimates, fog, and significant amount of rainfall. Daily average air temperatures can range from 16.9 degrees Celsius, with July being the hottest month to -5.1 degrees Celsius with January being the coldest month. Precipitation can vary from 38 mm to 109 mm (En.climate-data.org, 2021).

Hutsuls are associated with Ukrainians (Figlus, 2009; Mohatych, 1994) and Ruthenians (Nistor, 1915; Tufescu, 1970), yet they consider themselves a freestanding ethnicity. Political boundaries running through the territory have had minimal effect on Hutsul unity or identity since it is the mountains that form the natural boundary among states, not the artificial lines drawn through them (Domashevsky, 1985). Lifeway overrides these century-old claims to land, and peoples as seen through shepherding, farming, use and knowledge of plants, embroidery, song, storytelling, and language. Hutsul, considered a unique dialect (Figlus, 2009) is endangered due to various socio-economic pressures (Coyne 2014, pg. 218), and in many instances is indistinguishable from Contemporary Standard Ukrainian (CSU) (Hrabec, 1950). Even from village to village which can be distant across mountain ranges (~2-12 miles apart) there are notable linguistic differences, as an old saying goes, "in every cottage a different tongue" (Haratyk, 2014). The same can be said with local Hutsul plant names and uses as well as place names.

2.2 Field Study

I traveled extensively throughout Hutsulschyhna and spent four months meeting various community members (at parks, universities, and in villages), and collaboratively determined research questions and methodologies before beginning the research process (Figure 2.3). I chose to center my field work in villages surrounding the historical heart of Hutsulshchyna in Verkhovyna/Верховина (historically known as Zhab'ye/Жаб'є), which lies at an elevation of 610 meters and has a population of 5,812 people. Zhab'ye (renamed Verkhovyna by the Soviets in the 1962) is considered the historical, cultural, and geographical center of Hutsulshchyna, as it lies along the Black Cheremosh River/Чорний Черемош at an elevation of 600 meters, at the base of the Black Mountains/Chornohora/Чорнагора (Velyoha 2006). Chornohora, the highest mountain range of Ukraine (~2000 m), is a culturally traditional area for Hutsulshchyna and Hutsul people (Warchalska-Troll and Troll, 2014).

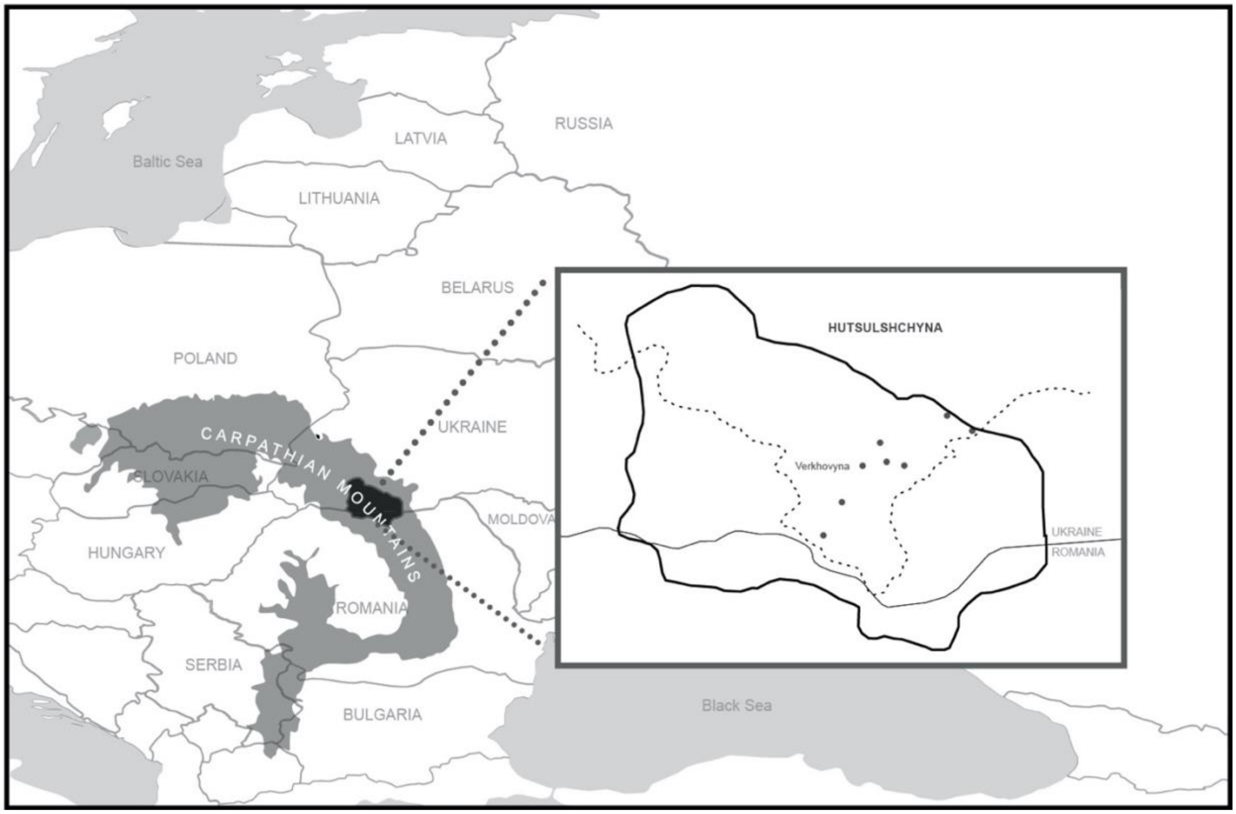

Figure 2.3. The bolded outline marks the current area of Hutsulshchyna, the land of Hutsuls (Adapted from Figlus, 2009). Hutsulshchyna today borders both Ukraine and Romania. The dotted line transecting Hutsulshchnya represents borders established before World War II whereby Hutsulshchyna was split between Romania, Czechoslovakia, and Ukraine. In 1940, borders split Hutsulschyhna between the Soviet Union (now Ukraine) and Romania. The dots represent villages visited and places of interviewing. Verkovyna, the historical cultural center of Hutsulshchyna, and the surrounding villages all fall within a centralized area between borders established before World War II.

I conducted my field research over the course of two field seasons (2017-2019). My methodologies are both quantitative and qualitative in nature. To understand the documented regional ethnobotanical knowledge, I conducted historic and ethnographic literature reviews, as well as visited local museums including Didova Apteka, The Hutsulshchyna Museum, and The Ivan Franko Museum. Two qualitative methods guide this research: 1) participant observation in which I, as a researcher, took part in daily activities, interactions, and events, including gathering trips (Musante and DeWalt, 2010) and 2) community-based participatory action research (CBPAR) (Ballard and Belsky, 2010), in which I worked collaboratively with community members on the framing and formation of this study.

During the first field season, between December 2017 and August 2018, I conducted in-depth qualitative semi-structured interviews (Idolo et al., 2010), using ethnographic interview methods (Weiss, 1994; Siedman, 2006) with 40 people including elders, herbalists, villagers, farmers, and knowledge holders through snowball sampling (Höft et al., 1999; Martin, 2004) in eight different villages. Interview participants also included foresters, rangers, and scientists at two national parks (Verkhovyna and Hutsulshschyna National Parks). Interviewees (17 men, 23 women) ranged in age from 25 to 93 years old, with an average age of 53. Interviews were conducted in Ukrainian, and participants responded in Hutsul and Ukrainian. Interviews typically ranged from one hour to four hours, focused on topics of species use (primarily plants), gathering practices, species history and species ecology. I typically brought a camera, audio recorder, notebook, and a travel plant press to each interview. Each participant was asked for consent before recording or photographing occurred. Most interviews occurred at homes, places of work, or at places of gathering. An IRB consent was completed and filed for the length of the study and the project followed the ethical guidelines outlined in the International Society of Ethnobiology (ISE, 2006).

A second field season (June-August 2019) consisted of conducting follow-up interviews with community members, along with Hutsul mycologist, Maria Pasailiuk. We asked questions to further clarify species names and uses, as well as conducted participant observation. Particular attention was paid to gathering practices and plant names used, whether they were Hutsul, common or scientific names. Throughout both field seasons (2017-2019), key elders and knowledge holders were interviewed multiple times to clarify plant names and plant uses with the aid of photographs and voucher specimens. Alignment of common names with botanical names, and plant identification of voucher specimens was confirmed and cross-referenced with botanists (Lyubomyr Derzhipilsky) and scientists (Oleh Pohribnyi, Mariia Pasailiuk) at the Hutsulshchyna

National Nature Park as well as botanist Roman Lysiuk, from Danylo Halytsky Lviv National Medical University. Taxonomic texts from the Hutsulshchyna National Nature Park library were also used to identify species including plants, mushrooms, and lichens. Additionally, throughout both field seasons, guided by elders and specialists, I participated in trips throughout the gathering season (typically, fall, spring, and summer) to the Chornohora Mountain range and local areas to better understand gathering practices in the region. Lastly, I organized a total of five informal group discussions with local women regarding plant use and environmental change seen in the region.

Interviews were then transcribed, translated, and coded. Semi-directed interviews were transcribed in Ukrainian by me as well as colleagues (Natalia Promirko, Serhiy Balabai, Bozhena Hryniv, Khrystyna Hnativ, Nataliia Koretska, Marta Krysan, Yulia Dulchak, Sofia Petruk, Yana Terletska, and Sviatoslav Bashchuk). I then translated the interviews into English and coded them using a mix of deductive and inductive codes in Nvivo. A round of structural coding was employed to sift out general themes and basic categorization (Saldaña, 2014).

Data were organized in Excel and in R including pertinent information - plant name (Latin, Ukrainian, Hutsul), plant part used, method(s) of preparation, recorded use (alcoholic beverage, fruit, recreational beverage, seasoning, vegetable, tea, fungi, medicinal tincture, medicinal topical treatment, ground medicinal use, symbolic, toxic, veterinary, ecological use, textile, repellant, economic use), as well as habitats found (Figure 2.2). This last category, habitats found, denotes where a particular species is found and gathered. Using the ethnobotany R package, developed by Cory Whitney (2020), ethnobotanical quantitative metrics were calculated including use report (UR), cultural importance index (CI), frequency of citation per species (FC), number of uses per species (NU), relative frequency of citation index (RFC), and fidelity level per species (FL) for both wild species (including plants, lichens, and fungi) and commonly cultivated plants. All species were included (wild species, cultivated species and fungi) in the cumulative calculation of indices in order to evaluate where each species ranked overall, regardless of categorization.

After calculating each of these indices, this knowledge was further organized to explore cultural prevalence and TEK surrounding species use. I created a use category called "ecological use" to signal TEK surrounding species use; This denotation indicates that a species holds specific TEK and this "ecological use" was incorporated in the calculation of the indices. Quantitative ethnobotanical indices provide a starting point for discussion of cultural consensus (Albuquerque et al., 2006) surrounding species use. However, this discussion deepens by integrating qualitative methods (such as participant observation, in-depth interviews, community-based participatory methods), which examine 'the why' and 'the how' behind species gathering and use, elucidating the context of these ecological practices – specifically TEK in the historical, cultural center of Hutsulshchyna. In order to understand traditional ecological knowledge (TEK), thorough investment of time in place and relationship-building with community members is needed. Qualitative methods can better elucidate the TEK surrounding species' cultural importance, use, stories, rituals, and the context-driven meaning behind the indices themselves.

Outings, informal meetings, participant observation, multiple meetings and long-term presence with key elders allow for the development of shared trust and the witnessing of lived knowledge. Many times, a plant is used but not explicitly mentioned in interviews, not because it isn't important but because it is subsumed into the daily rhythm of existence. By incorporating this qualitative approach alongside quantitative indices, a richer, place-based perspective can be gained based not only on participant consensus on diverse species use, but how TEK supports and informs community relationships to the broader landscape.

3. Results

With the direction, guidance, and cooperation from Hutsul elders, farmers, herbalists, and community members, I recorded a total of 108 species from 79 genera and 48 families (Appendix A) in a total of ten different habitats (Table 2.1). While the goal was to understand the role wild plant use and management in Hutsulshchyna, while interviewing, other topics arose such as use of cultivated plants (23 species), mushrooms (9 species), and lichens (2 species). The notation of which plants were considered 'wild' was determined by the interviewees. Species noted by interviewees as cultivated were defined as such. Additionally, I noted instances where observed wild species were seen growing in cultivated spaces such as gardens. Among the wild species, the most well represented families included Rosaceae, Asteraceae and Gentianaceae. Among the cultivated plants, the most well represented families include Apiaceae and Asteracea. A total of 1508 UR for wild plants, a total of 220 UR for cultivated plants and a total of 68 UR for mushrooms were provided by participants. Out of 97 plant species examined, 23 plants were cultivated, and 74 plants were wild. Out of 97 plants stated as culturally important (as indicated by the CI index), there are 4 species of evergreen trees, 11 species of deciduous trees, 15 species of shrubs, 62 species of perennials, 4 species of annuals, 1 aquatic plant species along with 2 species of lichen.

Table 2.1. Occurrence of taxa within habitats

Habitat	Number of taxa
Woodland	67
Forest	54
Roadside	51
Meadow	49
Polonyna (alpine pastures)	41
Toloka (generational pastures)	40
Pasture	31
Garden	23
Field	22
Alpine meadow	17

These data are based on interviews, participation observation, participatory action research, and collaboration from the Hutsulshchyna National Park. In this table, I did not include extended ranges of wild species seen in gardens (23 species of cultivated plants were noted). A species' range can extend across various habitats. (For example, St. John's wort is found along roadsides, *toloka*s, pastures, meadows, woodlands and sometimes in gardens).

The quantitative outputs are a result of different ways of distinguishing importance by number of uses, spread of uses within a community, frequency of citation, and diversity of uses. Frequency of citation (FC) deliberately considers only the number of people that mention a species useful, while all other indices consider the number of uses for a species. Relative importance (RI) assigns greater importance of the number of uses of a species, accounting for use categories. Cultural Importance index (CI index) calculates the spread of use among the participants for each species as well as the diversity of uses. The CI index is useful since the measure is independent of the number of informants and can be used for comparing regional botanical knowledge (Tardío and Pardo-de-Santayana, 2008). By calculating each of these indices, a range species of cultural importance arises (Table 2.2).

Table 2.2. Top Twenty Species of Noted Cultural Importance in the historical heart of Hutsulshchyna

Botanical Name	Habitat (Gathering site)	NU	FC	UR	CI Index
**Hypericum perforatum*	RD, PAS, TOL, MEA, WD, POL, FIE, (GAR)	6	28	87	2.175
**Vaccinium myrtillus*	TOL, WD, FOR, POL, ALP	8	22	81	2.025
**Rubus ideaes*	RD, WD, FOR, POL, ALP, (GAR)	6	23	77	1.925
**Arnica montana*	MEA, WD, ALP, POL, (GAR)	7	26	69	1.725
**Mentha spp.*	WD, POL, FIE, (GAR)	7	22	53	1.325
**Thymus serpyllum*	RD, PAS, TOL, MEA, WD, POL , (GAR)	8	18	51	1.275
**Gentiana lutea*	MEA, ALP, POL	5	16	50	1.250
**Fragaria vesca*	RD, PAS, TOL, MEA, WD, FOR, POL, (GAR)	7	14	50	1.250
**Rosa canina*	RD, PAS, TOL, MEA, WD, (GAR)	5	19	48	1.200
Rubus caesius	RD, PAS, TOL, MEA, WD, POL, (GAR)	5	20	45	1.125
Rhodiola rosea	POL, ALP	4	16	43	1.075
**Vaccinium vitis-idaea*	TOL, WD, FOR, POL, ALP	6	18	43	1.075
**Tilia cordata*	MEA	7	16	41	1.025
Cetraria islandica (Lichen)	FOR, POL, ALP	6	10	38	0.950
**Carum Carvi*	RD, PAS, TOL, MEAD, POL, (GAR)	5	11	35	0.875
**Origanum vulgare*	RD, PAS, TOL, MEAD, WD, FOR, POL, (GAR)	7	12	33	0.825
Chamaenerion augustifolium	MEAD, WD, FOR, POL, (GAR)	5	12	32	0.800
Amanita muscaria (Fungi)	FOR	5	10	32	0.800
Pinus cembra	FOR, POL, ALP	6	7	29	0.75
Arcostaphylos uva-ursi	WD	7	12	27	0.675

UR- use report, CI index – cultural importance index, NU-Number of uses, FC-Frequency of citation

Habitats – Roadside-RD, pastures -PAS, toloka - local family pasture land -TOL, meadows -MEA, woodlands -WD, forests -FOR, fields -FIE, polonyna- summer shepherding pastures -POL, alpine areas -ALP, gardens -GAR. Species noted as (GAR) show extended and observed ranges for typically wild plants seen growing in gardens. This exemplifies their potential extended range.

* Plants that show consistent use on both sides of the border of the Ukrainian-Romanian border based on literature reviews (Soukand and Pieroni, 2016; Pieroni and Soukand, 2017; Mattalia et al., 2020

3.1 Culturally Important Wild Plants (CI index)

"The higher the plant grows,
as they say, closer to the heavens,
it has better taste and better berries."
[Ivan (J.)]

The cultural importance index (CI) index is the sum of the use reports (URs) divided by the number of interviewees. This allows for the accounting for the diversity of uses of each species (Prance et al., 1987). CI values match the same progression of values of the use reports. The use report (UR) calculates the total uses for all species by all informants within each use-category for that species (Rossato et al., 1999; Albuquerque et al., 2006). St. John's wort (*Hypericum perforatum*), bilberry (*Vaccinium myrtillus*), and raspberry (*Rubus ideas*) were denoted as the most culturally important species (CI index) with highest noted use reports (UR) (Table 2.2).

3.1.1 St. John's Wort (Hypericum perforatum)

St. John's wort (CI index: 2.175), used by people since ancient times, is used sparingly due to its strong medicinal properties. Noted by participants to "cure 99 diseases", it is used medicinally in teas and tinctures (for colds and stomach issues). As a prevalent and abundant species, it is commonly found in disturbed areas (along roadsides), pastures and alpine areas. Noted for its honey-like aroma, it is generally avoided by cattle due to its toxicity, its common name, "звіробій" (zvirobiy), reflects its this attribute, translating to "kill the beast!" alluding to both animals and the ailment. Its Hutsul name, "Божа крівця," translates to the blood of God, and refers to the burgundy color pigment, hypericin, that the plant releases (Figure 2.4).

3.1.2 Bilberry (Vaccinium myrtillus)

Bilberry (CI index: 2.025) is one of the most gathered, eaten, and sold species, providing a source of secondary income. It is used as a flavoring in alcoholic tinctures, fruits, and juice.

Bilberry, an important cultural staple food in each household, is used in traditional foods like *varenyky* (a boiled dumpling). In terms of detecting quality of bilberries, berries that are "further from civilization, closer to the sun and sky" are better for "this is the only thing that they need [sun and sky]" [Vitalyna (W)]. Bilberry is found in a range of elevations, from forests, *toloka*s, woodlands, *polonyna*s, to high alpine areas (Figure 2.4).

Figure 2.4. Left photo: St. John's Wort held by Lyuba Tsvilunyuk. (Photo credit: Nina Fontana) Right photo: Bilberry and gathering comb used to gather billberry held by Ivan Halamasiuk. (Photo credit: Ivan Halamasiuk).

3.1.3 Raspberry (Rubus ideas)

Raspberry (CI index: 1.925) is eaten as a fruit, used as flavoring in alcoholic tinctures, prepared as tea, and made into a juice and jam. Raspberry, is consumed recreationally and its leaves, stem and berries are commonly brewed into a medicinal tea. There is a noted difference between cultivated raspberries and forest raspberries in terms of physical appearance, taste, aroma, and medicinal properties. Forest raspberries have more curative properties, are more flavorful, aromatic and are generally smaller than those transplanted to garden environments.

3.1.4 Frequency of Citation (FC)

The frequency of citation is the sum of informants that cite a use for a species (Prance et al. 1987). The relative frequency of citation (RFC) index calculates the relative frequency of citation for each species in the data set. The ranking of the relative frequency of citation (RFC) index follows the most frequently cited (FC) plants. The most frequently cited (FC) plants were St. John's wort (*Hypericum perforatum*), followed by arnica (*Arnica montana*) and raspberry (*Rubus ideaus*). Arnica, a regionally important plant, is noted as a species declining in population in surrounding villages. *Arnica montana* was listed in Ukraine's Red Book of endangered species in 2008 and noted as a sought out commercially harvested plant. Currently, Hutsul locals have stated its disappearance in lowland areas due to commercial harvesting and climate change. "Now, it grows in the high mountains." [Vaselyna (M.)] In terms of gathering, flowers are preferred due to their high economic value; flowers are commonly used in a tincture to treat bronchitis and as a topical treatment in tea form. It is also noted to be toxic, and its usage is measured.

3.1.5 Number of Uses (NU)

The number of uses per species (NU) calculates the number of uses for each species in the data set (Prance et al. 1987). The plant indicating the most uses was thyme (*Thymus serpyllum*) (8 uses), followed by bilberry (8 uses) (*Vaccinium myrtillus*). Thyme is ubiquitous in the region, used as a seasoning in a variety traditional foods and tea. It is typically collected every summer, starting in June in the lowlands on village pastures. Medicinally, it is used to treat colds. "Where there is thyme - that is where the cold ends!" [Vaselyna (M.)]

3.1.6 Relative Importance (RI) and Fidelity Level (FL)

The relative importance (RI) index calculates the relative importance index for each species in the data set. The relative importance index (RI index) varies from 0, whereby nobody mentions use of the species to 1 in which case it is the most frequently mentioned as useful and in the maximum number of use categories. The ranking of the RI index is as follows: bilberry (*Vaccinium myrtillus*), arnica (*Arnica montana*) and St. John's wort (*Hypericum perforatum*. Fidelity level (FL) calculates the percentage of informants who use the plant for the same purpose as compared to all uses of all plants. In the calculation, N is the number of informants that use that plant for a specific purpose, and URs is the total number of use reports for the species (Friedman et al. 1986). In Appendix A, Table A3 shows wild species' uses and their corresponding fidelity levels.

3.2 Home gardens: A place of cultivation and experimentation

Although participants were asked about wild plant use, they cited 23 commonly used cultivated plants (Table 2.3). There are an extensive number of cultivated plants, seen in gardens, but not mentioned in interviews, and these plants were not included in quantitative indices. Out of the 40 people interviewed about wild plants, 32 mentioned uses of cultivated plants unprompted and stated the importance of cultivating their own gardens. Stressing the differences between cultivated and wild plant species, participants stated wild plant species harvested from landscapes other than gardens have more desirable properties in taste, smell, and medicinal quality than their garden analog varieties (ex. raspberry and mint). Certain cultivated plants are perennial and easy-growing such as *Melissa officinalis* and *Mentha spp.*, and are therefore available and abundant. These garden plants are used more for food and seasoning purposes, while wild plants are relied upon for their medicinal properties.

Gardens provide a reliable, semi-predictable resource of nutrition and medicine. In the Carpathian Mountains as well as generally in Ukraine, home gardens provide a source of food and medicine. In addition to various habitats nested within the landscape (Figure 2.2), these microenvironments within the agroecosystem create another function and layer of resilience in a larger ecosystem. Home gardens act as centers of experimentation, supporting introduction of new crops, and crop improvement. In some cases, elders mention transplanting wild plant species into their own home gardens including *Fragaria vesca* and medicinal root species such as *Rhadiola rosea a*nd *Arnica montana*. In all cases, by incorporating wild species into gardens, perceived medicinal properties, taste and structure were altered and diminished. For example, they noted that the curative medicinal qualities of alpine medicinal roots grown in the garden are diminished in comparison to their wild analogs. While participants were not explicitly asked about cultivated plants, their use arose when asked about plants that are commonly gathered. These plants have importance due to their spontaneous inclusion in the discussion (Table 2.3). To see recorded taxa including habitats, names, parts use, mode of use, see Appendix A, Table A1.

Table 2.3. Recorded cultivated taxa and corresponding basic values, indices and ranking of cultivated species gathered in the historical heart of Hutsulshchyna.

	Basic values			**Indices**			**Ranking**		
Botanical name	***FC***	***UR***	***NU***	***CI***	***RFC***	***RI***	***CI***	***RFC***	***RI***
Matricaria chamomila L.	15	26	4	0.650	0.375	0.438	1	1	4
Malus spp.	6	21	6	0.525	0.150	0.450	2	9	3
Aronia melanocarpa	5	18	7	0.450	0.125	0.500	3	12	2
Chelidonium majus	10	17	3	0.425	0.250	0.312	4	2	8
Papaver somniferum L.	6	17	5	0.425	0.150	0.388	5	8	6
Brassica oleracea	5	12	5	0.300	0.125	0.375	6	11	7
Anethum graveolens	6	11	5	0.275	0.150	0.388	7	6	5
Solanum tuberosum	7	11	3	0.275	0.175	0.275	8	5	12
Zea mays	3	11	4	0.275	0.075	0.288	9	16	11
Cannabis sativa	6	10	7	0.250	0.150	0.512	10	7	1
Melissa officinalis	7	9	2	0.225	0.175	0.213	11	4	16
Calendula officinalis	5	8	2	0.200	0.125	0.188	12	10	19
Symphytum officinale	7	8	2	0.200	0.175	0.213	13	3	15
Petroselinum crispum	4	7	4	0.175	0.100	0.300	14	13	9
Ribes nigrum/rubrum	4	7	3	0.175	0.100	0.238	15	14	13
Ribes uva-crispa	3	5	4	0.125	0.075	0.288	16	15	10
Galanthus nivalis	2	4	2	0.100	0.050	0.150	17	18	20
Armoracia rusticana	2	4	3	0.100	0.050	0.212	18	19	17
Helianthus tuberoses	2	4	3	0.100	0.050	0.212	19	21	18
Aesculus hippocastanum	3	4	3	0.100	0.075	0.225	20	17	14
Centaurium erythraea	2	3	2	0.075	0.050	0.150	21	20	21
Rheum rhaponticum	1	2	2	0.050	0.025	0.138	22	23	22
Levisticum officinale	1	1	1	0.025	0.025	0.075	23	22	23

FC – Frequency of Citation, UR – Use Report, NU – Number of Uses, CI – Cultural Importance,
RFC – Relative Frequency of Citation, RI – Relative Importance

3.2.1 Cultivated species: Cultural Importance (CI index) and Use Reports (UR)

The top three cultivated species with the highest noted cultural importance and highest noted use reports (UR) were chamomile (*Matricaria chamomilla L.*), apple (*Malus spp.*), and chokeberry (*Aronia melanocarpa*). Chamomile (CI index: 0.650) is used in bathing (as an antiseptic), as a tea (calming agent), and as a medicine for cattle. Chamomile is a versatile and common plant where participants generally "always have a little bit of this in the cupboard." [Hanya (E.)] Historically, chamomile was used and planted in herbal gardens called a zilnyk (зільник). Wild field chamomile populations are in decline, hence their cultivation in gardens. Apple species (CI index: 0.525) are used not only for food but also for various drinking beverages including uzvar and compote (recreational drinks). In addition, apple species (*Malus spp.*) vary across the region and are also of cultural importance on a holiday called Spas (Спас) where orchards are blessed by the local priests. Chokeberry (CI index: 0.450) is culturally significant and nearly everyone plants this bush near their house. It is easily found in gardens and nearby forests. There are designated gathering spots that people go to gather chokeberry. Chokeberry is used to make wine, jam, kvass (a recreational drink), and medicinally treats blood pressure changes.

3.2.2 Frequency of Citation (FC)

The most frequently cited (FC) plant was chamomile (*Matricaria chamomilla L.*), followed by greater Celandine (*Chelidonium majus*) and comfrey (*Symphytum officinale*). Greater Celandine is noted for its extreme toxicity, grows alone, and is used for topical treatment of warts. Comfrey root (*Symphytum officinale*) is regarded as a "human plant," in that it is typically found near homes and villages. Comfrey, used for centuries, is targeted for pain management and treatment of lungs. Ecologically speaking, comfrey is an ecological indicator species; it is found in edge habitats (disturbed areas), indicating that beech forests are present or expanding.

3.2.3 Number of Uses (NU)

The plant indicating the most uses was cannabis (*Cannabis sativa*), followed by chokeberry (*Aronia melanocarpa*) and apple (*Malus spp.*) Cannabis was historically used but is currently outlawed in Ukraine. From about 1950 to 1980, the world's largest cannabis fiber producer was the Soviet Union with the main production areas being in Ukraine, Russia and near Poland's border (Ehrensing, 1998). Its primary use was as a textile (shirts, bags, woven thread). Cannabis was also used as a tea, processed as an oil, used as medicinal treatment and in rituals. Its symbolism and use was integral in the celebration of St. Andrew's feast day. There's a story that boys would go and plant hemp under windows. They would mix it with sand and dirt and say, "Hemp, hemp, with the help of St. Andrew, I plant you/ Here I plant this [hemp], married I want to be" [Lubomyr (C.)] and the boys would plant hemp under windows of girls that they would want to marry. Chokeberry (*Aronia melanocarpa*), typically eaten as a fruit, is brewed into a tea, and other recreational beverages including kvass, and wine. In addition, it is made into tinctures. Ecologically, it is a plant that thrives in edge plant communities between village and forest.

3.2.4 Relative Importance (RI) and Fidelity Level (FL)

The ranking of the relative importance index (RI index) is as follows: cannabis (*Cannabis sativa),* chokeberry (*Aronia melanocarpa*) and apples (*Malus spp.*). Interestingly, cannabis isn't a plant of current importance, yet was cited with the most uses because people still use items today passed down generationally. In many Hutsul homes today, there are cannabis-derived textiles (including embroidered shirts and bags) still in use. Appendix A, Table 4A shows cultivated species' uses and corresponding fidelity levels.

3.3 Ethnomycology: Incidental and Critical Knowledge

Nine mushroom species were identified, with Boletaceae being the most well represented family. Like the inclusion of cultivated plants in the indices, mycological knowledge came as a byproduct of a different series of topical questions. Incidental gathering of wild plants typically occurs when mushroom hunting hence their inclusion in the analysis. Out of the 40 people interviewed, 18 mentioned the gathering of mushrooms and stated the importance of mushrooms in culture, economics, and diet. This dataset is small since it was incidental knowledge gathered through interviews and participant observation on plant knowledge; it does not fully capture the extensive deep and rich mycological knowledge rooted in this region.

Most people go out with their families and gather mushrooms in the summer and fall. It is a recreational and seasonal activity that bonds generations. For example, one elder mentioned, "I take my grandson and we go together to pick mushrooms. I show him the place where mushrooms grow." [Mykola (L.)] Participant observation over the course of a year as well as an additional summer field season reveals the importance of mushrooms. There are a couple of mushroom species that are consistently collected on a yearly basis, serving as an important food source. During specific Christian holidays, fasting is a practice and "it is important for people to stock with dried mushrooms." [Katya (K.)] Another elder stated,

> Many tourists come here because of mushrooms. And we have a lot of mushrooms. If it is hot and dry, they don't grow. If it is warm and rain falls, mushrooms like it. And we also collect, dry, and preserve them. And you can sell them. This is how we live. [Ira (S.)]

The act of gathering is mushrooms embedded in Ukrainian culture overall (seen in traditional foods) but even more so in the Carpathian forests, where these species live. This incidental gathering of knowledge presents a significant starting point in understanding the importance of ethnomycology in Hutsulshchyna.

3.3.1 Ethnomycological Indices

Considering cultural importance (CI), frequency of citation (FC), relative frequency of citation (RFC), relative importance (RI), and use reports (UR) among mushrooms noted, fly agaric (*Amanita muscaria)* ranks first and penny bun (*Boletus edulis*) ranks second. Chanterelle (*Cantharellus cibarius)* ranks third in terms of cultural importance (CI) and relative importance (RI), and ranks fourth in terms of relative frequency of citation (RFC). The ranking of the frequency of citation (FC) and relative frequency of citation (RFC) is as follows: fly agaric (*Amanita mascara),* followed by penny bun (*Boletus edulis*) and common stinkhorn (*Phallus impudicus*). The mushrooms indicating the most uses (NU) was shared by penny bun (*Boletus edulis*) and fly agaric (*Amanita mascaria)* followed by chanterelle (*Cantharellus ciborium).* A total of 68 UR were provided by participants (Table 2.4). In Appendix A, Table 5A shows all mushrooms, uses and their corresponding fidelity levels.

Table 2.4. Recorded fungi taxa and corresponding basic values, indices and ranking of fungi gathered in the historical heart of Hutsulshchyna.

	Basic values			**Indices**			**Ranking**		
Botanical Name	***FC***	***UR***	***NU***	***CI***	***RFC***	***RI***	***CI***	***RFC***	***RI***
Amanita muscaria	10	32	5	0.800	0.250	0.438	1	1	1
Boletes edulis	6	13	5	0.325	0.150	0.388	2	2	2
Cantharellus cibarius	2	7	5	0.175	0.050	0.338	3	4	3
Phallus impudicus	3	5	2	0.125	0.075	0.162	4	3	6
Leccinum aurantiacum	2	4	3	0.100	0.050	0.212	5	5	4
Lycoperdon perlatum	1	3	3	0.075	0.025	0.200	6	7	5
Armillaria mellea	1	2	2	0.050	0.026	0.138	7	6	7
Leccinum scabrum	1	1	1	0.025	0.025	0.075	8	8	8
Russula sp.	1	1	1	0.025	0.025	0.075	9	9	9

FC – Frequency of Citation, UR – Use Report, NU – Number of Uses, CI – Cultural Importance, RFC – Relative Frequency of Citation, RI – Relative Importance

3.3.2 Fly Agaric (Amanita muscaria)

Amanita mascara is abundant in the region, growing in association with a diversity of tree species including pine, fir, birch, cedar, oak, and spruce (Figure 2.5). Fly agaric, noted for its toxicity, is typically used in medicinal cancer treatment. Use of this fungus is not ubiquitous but rather specialized among experts due to its toxicity. Two stories were told in interviews whereby a man was sick and decided to poison himself by cooking and ingesting the fly agaric. Instead, the man ate it and went to sleep. He woke up feeling better, and eventually recovered. Its toxicity is noted as well as tincture preparation discussed extensively. One participant stated that fly agaric is even considered delicious but needs to be specifically prepared to be edible. While it was discussed the most, it is sparingly gathered and if gathered, rarely. Its bold presence in the analysis has more to do with its symbolic prevalence and ecologically frequent presence in the region than its use in everyday life. For this reason, it also holds symbolic importance.

Figure 2.5. Fly agaric (*Amanita muscaria*) typically grows in association with pine, oak, spruce, fir, birch, and cedar trees. The fruiting cap is typically gathered. It is used medicinally both topically and as a tincture. Noted for its toxicity, it has medicinal and symbolic uses. (Photo credit: Nina Fontana).

3.3.3 Penny bun (Boletes edulis)

Penny bun, plentiful in the region, grows in symbiosis with pine and spruce tree species. It is gathered following local ecological cues and is symbolically important in Hutsul culture. Penny bun, typically eaten, is noted to be of great importance, culturally, economically, and nutritionally. Although there are other mushrooms that are edible in the Carpathian Mountains, this mushroom is preferred; its use is frequent in traditional foods (like *kulesh*) (See Chapter 3). Extremely important in day-to-day life, most people gather this mushroom as a source of nutrition as well as source of secondary or tertiary income. One participant noted its medicinal use as a tincture, used topically to treat pain.

3.3.4 Chanterelle (Cantharellus cibarius) and Other Important Fungi

Chanterelle, commonly found in coniferous forests, is both a source of food and medicine. As an economically important mushroom, these mushrooms are typically sold at a higher price than other mushrooms. Common stinkhorn (*Phallus impudicus*), which has distinctive physical characteristics, is also used for cancer treatment. While it is considered rare in local forests, it is still present. Lastly, Red pine mushroom (*Lactarius deliciosus)* was not explicitly mentioned in interviews is gathered seasonally (Figure 2.6).

Figure 2.6. Local gathering trip (summer 2018) Mushrooms seen in this photo include red pine mushroom (*Lactarius deliciosus),* birch bolete *(Leccinum scabrum)* and Bare-toothed Russula (*Russula vesca*). (Photo: Nina Fontana)

3.4 Why Gather?: Context of Use

Culturally important species derive their importance and presence in culture from their various uses as stated by Hutsul community members. Why do Hutsul community members gather these species? What uses are continually cited as being relevant, useful, and salient? Three commonly cited uses emerged in my analysis – medicinal (30.8%), food (30.6%) and ecological uses (23.7%) (Figure 2.7). By exploring the nuances of medicinal and food uses as stated by Hutsul community members, the reliance on landscape as an ethnoecosystem serving as a safety net emerges (Turner et al. 2011).

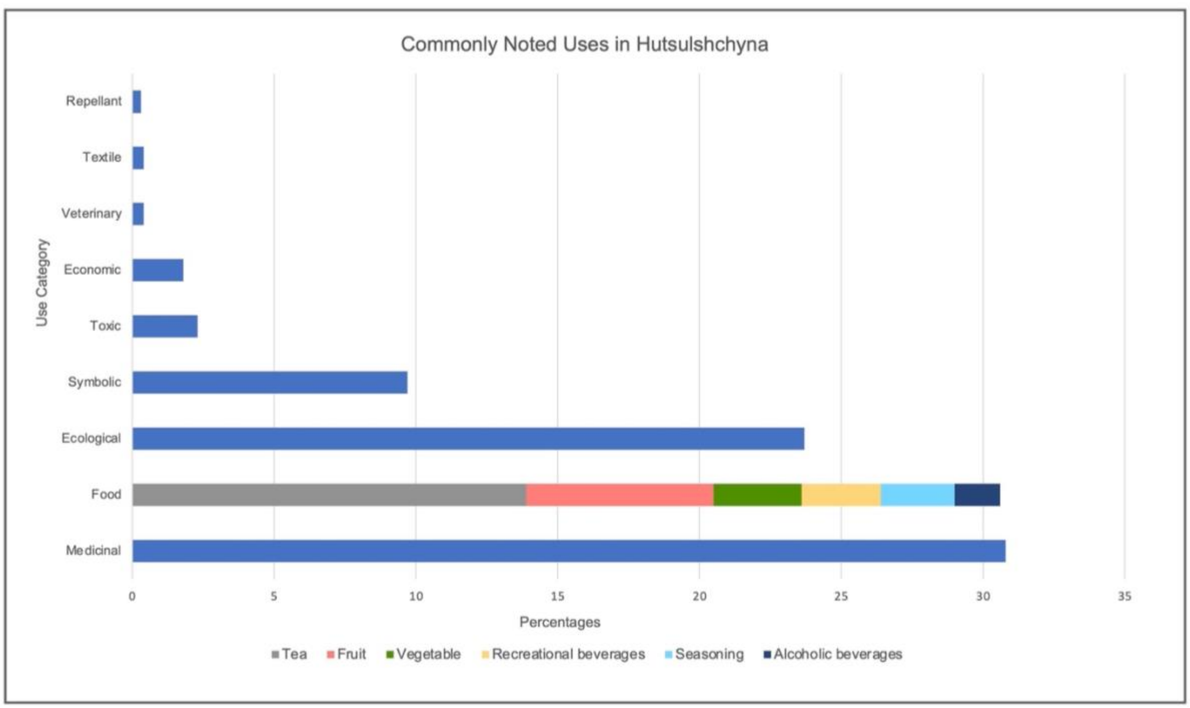

Figure 2.7. Commonly Noted Uses in Hutsulshchyna. Percent use categories are based on calculations from both cultivated and medicinal plants, lichen, and mushrooms. Repellant (0.3%), Textile (0.4%), Veterinary (0.4%), Economic (1.8%), Toxic (2.3%), Symbolic (9.7%), Ecological (23.7%), [Food (30.6%): Tea (13.9%), Fruit (6.6%), Vegetable (3.1%), Recreational beverages (2.8%), Seasoning (2.6%), Alcoholic beverages (1.6%)], Medicinal (30.8%).

3.4.1 The Purpose of Gathering: "Medicine beneath our feet"

When inquiring a little bit more about the context of medicinal use, some insightful reasons arise as to why communities gather, relating to social and economic realities under the context of ensuring health resilience within the community. Local populations gather species 1) to ensure preventative medical care, 2) to address community health needs, 3) to guarantee quality of ingredients, and 4) to ensure a safety net during times of need (Figure 2.8).

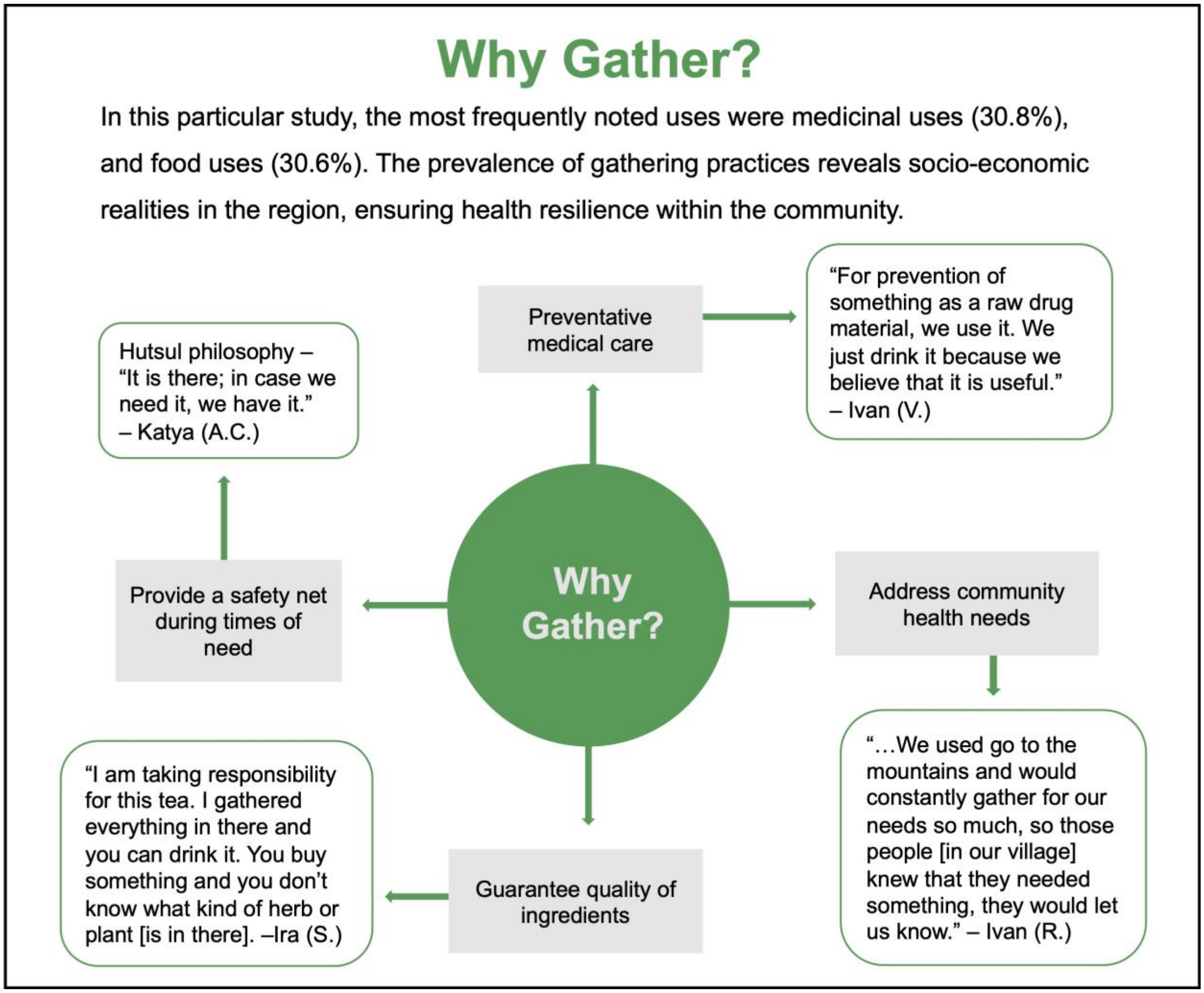

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Figure 2.8. Why Gather? This figure presents four main reasons behind gathering practices in Hutsulshchyna noted in interviews.

There are plants that are gathered for preventative medical care purposes and can be consumed on a regular basis due to their cumulative prophylactic effects, as well as plants that are used to treat medical conditions. As stated by village elder, Ivan: "[gathering of medicinal plants is practiced] for the prevention of something - as a raw drug material we use it. We just drink because we believe that it is useful." [Ivan (V.)] Most locals stated the need to gather plants for preventative care, rather than medicinal treatment. Other elders described both the personal and communal aspect to gathering medicinal plants:

> I collect for my own needs. Along with my wife, we gather along with our children. When our children were little, we used to go to the mountains and we would constantly gather, for our needs so much, so those people in [our village] knew that if they needed something, they would go let us know. Therefore, we collected plants for our own needs. [Ivan (R.)]

Locals not only gathered for themselves but also recognized their own needs as an extension of communal needs. Another elder detailed that by gathering and serving tea to a guest, there is trust-building, respect and transparency intertwined embedded in the act:

> It is really nice for a person to have tea and know who gathered it and you [can] explain it to them, "I am taking responsibility for this tea. I put everything in there and you can drink it." You buy something and you don't know what kind of herb or plant, you don't understand what is crumbled in there… this is our matter. [Ira (S.)]

Regulation of products, such as teas, in Ukraine is generally weak; there is a certain level of distrust among the general population on product transparency and standards. Therefore, by personally gathering species, it helps ensures quality of ingredients. Another elder explains the different approaches present in traditional medicine (Western medicine) and folk medicine:

> I think that there are more benefits given by folk medicine. I do not deny traditional medicine [Western medicine], but the thing is that now it's a lot of fakes in traditional medicine [Western medicine], a lot of strong chemistry; Folk medicine is better. But it is necessary to have a longer, more patient approach, more long-lasting treatment, but it has more effect and less harm. And on the other hand, it all costs money. Medicine is expensive. It's not affordable for everyone to go out and buy medicine. And it's all grown under our feet. It's all here. Antibiotics, and antiseptics and …the immune system and taste. You ingest it and you are strong. It is necessary to know the right proportions and recipes. Also it is necessary to

> consider that you need to use plants this year, so in next there will be plants. Perennials rarely retain their properties for a long time. If it is root or the seeds - it is kept, and if it is the berry or in the leaves - less so. It is better to use it in one biological cycle. [Vaselyna (AB.)]

Folk medicine requires more patience, more time with longer lasting effects. Traditional (Western) medicine is costly and so the ubiquitous use of folk medicine arises both out of necessity as well as a result of traditional ecological knowledge (TEK). Additionally, the length of time that plants retain their medicinal qualities coincides with their perennial life cycle. Living in relationship with various habitats means that there are years where plant communities may be more or less productive.

The last reason relating to medicinal gathering practices acknowledges the uncertainty surrounding human health. Local Hutsuls mention gathering to ensure security, in case a health need arises:

> Well, just, you know, we have among the Hutsuls a philosophy – it is there, so in case we need it, we have it. Even if suddenly someone needs it. If someone needs a medicine. For me, for example, I took everything that I gathered, I gave it away. In Verkhovyna a woman suffering from diabetes mellitus, so I collected *afyny* (bilberries) with bloom and dried with berries. [Katya (AC.)]

As noted by diverse Hutsul community members, medicinal uses of various plants serve as a safety net for personal and community health; what is gathered and used for oneself extends to sharing with one's community, since personal and communal needs are intertwined. Berries, mushrooms, and seasonings (used in traditional foods) all have medicinal qualities. In exploring the various purposes of use, including preventative care, community health needs, ensuring quality and integrity of species, there is a theme of insecurity, uncertainty, and preparation for unforeseen outcomes as well as a sense of sovereignty and community interdependence.

4. Discussion

4.1 The Story behind the Data

Top three uses that were highlighted as particularly important in the historical heart of Hutsulshchyna were medicinal (30.8%), food (30.6%) and ecological uses (23.7%). In this chapter, I focus on the medicinal use and TEK supporting medicinal use (as seen through the denotation of "ecological" uses), while in the last chapter (Chapter 3), we focus on the critical importance of food use and how TEK informs and maintains regional food sovereignty. In the first section of the discussion, I will investigate the role of medicinal uses and how they relate to previous studies. In the second section of the discussion, I will explore the role of TEK upholding ethnobotanical uses (denoted as "ecological use" in the indices) in Hutsulshchyna. TEK, as a knowledge base, informs practices, specifically relationships to habitats within landscapes, as well as accessibility to habitats and availability of species.

4.2 Medicinal Uses in Hutsulshchyna

"There is a phrase: Where you live, there is a cure for you. Because our body is accustomed to these natural conditions, to this earth, to these microelements that are in it. We live in such symbiosis and this is the reason why it is useful and effective."
[Ivan (J.)]

Looking closer at the medicinal uses in the region, 92 taxa were used for medicinal purposes, including the unique documentation of two lichen species (*Cetraria islandica*, *Cladonia rangiferina*) and three fungi species (*Amanita muscaria, Lycoperdon perlatum, Phallus impudicus*). Among the taxa noted, 17 species were explicitly noted to be given to children treating ailments including fevers (*Artemisia absinthium, Solanum tuberosum*), warts (*Chelidonium majus*), digestion issues (*Carum carvi, Anethum graveolens*), coughs (*Cetraria islandica, Juniperus communis, Rubus idaeus, Virbunum opulus*), colds (*Fragaria vesca, Thymus serpyllum*) and wound treatment (*Bidens tripartita, Capsella bursa-pastoris*). Several plants also provide a source of vitamin C (*Brassica oleracea*), while others contain sedative properties (*Pulmonaria officinalis, Sambuca nigra, Melissa officinalis*). Out of the 62 medicinal use categories, the most cited medicinal categories include: 1) treating various stomach ailments (7.6%), 2) reducing fever (5.0%), 3) providing a source of vitamin C (4.5%), 4) regulating blood pressure (4.5%), and 5) treating topical wounds (4.5%). Two of the most cited medicinal categories address preventative care concerns - providing a source of vitamin C and regulating blood pressure while the other three address treatment of an ailment (stomach, fever, and wound treatment).

To date, research in the southeastern Hutsul region highlights how the policies of socio-political change (wars) and geography (borders) influence changes, trends and differences seen in Hutsul ethnobotanical plant uses (Mattalia et al., 2020; Mattalia et al., 2021a; Mattalia et al., 2021b; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016; Stryamets et al., 2021b). While governance structures play a role, Hutsul culture and knowledge transmission could also cross these borders. As seen in Table 2.5a, there are 31 plant taxa and corresponding medicinal uses shared by Hutsul communities on both sides of the Ukrainian-Romanian border as well as in Hutsul communities in the historical cultural center (in this study). Thirteen of these noted species are also in the top 20 species of noted cultural importance, showing high fidelity levels in medicinal plant use across borders, and therefore cultural significance in Hutsulshchyna due to their prevalence, breadth, depth, and continuity of use.

Table 2.5a. Shared and unique medicinal uses in Hutsulshchyna

Medicinal Plant Uses in Hutsulshchyna *(shared in this study and other studies along the Ukrainian-Romanian border)*			
CI index	**Plant Species**	**Shared Medicinal Uses** *(* denotes seen in this study)*	**Uniquely Documented Uses** *(in this study)*
0.475	*Achillea millefolium*	Stomach (R/U),*	Anti-inflammatory (internal) Stops bleeding (coagulating properties)
0.100	*Aesculus hippocastanum*	Varicose veins (R/U),* Pain management – topical (U),*	-
N/A	*Aloe arborenscens*	Wound treatment (R/U),*	Gums Lungs Ulcers
1.725	*Arnica montana*	Topical treatment (R/U),* Joint pain (R/U),* Stomach (U),*	Lungs Gynecological concerns Cancer treatment Anesthetic analgesic Bronchitis Blood pressure
0.450	*Artemisia absinthium*	Digestion (R/U),* Treatment (parasitic worms) (U),* Fever (U),*	Veterinary treatment (pigs)
0.200	*Calendula officinalis*	Kidneys (R/U),* Liver – jaundice (R/U),* Gynecological issues (U),* Prophylactic against cancer (U),*	-
0.250	*Cannabis sativa*	Ritual healing (R),*	Hepatitis Sedative properties
0.875	*Carum carvi*	Digestions (R/U),*	Diuretic Appetite stimulating Kidney stones
0.325	*Equisetum arvense*	Diuretic (R/U),*	-
1.250	*Fragaria vesca*	Heart (R/U),*	Insulin regulation (Diabetes) Colds

Medicinal Plant Uses in Hutsulshchyna *(shared in this study and other studies along the Ukrainian-Romanian border)*			
CI index	**Plant Species**	**Shared Medicinal Uses** *(* denotes seen in this study)*	**Uniquely Documented Uses** *(in this study)*
			Metabolism
1.250	*Gentiana lutea*	Intestinal diseases (R/U),*	Pancreas
2.175	*Hypericum perforatum*	Stomach (R/U),* Stops bleeding (R/U),* Cures 99 diseases (U),*	Antibiotic Colds Hair loss Coughs
0.400	*Leonurus villosus/ Leonurus cardiaca*	Nervous system (R),* Blood (U),*	Veterinary – cows (bites) Gynecological issues Hair loss
0.150	*Matricaria chamomilla*	Antiseptic (R/U),* Inflammation (U),*	Veterinary - cow
1.325	*Mentha sp.*	Sedative properties (R/U),*	-
0.825	*Origanum vulgare*	Stomach (R/U),* Women's health (R/U),*	Intestine
0.325	*Picea abies*	Gastritis (R),*	
0.075	*Pinus silvestris*	Respiratory system (R/U),*	Heart
0.675	*Plantago major*	Topical treatment of wounds (R/U),* Colds (R/U),*	Stops bleeding (coagulating properties) Inflammation
1.200 *(Rosa canina)*	*Rosa spp. (Rosa canina, Rosa acicularis)*	Cough (R/U),*	Treating fevers Source of Vitamin C
1.925	*Rubus idaeus L.*	Cough (R/U),* Fever (R/U),*	Inflammation Gynecological issues Source of Vitamin C
0.275	*Solanum tuberosum*	Fever (R/U),* Headache (R/U),* Cough (U),*	Inflammation

Medicinal Plant Uses in Hutsulshchyna
(shared in this study and other studies along the Ukrainian-Romanian border)

CI index	**Plant Species**	**Shared Medicinal Uses** *(* denotes seen in this study)*	**Uniquely Documented Uses** *(in this study)*
		Pain management (U),*	
0.200	*Symphytum officinale*	Pain management (R/U),*	Lungs Burns
1.275	*Thymus serpyllum*	Cough (R/U),* Colds (R/U),*	Inflammation Urinary tract
1.025	*Tilia cordata, T. platyhyloos*	Colds (R/U),* Fevers (U),* Gynecological issues (R),*	Lowers blood pressure Respiratory system
0.400	*Trifolium pratens*	Headache (R/U),*	Reproductive system Lowers blood pressure
0.425	*Tussilago farfara*	Bronchitis (R/U),* Respiratory system (R/U),*	-
2.025	*Vaccinium myrtillus*	Vision (R/U),* Upset stomach (R/U),* Lowers blood super (R/U),* Liver (R),*	-
1.075	*Vaccinium vitis-idaea*	Blood pressure (R/U),*	-
0.375	*Viburnum opulus*	Cough (R/U),* Heart (U),* Fevers (U),*	Women's health Headache
0.550	*Taraxacum officinale*	Liver (R),* Source of vitamins (U),*	Cancer treatment Appetite-stimulating

This study (denoted by *) shares documented uses with other studies in Hutsulshchyna both in Ukraine and Romania (Sõukand and Pieroni, 2016; Pieroni and Sõukand, 2017; Mattalia et al., 2020). As seen in the "Shared Uses" column, previous studies document these uses by Hutsuls in Romania (R) and/or Ukraine (U).

Of all current studies, including this one, medicinal plant uses only seen in the Hutsul region of Ukraine include the following species: *Acorus calamus, Anethum graveolens, Arctium lappa, Aronia melanocarpa, Bidens triparta, Brassica oleracea, Chelidonium majus, Crataegus spp., Juglans regia, Levisticum officinale, Melissa officinalis, Primula Veris* (Table 2.5b). Table 2.5c displays uniquely documented uses from taxa cited by previous studies.

Table 2.5b. Shared and Unique Medicinal Uses in Hutsulshchyna

Medicinal Plant Uses in Hutsulshchyna *(prevalent only in Ukraine)*			
CI Index	**Plant Name**	**Shared Uses Seen in this Study** *(and other studies)*	**Uniquely Documented Uses** *(in this study)*
0.450	*Acorus calamus*	Fevers * Stomach **	Stimulant used to help stop smoking Inflammation of the throat
0.275	*Anethum graveolens*	Stomach *** Blood pressure ***	Kidney stones
0.175	*Arctium lappa*	Blood vessels * Hair loss *, ***	Cancer treatment
0.450	*Aronia melanocarpa*	Blood pressure *, ***	Immunity
0.100	*Bidens tripartita*	Skin issues ***	Antiseptic Antibiotic
0.300	*Brassica oleracea*	Fever *** Stomach *** Headache *	Vitamin C Pain management Cold
0.425	*Chelidonium majus*	Wart treatment * Cancer treatment * Wounds/burns *	-
0.575	*Crataegus spp.*	Heart * Lowers blood pressure *	-
0.175	*Juglans regia*	Stomach *	-
0.025	*Levisticum officinale*	Hair treatment ***	-
0.225	*Melissa officinalis*	Sedative properties ***	Bloating Immunity
0.350	*Primula veris*	Cough ***	-

These uses are shared among Hutsuls on the Ukrainian side of Hutsulschyna. This study documents additional uses seen in the column, "Uniquely Documented Uses." Asterisks refer to previous studies: *Sõukand and Pieroni, 2016, **Pieroni and Sõukand, 2017, ***Mattalia et al., 2020

Table 2.5c. Shared and Uniquely Documented Uses in Hutsulshchyna

Medicinal Plants and Uses in Hutsulshchyna *(Taxa cited by this study and previous studies; this study documents unique uses.)*		
CI Index	**Plant Name**	**Uniquely Documented Uses** *(in this study)*
0.100	*Bidens tripartita*	Antiseptic, antibiotic
0.225	*Capsella bursa-pastoris*	Stops bleeding (coagulating properties)
0.075	*Centaurium erythraea*	Stomach
0.800	*Chamaenerion angustifolium*	Diarrhea
0.225	*Corylus avellana*	Immune system Fever (bark is rich in salicylates)
0.400	*Juniperus communis*	Laryngitis; bronchitis Esophagus Stomach
0.175	*Petroselinum crispum*	Headaches Blood pressure
0.550	*Potentilla erecta rhizomata*	Stomach
0.200	*Polygonum aviculare*	Stomach Lungs Genitourinary system Sedative properties
0.275	*Pyrus pyraster*	Source of Vitamin C Nerves
0.50	*Rheum rhaponticum*	Source of vitamin C
1.125	*Rubus caesius*	Ulcers, hypertension, liver, source of vitamin C
0.300	*Salix spp.*	Fever
0.625	*Sambucus nigra*	Calming tea Cancer treatment Pain management
0.275	*Solanum tuberosum*	Inflammation
0.225	*Sorbus aucuparia*	Source of Vitamin C
0.225	*Tanacetum vulgare*	Antiseptic
0.275	*Zea mays*	Stomach

Additionally, this study documents unique place-based uses of 35 species this study documents, grounding this regional TEK in environment, geography, and place. Unique to this study (Table 2.6a and Table 2.6b) was the medicinal use of high elevation root species including Gentian species *(G. punctata, G.asclepiadea, G. cruciate)*, *Geum montanum* as well as two lichen species *Cetraria islandica* and *Cladonia rangiferina*. Several evergreen species are used as syrups to treat bronchitis including *Pinus abies,* and *Juniperus communis* as well as the unique use of *Pinus cembra*. Two fungi species, *Amanita muscaria* and *Phallus impudicus,* were mentioned to treat cancer as well as the unique use of two species of endangered orchids (*Orchis macula* and *Plantanthera bifolia)*.

Table 2.6a. Uniquely Documented Medicinal Uses in the historical center of Hutsulshchyna

CI Index	**Unique Species in this Study** *(including lichen and fungi)*	**Parts Used**	**Preparation**	**Corresponding Medicinal Uses**
0.100	*Agrimonia eupatoria*	Aerial parts	Tea	Liver Diseases of gastrointestinal tract Enuresis in children
0.625	*Allium ursinum L.*	Bulb	Raw	Heart Reduces cholesterol Veterinary – cows (bites) Antibiotic properties
0.800	*Amanita muscaria (fungi)*	Caps	Tincture	Cancer treatment
0.125	*Angelica archangelica*	Root	Tincture	Respiratory system Gastrointestinal system
0.675	*Arctostaphylos uva-ursi*	Aerial parts (especially flowers)	Tea Tincture	Kidneys Bladder
0.075	*Asarum europaeum*	Root	Tincture	Emetic (treatment of alcoholism)
0.950	*Cetraria islandica (lichen)*	Aerial parts	Tea (alone or with milk)	Antibiotic Congestion Bronchitis Inflammation Cancer Fevers
0.150	*Cladonia rangiferina (lichen)*	Aerial parts	Tea	Cough (Expectorant)
0.150	*Colchicum autumnale*	Seeds	Tincture	Prophylactic against cancer (tumor growth)
0.150 0.125 0.025	*Gentiana punctata* *Gentiana asclepiadea,* *Gentiana cruciata*	Root	Tea Tincture	Immunity Choleretic Bactericidal action Appetite-stimulating
0.300	*Geum montanum*	Root	Tea Topical tincture	Inflammation Topical treatment of pain

CI Index	**Unique Species in this Study** *(including lichen and fungi)*	Parts Used	Preparation	Corresponding Medicinal Uses
				Stimulant Relaxes muscles
0.100	*Helianthus tuberosus*	Tuber Leaves	Salad Tea	Type II diabetes
	Helleborus purpurascens	Root	Tincture	Gynecological inflammations Kidney disease
0.150	*Laserpitium alpinum*	Root	Tincture	Antiseptic (stimulates pancreas) Gynecological issues
0.075	*Lycoperdon perlatum (fungi)*	Spores	Topical treatment	Stops bleeding (coagulating properties)
0.150	*Matricaria discoidea*	Aerial parts	Tea	Sedative properties
0.175	*Orchis mascula*	Tuber	Ground powder	Men's health (potency)
0.425	**Papaver somniferum L.*	Poppy pods	Tea	Sedative properties
0.125	*Phallus impudicus (fungi)*	Fruiting bodies	Tincture	Cancer treatment Topical treatment of wounds
0.725	*Pinus cembra*	Cones, resin	Tincture with sugar	Bronchitis (syrup) Internal diseases
0.200	*Plantanthera bifolia*	Tuber	Tincture	Men's health (potency) Lungs Topical pain treatment
0.150	*Prunus spinosa*	Berries	Tea	Diuretic Diaphoretic
0.125	*Pulmonaria officinalis*	Leaves, flowers	Tea Tincture	Sedative properties Cough
1.075	*Rhodiola rosea*	Root	Tincture	Stimulant Stomach
0.125	*Ribes uva-crispa*	Berries, stems, leaves	Juice Tea	Source of Vitamin C Appetite stimulant
1.125	*Rubus caesius L*	Leaves, stem, berries	Fruit	Ulcers

CI Index	**Unique Species in this Study** *(including lichen and fungi)*	Parts Used	Preparation	Corresponding Medicinal Uses
			Juice Tea	Hypertension Liver Source of Vitamin C
0.250	*Vinca minor*	Aerial parts	Tea	Blood pressure Cardiovascular disease Nervous system
0.225	*Veratrum album W.*	Root	Tincture	Veterinary – cows Topical treatment

Table 2.6b. Uniquely Documented Uses in the historical center of Hutsulshchyna

CI Index	Unique Species in this Study (including lichen and fungi)	Corresponding Uses
0.125	**Acer pseudoplatanus*	*Food (Juice) *Symbolic (Folk tales) *Ecological (Name of places, Wood for musical instruments, Elevation-dependent)
0.025	**Cypripedium calceolus*	*Ecological (Population decline)
0.100	**Galanthus gracilis*	*Ecological (Indicator of seasonal change) *Symbolic (Stories)
0.150	**Melampyrum nemorosum*	*Food (Fermented food; Edible) *Ecological (Food for livestock)
0.050	**Nardus stricta*	*Ecological (indicator species)
0.050	**Populus L.*	*Ecological (Place names) *Symbolic (Holidays – Green Holiday, Ivana Kupala)
0.100	**Ulmus L.*	*Food (juice) *Ecological (Place names) *Textile (carpentry, furniture, housing)

4.3 “Ecological Use”: An Insufficient Proxy for TEK

In addition to medicinal uses being cited as central to driving gathering practices, “ecological uses” were also noted. As stated earlier, the denotation of “ecological use” was an indicator that a particular species had TEK importance and was included in the calculations of the quantitative indices. 23.7% of species noted exhibited TEK through the indication of “ecological use.” The nuances of TEK are insufficiently and naively expressed in the denotation of “ecological use”; these indices do not consider critical elements that are embedded in traditional ecological knowledge (TEK) such as the drivers of gathering practices, accessibility to species, dependence on species, multiplicity of uses (Albuquerque et al., 2006; Garibaldi and Turner, 2004), gathering cues, ecocultural meanings of local, Hutsul names (Appendix C), and ultimately the embedded story behind the data.

If a knowledge holder acknowledged a gathering cue or mentioned an ecological relationship in the ecosystem (such as role of habitat for a species, sensory cue, phenological cue, link between language and ecology, or gathering method of a species), it was noted as a species rooted in the landscape (having an “ecological use”), and therefore exhibiting important TEK (Table 2.7). For example, TEK can inform practice as seen through descriptive language, specifically in local Hutsul names, scaffolding sensory experience of gathering, and providing critical knowledge. For example, the plant Greater celandine *(Chelidonium majus)* in Hutsul (Вогники/Vohnyky) translates to “little fires”, denoting a distinct visual, sensory cue. As stated by an elder:

> When you approach it, you have this feeling that it dried a long time ago, but it isn’t dry. From far away, it looks like a little campfire, like it was burning, and it was left burning. – Ivan R.

From this local Hutsul name, one can tell that this plant is likely tall and appears vibrant yellow or orange from a distance, like a fire. Lastly, gathering cues can provide important contextual signals of identifying species within a landscape by recognizing a particular species (by sensory cue such as texture or color) to location of species (reproductive growth pattern along a mountainside).

Table 2.7. TEK in Hutsulshchyna

Traditional Ecological Knowledge (TEK) in Hutsulshchyna (Role of Place, Phenology, Gathering methods)		
A. ROLE OF PLACE		**GENERAL OBSERVATIONS**
Specific species' habitat noted		*Toloka* (generationally maintained pastures), forest, pasture, meadows, *polonyna* (alpine meadows), alpine areas, disturbed areas, roadsides, marshy areas Culturally and ecologically significant places in Hutsulshschyna like Black Mountains (Chornohora), Pip Ivan, Pysanyi Kamin (gathering sites)
Name of place denotes species presence/ common name links species to place		Names of villages bearing plants names and presence Specific plants linked to place characteristic (polonynska hran/haryachi kamin – *Cetraria islandica;* toloknyanka - *Arctostaphylos uva-ursi*) Invasive plant histories/names are aligned with historical invasions (*Acorus calamus*, *Orchis mascula*)
Physical characteristics of place noted (soil typology, elevation, vegetation, sun exposure)		Characteristics of places noted – very remote, mountain tops, muddy places, rocky areas, places with more sun/shade, wide open spaces, soil is rocky/sandy
Common gathering places		Plants with commonly maintained gathering areas *Arctostaphylos uva-ursi, Rubus caesius, Thymus serpyllum, Vaccinium myrtillus, Vaccinium vitis-idaea*
Population changes		Plants with noted population changes in specific areas – *Allium ursinum, Arnica montana, Carum carvi, Orchis mascula, Rhodiola rosea, Tanacetum vulgare*
Pioneer species		Pioneer species growing in logged/edged areas & disturbed areas – *Orchis mascula, Alder, Chamaerion angustifolia, Rubus idaeus, Aronia melanocarpa, Alnus L.*
Species interactions	Animal-plant	Plants that grow where livestock grazes (*Polygonum aviculare, Carum carvi, Origanum vulgare*) Plants are avoided by livestock (*Hypericum perforatum, Veratrum album, Rhodiola rosea*) Sheep – *Nardus stricta* Anthills – *Thymus serpyllum*

	Plant-plant	Plant community – *Hypericum perforatum, Thymus serpyllum, Carum carvi, Origanum vulgare, Mentha spp.* and *Vaccinium myrtillus, Vaccinium vitis-idaea* Comfrey species indicator of beech forests present (*Symphytum spp*.) Plant community relevance in plant medicine
	Human-plant	Changes in pasture mowing times impacts reseeding of plants such as *Carum carvi, Amoracia rusticana*
B. PHENOLOGY		**GENERAL OBSERVATIONS**
Time of gathering		Flowering time preferred (Most plants were noted with particular emphasis on *Achillea millefolium, Arctostaphylos uva-ursi, Arnica montana, Juniperus communis, Tilia cordata, Picea abies, Thymus serpyllum*) Roots gathered in fall to allow for reproduction (*Angelica archangelica*) Impact of rain or dew on gathering practices (*Arnica montana, Thymus serpyllum, Trifolium pratens*) Variance on gathering times based on phenology of plant and type of plant medicine (*Rosa spp., Taraxacum officinale, Vaccinium myrtillus*) Impact of climate change on gathering (*Rubus caesius*) Importance of local holidays are markers of gathering (Ivana Kupala – July 7th, Green Holidays, Religious calendar coincides with planting calendars i.e. St. George's Day)
C. GATHERING METHODS		**GENERAL OBSERVATIONS**
Strategies		Instruments used (knife, stick, comb, scissors, hands) Collected/broken (leaves/flowers), but root kept intact Root gathered

4.3.1 TEK: How it informs relationships to habitats within the broader landscape

When considering previous studies alongside this study, St. John's wort *(Hypericum perforatum)*, bilberry *(Vaccinium myrtillus)*, raspberry *(Rubus ideaus)*, mint *(Mentha spp.)* and arnica (*Arnica montana)* all share high cultural importance in the Hutsul landscape (Sõukand and Pieroni, 2016; Pieroni and Sõukand, 2017; Mattalia et al., 2020) on both sides of the border, occupying diverse habitats. As noted in a recent study, Hutsul interviewees in Bukovina reflected a sense of pride in their forests, underlining the strong curative power of medicinal plants derived from these forests (Mattalia et al., 2021b). While these species are culturally important, by extension the various habitats in which they are nested are also greater or at least of equal importance (Figure 2.2).

Each of these species is found in a range of habitats. Raspberry, St. John's wort and bilberry are found in five habitats, while arnica is found in four habitats and mint (wild and cultivated) in three habitats. These plants exhibit generalist life strategies and inhabit a broad range of environments with a varying range of human interaction. Of the 20 top culturally important species and their habitat ranges, the most cited habitats that species grew were *polonynas*, followed by woodlands, forests, meadows, *tolokas*, roadsides, pastures, alpine meadows, gardens, and fields (Figure 2.9). Species that were specialists, such as high elevation species occupied a narrower ecological range (such as *Gentiana lutea*, *Rhodiola rosea*, *Cetraria islandica*) yet exhibited high cultural importance, specifically for their curative medicinal qualities. Interestingly, several species (*Taraxacum officinale* -10 habitats, *Achillea millefolium* - 9 habitats, *Gentiana asclepiadea* - 9 habitats, *Trifolium pratens* - 9 habitats) that inhabit almost all ten habitats did not share high cultural importance according to the indices. An explanation for this could be that these plants are available and accessible and therefore not specifically sought out due to their accessibility, availability, and ubiquity.

Two habitats unique and important in Hutsul landscapes are *tolokas* and *polonynas*. *Tolokas* are generationally held pastures typically located on a nearby hillside, and passed down from one generation to the next, ensuring both connection and access to land and species. *Polonynas* are communal summer alpine meadows, which provide grazing for communal livestock. All livelihoods of Carpathian highland people are somehow tethered culturally or economically to the maintenance of *polonynas* (Geyer et al., 2011) (Figure 2.2). *Tolokas* and *polonynas* have co-evolved with agricultural practices and rely on human interaction to maintain community function, structure, and composition (Anderson, 2006; Halada et al., 2011; Ribot and Peluso, 2009). The most culturally important species inhabit a diversity of habitats and are commonly encountered (Figure 2.9). This is due to their visibility in the landscape (in multiple habitats) and their accessibility to the community.

It is the habitats nested within larger ecosystems that harbor a multitude of complex relationships between community members and landscape, providing medicine, fodder, firewood, clean water, and sustenance. Plants, mushrooms, and lichen serve as the multidirectional tether between humans and land; uses are one means of defining and understanding these relationships. TEK is the reservoir of place-based knowledge that illuminates critical ecological relationships seen through language, storytelling, art, rituals, and sensory experiences guiding gathering practices.

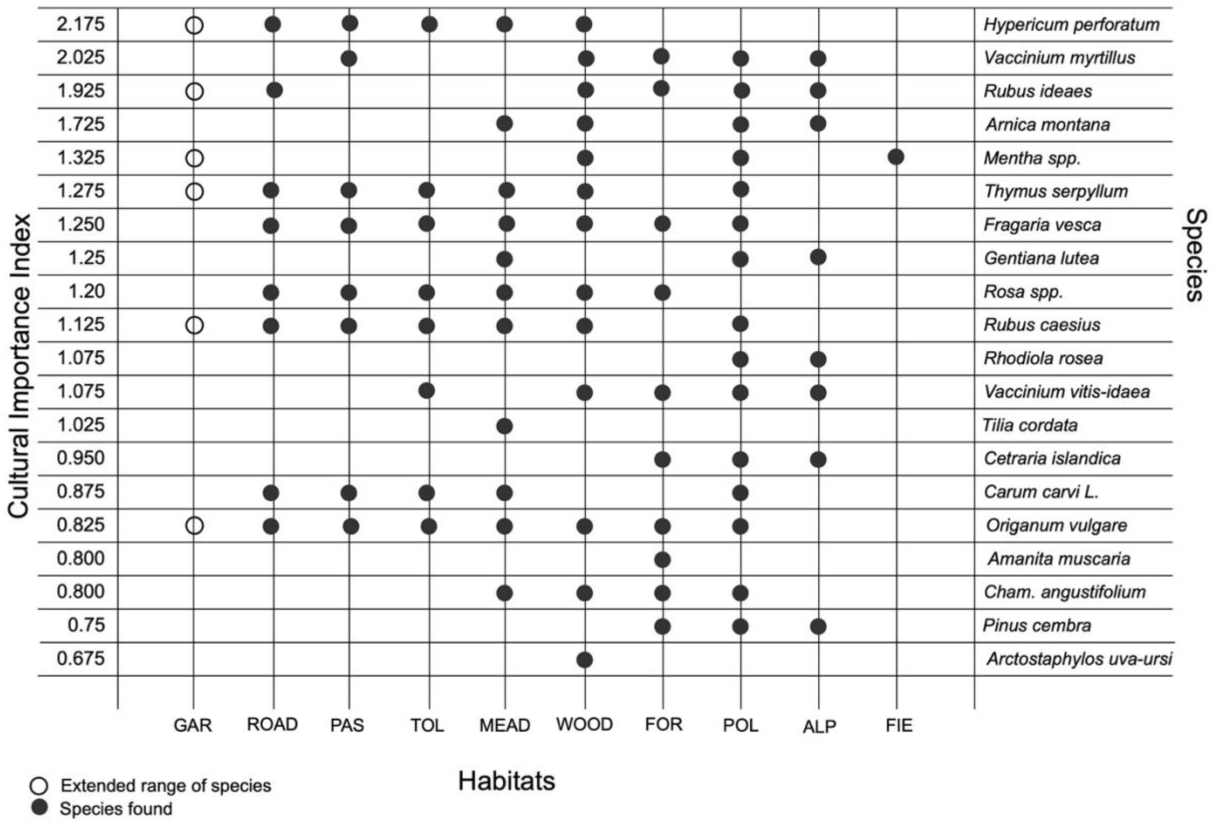

Figure 2.9. Top twenty culturally important species and the various habitats they are found and gathered. GAR – garden. ROAD – roadside. PAS – pasture. TOL – toloka. MEAD- meadow. WOOD – woodland. FOR – forest. POL – polonyna. ALP – alpine. FIE – field.

4.3.2 Accessibility vs. Availability: Impacts on TEK and Gathering Practices

While indices tangentially address cultural importance on the scale of frequency of use and citation, importance, fidelity levels, other factors, such as accessibility and availability are missing. By exploring the place-based knowledge that TEK encompasses, issues of accessibility versus availability to a habitat arise. The terms “available” and “accessible” tend to be used interchangeably; a species (like a plant) that is accessible is most likely available. However, a plant that is abundantly available, may not be accessible due to various socio-political or environmental factors. Accessibility implies ease of retrieval, an ability to interact with a species, through gathering, within a landscape. Availability is the first step to accessibility in terms of gathering a specific species. For example, species that are endangered are less available, less persistent in the landscape, and therefore less accessible as well. On the other hand, some plants may be preferred over others due to medicinal and/or cultural factors, yet constrained by their level of accessibility. For example, in the Hutsul context, a forest raspberry may be preferred due to its medicinal property, but a garden raspberry is more accessible and therefore more commonly used as food. While the forest raspberry has greater medicinal importance, its reduced immediate accessibility plays a considerable role in plant use and relationality in use.

The importance of accessibility arises when delving deeper into land stewardship policy and implications for maintaining livelihood for forest-dependent communities such as Hutsuls. Scholars Ribot and Peluso define access as the “ability to derive benefit from things” (2009). They state that the notion of “being able” incorporates pivotal social relationships, highlighting power dynamics, that underpin accessibility. Further, Ribot and Peluso exemplify the notion of access as networks of power that allow actors to obtain, direct and keep access. In the Hutsulshchyna, practical accessibility to forests and meadows can be hindered and redefined by local government officials, logging companies, borders, state parks and outdated laws. A plant may be available in relative abundance in a habitat, but not accessible. Access to a plant and rarity are often conjoined by shared geography (like elevation), but not always. Rarity of a plant can arise due to negligent harvesting practices seen in commercial harvesting, illegal logging, climate change, historical colonial management practices thereby making the plant less available to the local populations that depend on them (Table 2.8).

Table 2.8. Factors impacting plant populations in Hutsulshchyna as observed by Hutsul communities.

Factors impacting culturally important species	**Observations**	**Predicted Effects**
Socio-ecological consequences of historical, colonial policies	• Soviet policies (1939-1991) - Mass aerial fertilizing of land changed structure of grass cover (*Trifolium pratens* dominates) (3) • Austrian-Hungarian empire (1772-1918) - Excessively logging of culturally and ecologically important, endangered species (*Pinus cembra*) - Planting of monoculture pine species (E)	• Slow recovery of grass plant communities (Example: *Thymus serpyllum* has recovered; *Matricaria chamomila* still recovering) (E) • Impacts cultural use of species (weddings) (1) • Limits ecosystem functioning of forests (2) • *Pinus cembra* stays endangered status/reaches extinction (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)
Commercial Harvesting	• Improper harvesting techniques (*Arnica montana*) (1) - Not leaving root behind - Gather flower before seed release • Mass harvesting (*Cetraria islandica*) (2) - No recovery growth of slow-growing lichen	• Culturally important plants become rarer; less accessible to local Hutsul populations (1)
Logging	• Legal/illegal logging practices on mountainsides (1)	• Impacts succession of species (berries and mushrooms) (1) • Increase of regional flooding (1)
Climate Change	• First mowing of hayfields occurring earlier in the season (2) - Plants of importance are being cut down before reseeding occurs (*Carum carvi*, *Centaurium erythraea*) • Elevation shifts of plant habitats (*Arnica montana, Rhodiola rosea, Veratrum album*) (1) • Extreme weather conditions (shortened time frames between flooding events) (1)	• Dysregulated phenological cycles of plant communities (1) • Stay at endangered status (*Gentiana spp.*, *Allium ursinum, Orchis mascula, Platanthera bifolia*)(1) • Increased incidence of pests (*Leptinotarsa decemlineata*) on cultivated crops (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)

Observation rankings: 1=widely shared (many observations/expert generalizations across villages), 2=place specific (well-accepted within a particular community), 3=somewhat common (various participants), 4=less common (one or a few local experts), E=observation mainly reported by elders.

If the relationship to the plant is weakened due to its rarity, it can impact the culture surrounding its use such as Edelweiss (*Lontopodium alpinum*). For example, interwar efforts in the region to fertilize pastures and meadows with manure caused the succession of tall grasses, eventually leading to the endangerment of Edelweiss, a once culturally important yet very endangered plant. Historically, there were many stories, songs and folklore surrounding this plant. Today, its presence on alpine pastures is rare and its cultural significance is also waning (Geyer et al., 2010). In interviews, it was only mentioned once as an endangered species. Therefore, incorporating a more explicit accessibility factor into a cultural importance index (Tardío and Pardo-de-Santayana, 2008; Turner, 1988) could provide important community-driven insights regarding local forestry policy. This factor would acknowledge the difference between availability which denotes the relationship between species and environment, and accessibility which emphasizes governance factors surrounding its use.

4.4 Colonial Legacies in Hutsulshchyna: Impacts on Access to Land

The definition of accessibility includes the ability to benefit from species, habitat, people, and institutions while property underlines socially acknowledged claims or rights, by law, tradition or custom (Ribot and Peluso, 2009). Since 1991, Ukraine has experienced more democratic governance. However, under Soviet rule, private property was surrendered to the Soviet government, causing access to places to become an even more important function and sign of resistance. Although Marxist philosophy states that labor with land or resource use takes the place of state institutions of property, Communist policies in Hutsulshchyna saw even ownership of cattle as thievery of state property, essentially eroding traditional governance in the region. Policies included culturally destructive practices such as resettlement actions, Sovietization, and depopulation measures. The Soviet regime had a particularly brutal impact on tradition, language, land use and lifeways. Between 1945-1991 Soviet policy required nationalization, including mass collectivization of farms (*kolhospy*). Forests were transferred to the state, and private plots of land were joined into collective farms. All land was surrendered and tilled for the benefit of the larger state (Trokhimchuk, 1968). During this era, clearing of Carpathian forests for agricultural development, specifically *kolhospy*, led to habitat fragmentation, leading to (45.6%) of planted spruce monoculture forests (Elbakidze and Angelstam, 2013).

How did these land management policies impact the gathering of plants and mushrooms? Ethnobotanical gathering practices did not stop under any colonial rule. However, these policies impacted the extent of access to land and forests (Munteanu et al., 2017) where these species live, thereby shifting relationships to land and environment (specifically woodlands and forests). Scholars state that Soviet policies also caused hybridization of Soviet knowledge into local ethnobotanical knowledge in Ukraine (Mattalia et al., 2020; Mattalia et al., 2021a). After the historic collapse of the Soviet Union, tens of thousands of workers faced unemployment, which catalyzed rural depopulation and migration for work outside of Ukraine (Geyer et al., 2010). This migration also led to the decline of traditional agricultural systems, which also changed the landscape, causing the reduction of secondary grasslands (alpine meadows and *polonynas*). In response and despite all these stressors, Hutsul communities' reflexive response continues to be subsistence farming along with a gathering of wild species, fishing, and game.

Today, ecosystem challenges include illegal and destructive logging, the rise of ecotourism and accompanying infrastructure development, commercial harvesting of wild species, and climate change impacts (Table 2.8). Introduction of Ukraine to the market economy has resulted in the privatization of state properties leading to the rise of ski resorts (Drahobrat and Bukovel) in the region. As the main regional challenge, illegal logging is managed by organized criminal networks under the guise of semi-legitimate businesses and corporations (Associação Natureza Portugal, 2020). The main avenues of illegality include falsification of paperwork along the supply chain, as well as fraud and collusion with government officials (Kuemmerle et al., 2007; Kuemmerle et al., 2009). Minimal legal and financial penalties tend to make these activities fairly appealing within organized crime networks. However, more recently, the use of multi-time satellite images, DNA and isotope analyses of wood, along local citizen activism has helped combat illegal logging in the region. (WWF, 2017; Associação Natureza Portugal, 2020).

According to local Hutsul knowledge holders, logging in this region encourages succession of species such as *Rubus idaeus, Rubus caesius, Vaccinium myrtillus, Chamaerion angustifolium, Orchis macula*, and *Aronia melanocarpa*. These species are used, appreciated, and gathered fairly frequently (*Rubus spp*.) but they are also noted to be highly invasive and hinder forest growth. The gathering of these species (*Rubus spp*.) helps curb their encroachment. Illegal logging also impacts mushroom growth and nutrient cycling, weakening overall forest health.

Additionally, Hutsul knowledge holders stress the impacts of external commercial harvesting of culturally important species including *Vaccinium myrtillus, Arnica montana, Cetraria islandica,* and *Gentiana lutea* has increased in recent years. Commercial harvesting of important NTFPs raises concerns expressed by communities impacted by these practices worldwide, including: 1) intensified impacts on habitats, 2) increased harvest volumes, 3) restricted access to land, as well as 4) changes in financial and technological incentives promoting intensive harvesting (Emery et al., 2006). In this context, commercial harvesting impacts the curative qualities of medicinal plants harvested, reduces accessibility to habitats and availability of these culturally important species to local Hutsul populations. Lastly, the convergence of colonial policies of forest mismanagement and rising threats of climate change have compounded the rise of pine bark beetle invasion. With all these factors impacting culturally important habitats such as woodlands and forests, relationship to land have been continually challenged and threatened by external governance structures. Accessibility to place in Hutsulschyna, a socio-ecological-political issue, is beginning to be addressed through the reconciliation of harmful historic forest management practices and illegal logging practices.

Despite these continual and traumatic eco-cultural-political stressors, the dialogue between landscape and Hutsul communities has not weakened. It through the continual gathering of wild and cultivated species that relationship, community needs, traditional food, and place remain intertwined and inseparable (Turner et al., 2020). It is the ecology of the forest understory that provides both culturally important plants and mushrooms (*Vaccinium spp., Rubus spp., Boletes edulis, Cantharellus cibarius*) providing for multiple needs such as food and medicine nested in cultural practice. Hutsul management of *polonynas* or alpine meadows, harbors successive sets of plant communities and important root medicines like arnica (*Arnica montana*), and Gentian root species (*Gentiana spp*). In general, floral composition of *polonynas* is incredibly diverse, harboring a high proportion of species and habitats that are almost completely absent in the forest belt below. Ultimately, the diversity of habitats in Hutsulshchyna – garden, roadside, field, pasture, meadow, woodland, forest, *toloka*, alpine meadow and *polonyna* – provide a range of landscape interaction as well as a diversity of species use and reliance.

5. Conclusion

By integrating quantitative and qualitative approaches, a more synthesized and community-driven understanding of the role of ethnobotany surrounding the cultural historical center of Hutsulshchnya of Verkhovyna arises. As this study shows, an integrated qualitative and quantitative approach is necessary to elucidate the context of ethnobotanical use and community use implications surrounding responses to historic and present ecosystem challenges. Quantitative ethnobotanical indices (Use Report (UR), Cultural Importance (CI), Frequency of Citation (FC), Number of Uses (NU), Relative Frequency of Citation (RFC), Relative Importance (RI)) reveal information about 108 species from 79 genera and 48 families including 23 species of cultivated plants, 9 species of mushrooms and 2 species of lichens. Carpathian forests, mountains, woodlands, fields, alpine meadows, pastures, meadows, *polonyna*s, *toloka*s, and roadsides serve as a biocultural reservoir for wild plant, mushroom, and lichen species while home gardens serve as places of experimentation of domesticating wild species and diversification of therapeutic remedies using cultivated species.

Gathering serves multiple purposes with the overarching theme of addressing community health needs in the form of preventative care, quality control of ingredients, and surplus in times of scarcity. The most frequently cited uses for these species were medicinal (30.8%) and food (30.6%). Although Hutsulshchyna is split between two countries, certain medicinal species uses transcend borders, grounding TEK to place. Shared medicinal uses include 13 species that are noted in the top 20 species of cultural importance according to indices explored. Additionally, there were 35 unique place-based plants and corresponding uses that ground this TEK in the cultural, historic center of Hutsulshchyna, Verkhovyna.

Lastly, unique to this study, “ecological use” (23.7%) was created as an attempt to integrate TEK into quantitative ethnobotanical indices, failing to capture both the depth and richness of knowledge. TEK is explored through qualitative methods including participant observation and community-based participatory action research, elucidating meaning to the role of place, phenology and gathering methods present in Hutsulshchyna. The range of accessibility to habitats in forest-dependent communities is imperative especially if it serves as a relational thread to food, medicine, and ecological grounding in cultural practice. Future indices acknowledging the variance of accessibility in today's rapidly environmentally changing world could inform broader policy initiatives.

Acknowledging TEK goes beyond the use of the organism and acknowledges derivation of place that sustains the stewardship and future accessibility of species (plants, fungi, or lichens). It is the link between use, stewardship, and culture. Typical agricultural systems attempt to control extraneous variables in order to maximize output of yield, while traditional management cultures are based on a locally-based, small-scale approaches that center interaction with natural components of the environment. The resulting system is an ethnoecosystem that embeds management as a relationship between environmental interactions and cultural practice. Current regional ecosystem challenges like illegal logging, commercial harvesting, and climate change, as well as the ripple effects of historical, colonial, environmental practices, continue to impact gathering practices and conservation status of endangered culturally important plants (*Allium ursinum, Atropa belladonna, Colchicum autumnale L., Gentiana luted, Gentiana punctuate, Orchis macula, Platanthera bifolia, Rhodiola rosea, Pinus cembra, Pinus sylvestris*) and their habitats. If a plant is culturally important, then the habitat or ecosystem in which it grows is by extension important. The Hutsul cultural practice of maintaining *polonynas*, a culturally important ecosystem, is declining, and with it the survival of plant and lichen communities that are conjoined in song, celebration, use, and cultural importance. By contextualizing the cultural importance of plants, lichens and mushrooms into their broader ecology and relationality with communities, we can learn to create meaningful stewardship policies that directly address ecosystem challenges and prioritize conservation measures.

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Chapter 3: Traditional Ecological Knowledge (TEK) to Traditional Foods: Supporting the Path to Food Sovereignty

1. Introduction

Climate change impacts, including but not limited to extreme weather events, the rise of global temperatures, and pandemic zoonotic diseases (like COVID-19), remind us of our interconnectedness with our local and global ecosystems. With impacts not evenly distributed across the globe but felt more drastically over land, the poles, and more arid regions (Main et al., 2008; Wheeler and von Braun, 2013), areas already experiencing food insecurity will be hit hardest. Growing challenges, such as competition for finite resources including accessible, arable land (Collins and Chandrasekaran, 2012) minerals, water, and energy (Strzepek and Boehlert, 2010) along with current, global, environmental, and economic changes are already impacting food production in response to climate change. This reality deserves attention and thoughtful, mindful action, especially for marginalized communities worldwide, specifically Indigenous Peoples and underrepresented ethnic groups, who may experience these impacts more immediately. Many Indigenous and underrepresented ethnic communities are both societally and spatially marginalized, living in edged biomes near forests, oceans, and deserts. According to the World Bank (2019), these same communities steward an estimated 80% of the world's remaining biodiversity. Additionally, they are overrepresented among the world's poorest, most destitute, and illiterate populations, as well as those displaced or threatened by environmental encroachment, wars, disasters, and socio-political stressors (Wheeler and von Braun, 2013). Yet, many of these communities still survive and thrive, with resilience.

In this case study, Hutsul communities, an ethnographic group of traditional pastoral highlanders in the eastern Carpathian Mountains of Ukraine, exemplify a socio-ecological approach to maintaining regional food system resilience and equity. Hutsuls have survived, thrived, and adapted in the face of colonial invasions, wars, food shortages, and now synergistic impacts of climate change and illegal timber harvest causing an increase of flooding events. Many Hutsul communities in the Carpathian Mountains are guided by traditional ecological knowledge (TEK) in their day-to-day lives. Lived and experienced by local and Indigenous communities worldwide, TEK is cultural, spiritual, intergenerational, dynamic, place-based, environmental knowledge and wisdom; TEK, as a living knowledge base, is revisited, reinterpreted, and re-evaluated consistently (Berkes, 2012; Molnár et al., 2008). TEK, the scientific method brought to life through culture, plays a significant role in meeting community needs, while adapting to environmental changes. TEK serves as the foundational base for ensuring resilience in communities. TEK is built upon personal stories, past traumas, innovations, and current realities to inform contextually driven, resilient responses that are aligned with community needs.

The path to achieving food security has a socio-ecological foundation, one that grafts community needs with a resilient, ecologically-grounded approach known as food sovereignty. Food sovereignty, as a term, can be controversial in its various meanings and origins (Hoover, 2017; Coté, 2016). Here, we refer to the definition stated in the Declaration of Nyeleni of the Forum of Food Sovereignty in 2007. “Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and the right to define their own food and agriculture systems.” Within this definition emerges a powerful recognition of self-determination in how food is grown, managed and sourced. In addition, it affirms that socio-ecological relationships, rooted in sustainability, are central to this type of food system. Lastly, it states that access to healthy environments and culturally important foods are inextricably linked.

Food sovereignty is not an endpoint in achieving food security; rather, it is an ongoing, adaptive capacity for a community to overcome food system threats. Adaptive capacity includes both coping mechanisms (short-term responses) and adaptive strategies (long-term responses) (Figure 3.1). Referring to terms commonly used in developmental studies (Singh and Titi, 1994) and anthropology (McCay, 1978), coping mechanisms are short-term, quickly implemented strategies to situations that threaten livelihoods. Conversely, adaptive strategies are long-term changes implemented by communities, modifying local rules, institutions, and productive activities to ensure livelihoods. Coping mechanisms tend to emerge on individual or household levels, while adaptive strategies tend to emerge on community levels. Both coping mechanisms and adaptive strategies exist across temporal scales, whereby over time, coping mechanisms can become adaptive strategies (Berkes and Jolly, 2001).

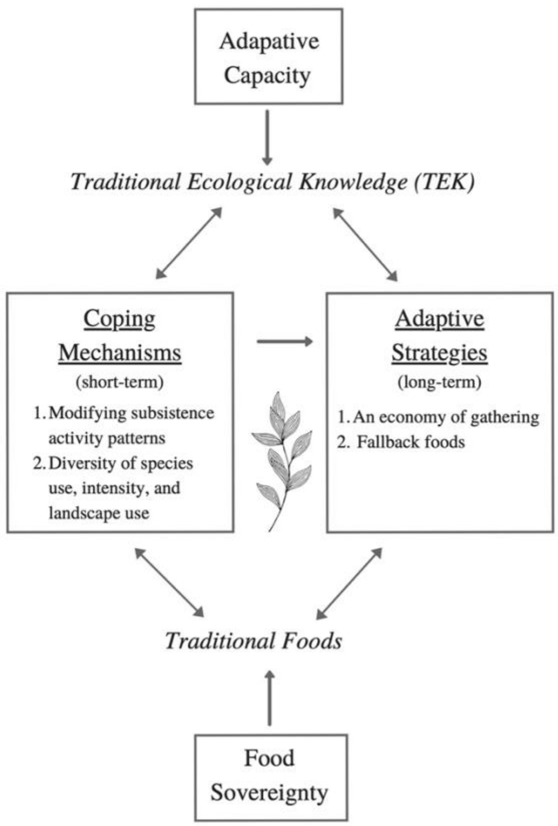

Figure 3.1. Adaptive capacity is grounded in traditional ecological knowledge (TEK). Coping mechanisms and adaptive strategies support a community-based food system consisting of traditional foods, which ultimately result in food sovereignty.

Through semi-structured interviews, participant observation, and long-term community-based participatory action research (CBPAR) (Ballard and Belsky, 2010), we identify 108 culturally important species and distinct regional environmental changes with Hutsul elders, knowledge holders, foresters, and experts. By combining quantitative ethnobotanical approaches examining species use with more in-depth qualitative approaches, we identify short-term and long-term responses to regional, environmental changes resulting in the maintenance of traditional foods in Hutsul communities. Coping mechanisms (short-term) include modifying subsistence activity patterns in gathering culturally important species and incorporating a diversity of species use at varying intensities across habitats. Adaptive strategies (long-term) include the integration of fallback foods still used today as well as a local economy of gathering. The use of traditional foods is an expression of regional, socio-ecological resilience. Traditional foods are an integral part of Hutsul community life, as seen in culture and ritual, stewardship of landscapes, gathering practices, economies, nesting TEK in place. In this article, we seek to answer the following questions:

1) What factors threaten resilience in local Hutsul communities?

2) What are the coping mechanisms (short-term responses) and adaptive strategies (long-term responses) that support food sovereignty within Hutsul communities?

1.1 Regional Background

The Carpathian Mountains span several countries including the Czech Republic, Poland, Slovakia, Hungary, Serbia, Romania, and Ukraine. Containing Europe's largest remaining old-growth forest ecosystems outside of Russia, the Carpathians are a biodiversity hotspot, harboring one-third of all European vascular plant species. Considered the "Amazon of Europe", this region is one of Europe's last fully undeveloped landscapes, a rich refuge for large carnivores and a principal source of subsistence to 16 million people (Gurung et al., 2009). The Carpathian region in Ukraine covers 3.5% of Ukraine's area and 10.3% of total area of the Carpathian Mountains (Elbakidze et al., 2013). The flora species composition of the Carpathian alpine forest provides key indicators of ecosystem health in response to climate change (Geyer et al., 2010). As an ancient corridor and refuge for humans, the cultural landscape mirrors the breadth and depth of the biological landscape. Beginning over 2,000 years ago, many tribes have established cultural roots in this region (Kibych, 2010).

In Ukraine, there are various Indigenous, ethnographic groups, ranging from the Tatars in Crimea, who are currently facing intensified persecution due to Russian occupation (Coynash et al., 2019), to the highlanders in the eastern Carpathian Mountains: including Hutsuls in

Hutsulshchyna (Figure 3.2), Boykos, in the Bystrytsia Solotvynska River Basin, and Lemkos, in the Low and Middle Beskyd Mountains (Magosci, 1997). Archaeological evidence points to human existence in the region dating back to 100,000 years before present (Stech, 2007). This study is centered in the cultural, historical center (Verkhovyna) of Hutsulshchyna, which translates to "Land of Hutsuls", a mountainous area of the Carpathian Mountains in southeastern Ukraine (Northern Bukovina) and northern Romania (Maramureș and Southern Bukovina areas). This territory covers three administrative regions (Ivano-Frankivsk, Chernivtsi and Zakarpattia) in Ukraine as well as a portion in northern Romania.

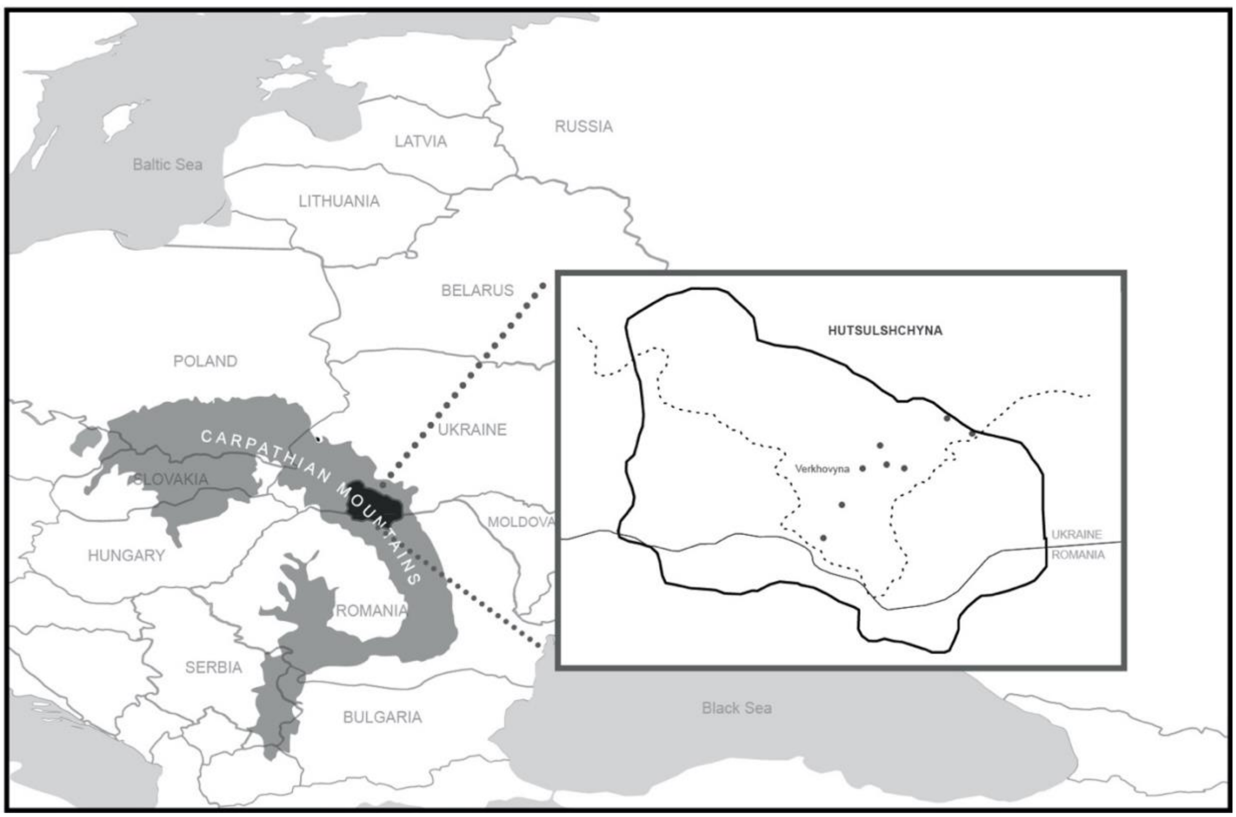

Figure 3.2. The bolded outline marks the current area of Hutsulshchyna, the land of Hutsuls (Adapted from Figlus, 2009). Hutsulshchyna today borders both Ukraine and Romania. The dotted line transecting Hutsulshchnya represents borders established before World War II whereby Hutsulshchyna was split between Romania, Czechoslovakia, and Ukraine. In 1940, borders split Hutsulschyhna between the Soviet Union (now Ukraine) and Romania. The dots represent villages visited and places of interviewing. Verkovyna, the historical cultural center of Hutsulshchyna, and the surrounding villages all fall within a centralized area between borders established before World War II.

At a landscape scale, Hutsuls, traditional pastoral highlanders of the Ukrainian Carpathians, have maintained alpine grasslands (*polonynas)* through mountain shepherding of cows and sheep (Figure 3.3). Currently, there is a continuing threat of cultural loss of this practice due to low economic competitiveness and increasing disinterest among younger generations (Amato, 2006). Maintenance of these alpine grasslands is declining quickly with newer pressures including tourism infrastructure and emigration of younger generations to cities. This recent decline of grazing on secondary grasslands has led to reforestation of previously cleared areas (Elbakidze et al., 2013). However, mountain shepherding and other traditional ecological practices, such as gathering of NTFP (non-timber forest products), like wild edible plants and mushrooms, although threatened, have survived. NTFPs, typically refer to substances, materials or non-woody species that provide economic value to rural communities (FAO, 1999). Forests and a multitude of other habitats (including gardens, roadsides, pastures, fields, woodlands, alpine meadows, meadows, forests, *polonyna*s (culturally-held alpine meadows), *toloka*s (generationally-held pastures), and alpine areas) bordering various village settlements provide an integral zone of nourishment through the gathering of wild and cultivated species. Flowers, birch sap, resin, honey, mushrooms, and berries gathered in these diverse habitats form an essential part of the social fabric and political economy of Ukrainian culture (Bihun, 2005; Elbakidze and Angelstam, 2007), particularly in forest-dependent Hutsul communities.

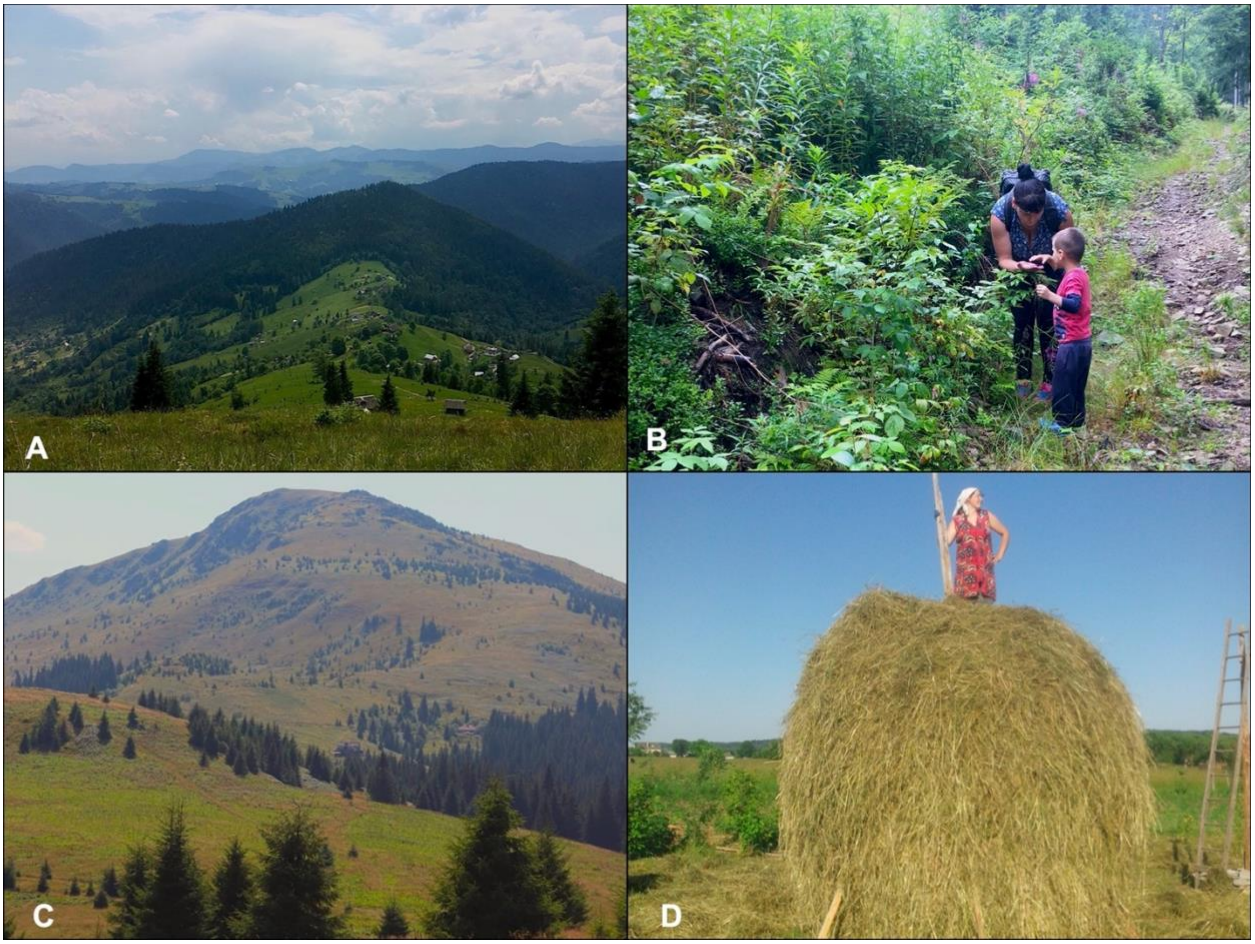

Figure 3.3. A – Common landscape in Hutsulschyna (Photo credit: Nina Fontana); B – Nadia Perepelytsia and her son, Maxim, picking bilberry (*Vaccinium myrtillus*) and fireweed (*Chamaenerion augustifolium*) in their nearby woodland and forest areas (Photo credit: Nina Fontana); C – *Polonyna* – an alpine grassland and culturally important ecosystem in Hutsulshchyna (Photo credit: Oleh Pohribnyi); D – Work on a *toloka* (a culturally important field for grazing cattle). Here, Ivanna Kovaliuk is using her feet to compact grass into a haystack. (Photo credit: Mariia Pasailiuk).

In the Ukrainian Carpathians, 59-91% of the population lives in rural areas (Bosch et al. 2008); this broad range is due to the socioeconomic inequality between rural and urban areas in the region (UNEP 2007). The interdependence between nature and need is explicit. While most houses have electricity, most water is taken from nearby wells and rivers (Geyer et al., 2011) and most villages have no sewage system (Bosch et al., 2008). People trek to natural mineral water springs, which is an old spiritual tradition. There are over 800 natural mineral sources in this region (Kolodiychuk, 2008). Communities are self-sufficient in terms of their nutritional needs, relying on a diversity of habitats nearby. Food is grown, gathered, and stored (dried, pickled, canned, fermented). Many households in this region rely on subsistence-based agriculture with homes surrounded by chickens, pigs, cows, goats, and additional income derived from family members going abroad for work. Low salaries demand multiple avenues of revenue from subsistence farming, gathering, and selling of culturally important wild species, as well as opening one's home to tourist stays (ecotourism).

For centuries, local Hutsul people have creatively and effectively managed culturally important species in the Carpathian Mountains (Griffiths et al. 2014) maintaining their productivity and availability, thus creating a socioeconomic safety net to sustain them in times of scarcity. As Ukraine continues to face political crisis (war), financial insecurity, food scarcity and increasingly expensive medical care, trade and direct consumption of NWFPs in local diets has increased in the Carpathian region **(**Stryamets et al., 2015). According to the Food and Agriculture Organization of the United Nations, 80% of developing countries rely on NWFPs for nutrition and health purposes (Sorrenti, 2017). NTFPs, like wild plants and mushrooms, contribute to a growing local economy, diversify diets, present possibilities for genetic research and development in new domesticated crops, and provide a lens for understanding cultural identity.

Hutsulshchyna has been a place of extensive ethnographic work starting in the early 1800s and continuing well into the 1930s, when this region was under various colonial regimes (including Poland and the Austro-Hungarian Empire) (Falkowski, 1938; Kujawska et al., 2015; Łuczaj, 2008;). In the last five years, a group of authors have centered their ethnobotanical research in Bukovina, the southeastern corner of Hutsulschyna (which falls along the Ukrainian-Romanian border) with several studies focusing on Hutsul ethnobotany (Mattalia et al., 2020; Mattalia et al., 2021a; Mattalia et al., 2021b; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016; Stryamets et al., 2021b). Their methodologies generally consist of qualitative interviewing followed by quantitative analyses including detailed use report (DUR) and calculations of the Jaccard Similarity Index (JI) to cross-culturally compare ethnobotanical uses on either side of the border. Their studies suggest that the establishment of the border between Ukraine and Romania in 1940 and the resulting impacts of Soviet policies in Ukraine contribute to differences in ethnobotanical use (Mattalia et al., 2021a; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016; Stryamets et al., 2021a) and knowledge transmission between Hutsuls in North Bukovina (Ukraine) and Hutsuls in South Bukovina (Romania) (Mattalia et al., 2020). Additionally, other studies analyze differences between wild and cultivated species' use between Romanians and Hutsuls in Bukovina (Mattalia et al., 2021a) as well as the revitalization of ethnobotanical practices in religious holidays of Hutsuls in Northern Bukovina (Ukraine) and Ukrainians in Roztochya, western Ukraine (Stryamets et al., 2021b).

The most recent study infers that Hutsuls in Northern Bukovina (Ukraine) exhibit greater reliance and dependence on forest habitats than Hutsuls in Southern Bukovina (Romania). The splitting of Hutsulshchyna between Ukraine and Romania in 1940 and the resulting socio-political policies implemented on each side of the border guide the narrative of these studies; differences seen in species uses, range of species as well as ethnobotanical knowledge transmission are attributed to this border creation. This study builds upon previous studies to focus in the cultural, historical Hutsul center and explore the role of ethnobotanical knowledge in supporting the various coping mechanisms and adaptive strategies present within Hutsul communities.

2. Methods

The methodologies employed in the case study were derived from extensive field seasons between 2017-2019 (as detailed in Chapter 2), employing historic and ethnographic literature reviews, participant observation (Musante and DeWalt, 2010), community-based participatory action research (CBPAR), and a translational approach (as outlined in Chapter 1). As discussed in Chapter 1, a translational approach was an integral part of this collaborative project, employing five key dimensions to resilience building including 1) communication and engagement, 2) policy, 3) education, 4) knowledge creation, and 5) personal actions. The main goal behind the translational approach is to produce policies based on transparent co-production of knowledge by all stakeholders impacted by those same policies (Fitzgibbons and Mitchell, 2019, Adler, 2020). This chapter will be co-published by Hutsul scientists, Mariia Pasailiuk and Oleh Pohribnyi, facilitating dissemination of knowledge on their terms, and serving as published affirmation of the importance of Hutsul ethnobotany in regional economic development and environmental policymaking.

During the first field season (August 2017-August 2018), the first author (Nina Fontana) met both the second and third authors, Hutsul scientists Mariia Pasailiuk and Oleh Pohribnyi, to begin this collaborative research project. The development of the research presented here is generated from an attempt understand the synergistic social, economic, and eco-cultural spheres that inform Hutsul community livelihoods. By publishing this research, we show the deep interconnectedness between Hutsul communities and their own landscapes, while voicing Hutsul community members' perspectives on regional environmental challenges.

Connections and relationships with community members and colleagues were made four months prior (between August 2017-December 2017) to interviewing to facilitate in-depth participation in the research process. There were distinct considerations made when thinking about how this publication could harm and benefit communities. To address these issues, community members are not named here, unless explicit permission was granted. Oral consent was obtained prior to each interview. All authors strictly followed guidelines prescribed the International Society of Ethnobiology (2006). However, since there is no official ethical review process regarding the protection of human participants in Ukraine, the first author obtained a local ethical review and approval of the project from the Verkhovyna National Nature Park in Ukraine (since most villages visited were centered around Verkhovyna). The local ethical review of the project was translated into English and then approved by the Institutional Review Board Committee at the University of California, Davis.

In the first field season, between December 2017 and August 2018, the first author conducted in-depth interviews of 40 Hutsul elders, herbalists, and knowledge holders through snowball sampling (Höft et al., 1999; Martin, 2004) in eight different villages, including Hutsul foresters, rangers, and scientists at two national parks (Verkhovyna National Nature Park and Hutsulshchyna National Nature Park) surrounding wild species use including names, habitats found, gathering methods, ethnobotanical uses, ways of preparation. Interviews were conducted in Ukrainian, and participants responded in Hutsul and Ukrainian. All interviewees were over the age of 18 (aged 25-93), with an average age of 53, with interviews ranging from 30 minutes to four hours. Key knowledge holders were interviewed multiple times to clarify plant names and plant uses with the aid of photographs and specimens. The first field season provided data for calculations to derive various ethnobotanical indices (use report (UR), frequency of citation per species (FC), cultural importance index (CI index), number of uses per species (NU), relative frequency of citation index (RFC), fidelity level per species (FL)) (Whitney, 2020) for wild species (including plants, lichen, and fungi) and commonly cultivated plants, with a focus on the cultural importance index (CI index).

During the second field season (June-August 2019) all authors participated in follow-up interviews and participant observation (gathering trips) to further clarify TEK surrounding species use, including names, habitats and more specifically interview elders about species gathered during times of scarcity. The first round of interviews captured current species use, gathering practices and ecology, while the second round of interviews focused on species relied on in times of scarcity and emerging environmental challenges. A discussion emerges from the two rounds of interviews between species currently used and those relied upon during times of scarcity. As part of our methodology, we also conducted an extensive ethnographic literature review comparing our findings on a species-by-species basis with noted fallback foods identified in past (Fischer, 1939) and current studies (Mattalia et al., 2020; Pieroni and Sõukand, 2017; Sõukand and Pieroni, 2016).

Throughout both field seasons (2017-2019), key elders and knowledge holders were interviewed multiple times to clarify plant names and plant uses with the aid of photographs and voucher specimens. Alignment of common names with botanical names, and plant identification of voucher specimens was confirmed and cross-referenced with botanists (Lyubomyr Derzhipilsky) and scientists (Oleh Pohribnyi, Mariia Pasailiuk) at the Hutsulshchyna National Nature Park as well as with botanist Roman Lysiuk, from Danylo Halytsky Lviv National Medical University. Taxonomic texts from the Hutsulshchyna National Nature Park library were also used to identify species including plants, mushrooms, and lichen. Additionally, throughout both field seasons, guided by elders and specialists, I participated in trips throughout the gathering season (typically, fall, spring, and summer) to the Chornohora Mountain range and local areas to better understand gathering practices in the region. Lastly, I organized a total of five informal group discussions with local women regarding plant use and environmental change seen in the region.

Interviews were recorded, transcribed, and translated into English (as described in Chapter 2) and data were organized in R, and the ethnobotany R packaged developed by Cory Whitney (2020) was used to calculate quantitative ethnobotanical indices (stated in more detail in Chapter 2).

Quantitative indices, based on in-depth and multiple semi-structured interviews, assess passive knowledge and "participant consensus," the degree of agreement among interviewees (Albuquerque et al., 2006). In this study, we focus on species' cultural importance derived from the cultural importance index (CI index), which is the sum of use reports divided by the number of participants to account for the diversity of uses for each species (Tardio and Pardo-de-Santayana, 2008). The diversity of uses noted include food (alcoholic beverage, fruit, recreational beverage, seasoning, vegetable, tea, fungi), medicine (tincture, topical treatment, ground) and other (ecological marker, symbolic, toxic, veterinary, textile, repellant and economic). Context-driven components, like habitat, are valuable in understanding species' impact on the day-to-day lives of people. A community ecology approach was incorporated in the analysis, by noting species' presence or absence (Gaston, 2009), in various habitat types including roadside, pasture, *toloka*, meadow, woodland, forest, field, *polonyna*, alpine area, garden. Each of these habitats (gathering site types) encompasses a range and gradient of human interaction or human structuring (most-roadside to least-alpine) as seen in Table 3.1.

Table 3.1. Description of 10 common habitats (gathering site types) in Hutsulshchyna.

Habitats (Gathering site types)	**Description**
Roadside	Roads provide thoroughfare to buses, cars, motorcycles, bicycles, and people. People walk along and sell local products (berries, mushrooms, crafts) along roadsides. Harvesting along roadsides happens but is undesirable due to pollutive effects.
Forest	A dynamic ecosystem consisting of trees and understory plants, with various interactions and species composition changes including: 1) firewood harvest, 2) collection of berries and mushrooms, 3) introduction of hitchhiker species, 4) recreation (hiking), 4) occasional livestock grazing, and 5) logging.
Garden	A field planted with fruit trees (apples, cherries, plums, peaches). It is planted once and harvested every year, resulting in a relatively static species composition.
Toloka	This culturally held fenced field is held within families intergenerationally near homes. It typically borders forests and serves as a grazing area for small cattle year-round. [Figure 3.3].
Polonyna	This culturally held high alpine meadow on a forestless mountain peak. Every year, there is a festival marking the transfer of cattle to high mountain shepherds. Grazing animals have a significant influence on plant species diversity. [Figure 3.3].
Field	A place where plowing and agricultural work occurs. Hay is harvested and vegetative propagation of plants and species composition is impacted by hay harvesting.
Pasture	This is a meadow where cattle graze together but no mowing occurs. Due to land privatization (after the collapse of the Soviet Union), there are not a lot of pastures. Pastures and fields have similar plant species composition.
Meadow	A field of grass that is used specifically for gathering hay. Cattle do not graze here and this habitat supports native vegetation.
Woodland	These are edge habitats with more open canopies than forests.
Alpine	Human and animal impact is minimal. There is no grazing. Minimal shrub and grass vegetation.

After calculating these indices, this knowledge was further organized to explore the cultural importance of these plants, habitat distribution and use in contextualizing adaptive capacity. Outings, informal group discussions, and long-term presence in Hutsulshchyna with key elders allowed for the development of shared trust and the witnessing of lived knowledge. By delving into these qualitative experiences, context and meaning emerge to provide a deeper understanding that cannot be captured in strictly quantitative ethnobotanical indices. By merging this collaborative, qualitative approach with quantitative indices, a richer perspective can be gained, based not only on informant consensus on wild species use, but on what this ethnobotanical knowledge means in supporting socioecological resilience in local food systems.

3. Results

With the direction, guidance, and cooperation from Hutsul elders, farmers, herbalists, community members and colleagues, I recorded a total of 108 species from 79 genera and 48 families (Appendix A) in a total of ten different habitats (Table 3.1). While the goal was to understand the role wild plant use and management in Hutsulshchyna, while interviewing, other topics arose such as use of cultivated plants (23 species), mushrooms (9 species), and lichens (2 species). The notation of which plants were considered ‘wild’ was determined by the interviewees. Species noted by interviewees as cultivated were defined as such. Additionally, I noted instances where observed wild species were seen growing in cultivated spaces such as gardens. Among the wild species, the most well represented families included Rosaceae, Asteraceae and Gentianaceae. Among the cultivated plants, the most well represented families include Apiaceae and Asteracea. A total of 1508 UR for wild plants, a total of 220 UR for cultivated plants and a total of 68 UR for mushrooms were provided by participants. Out of 97 plant species examined, 23 plants were cultivated, and 74 plants were wild. Out of 97 plants stated as culturally important (as indicated by the CI index), there are 4 species of evergreen trees, 11 species of deciduous trees, 15 species of shrubs, 62 species of perennials, 4 species of annuals, 1 aquatic plant species along with 2 species of lichen.

3.1 Cultural Importance Index

The CI index is useful since the measure is independent of the number of informants and can be used for comparing regional botanical knowledge (Tardío and Pardo-de-Santayana, 2008). When analyzing which species, overall, were considered the most culturally important (according to the CI index), among the top three wild plant species were St. John's wort (*Hypericum perforatum*), bilberry (*Vaccinium myrtillus*), and raspberry (*Rubus ideas*) (Table 3.2). The top three cultivated species with the highest noted cultural importance and highest noted use reports (UR) were chamomile (*Matricaria chamomilla L.*), apple (*Malus spp.*), and chokeberry (*Aronia melanocarpa*).

Among the 9 fungi species, Boletaceae was the most well represented family. Considering cultural importance (CI), frequency of citation (FC), relative frequency of citation (RFC), relative importance (RI), and use reports (UR) among mushrooms noted, fly agaric (*Amanita muscaria)* ranks first and penny bun (*Boletus edulis*) ranks second. Chanterelle (*Cantharellus cibarius)* ranks third in terms of cultural importance (CI) and relative importance (RI) and ranks fourth in terms of relative frequency of citation (RFC). The mushrooms indicating the most uses (NU) were penny bun (*Boletus edulis*) and fly agaric (*Amanita mascaria)* followed by chanterelle (*Cantharellus ciborium*). While fly agaric was discussed the most, it is very sparingly gathered, if gathered at all. Its bold presence in the analysis has more to do with its symbolic importance and ecologically frequent presence in the region than its use in everyday life. Mycological knowledge came as a byproduct of a different series of topical questions about plant use. Incidental gathering of wild plants typically occurs when mushroom hunting, hence their inclusion in the analysis. This dataset is small since it was incidental knowledge gathered through interviews and participant observation on plant knowledge. It does not capture the extensive deep and rich mycological knowledge rooted in this region.

Table 3.2. Top Twenty Species of Noted Cultural importance in Hutsulshchyna

Botanical Name	Habitat	Mode of Use	NU	FC	UR	CI Index
***_Hypericum perforatum_**	RD, PAS, TOL, MEA, WD, POL, FIE, (GAR)	Medicine: TEA, TIN (stomach, antibacterial) Other: TOX, ECO, SYM	6	28	87	2.175
****Vaccinium myrtillus***	TOL, WD, FOR, POL, ALP	FOOD: ALC, FRU, REC (juice, jam), SEA Medicine: TIN, TEA (stomach) Other: ECO, SYM, ECON	8	22	81	2.025
****Rubus ideaes***	RD, WD, FOR, POL, ALP, (GAR)	FOOD: FRU, REC Medicine: TEA, TIN (liver/inflammation/female reproductive organs) Other: ECO, SYM, ECON	6	23	77	1.925
****Arnica montana***	MEA, WD, ALP, POL, (GAR)	FOOD: TEA Medicine: TIN (lungs, stomach), TOP Other: ECO, TOX, ECON	7	26	69	1.725
****Mentha spp.***	WD, POL, FIE, (GAR)	FOOD: TEA Medicine: TEA, TIN (calming) Other: ECO, SYM, REP	7	22	53	1.325
****Thymus serpyllum***	RD, PAS, TOL, MEA, WD, POL, (GAR)	FOOD: REC, SEA, VEG Medicine: TEA (colds) Other: ECO, SYM, ECON	8	18	51	1.275
**Gentiana lutea*	MEA, ALP, POL	FOOD: FRU, REC Medicine: TEA (heart disease)	5	16	50	1.250
****Fragaria vesca***	RD, PAS, TOL, MEA, WD, FOR, POL, (GAR)	Medicine: TEA, TIN (stomach) Other: ECO, SYM, ECON	7	14	50	1.250
**Rosa canina*	RD, PAS, TOL, MEA, WD, (GAR)	Medicine: REC (juice), TEA, TIN (liver, Vitamin C) Other: ECO, SYM	5	19	48	1.200
Rubus caesius	RD, PAS, TOL, MEA, WD, POL, (GAR)	FOOD: FRU, REC (juice) Medicine: TEA, TIN (intestine/hypertension) Other: ECO, SYM, ECON	5	20	45	1.125
Rhodiola rosea	POL, ALP	Medicine: TEA, TIN (stomach) Other: ECO, SYM, ECON	4	16	43	1.075
****Vaccinium vitis-idaea***	TOL, WD, FOR, POL, ALP	FOOD: ALC, FRU, REC (juice, kvass), SEA, TEA Medicine: TIN (blood pressure)	6	18	43	1.075

Botanical Name	Habitat	Mode of Use	NU	FC	UR	CI Index
		Other: ECO				
****Tilia cordata***	MEA	FOOD: REC (juice) Medicine: TEA (cold) Other: ECO, ECON, SYM	7	16	41	1.025
Cetraria islandica (Lichen)	FOR, POL, ALP	Medicine: TEA (bronchitis) Other: ECO, ECON, SYM	6	10	38	0.950
****Carum Carvi***	RD, PAS, TOL, MEA, POL, (GAR)	FOOD: SEA Medicine: TEA (immunity, digestion) Other: ECO, SYM	5	11	35	0.875
****Origanum vulgare***	RD, PAS, TOL, MEA, WD, FOR, POL, (GAR)	FOOD: SEA, VEG, TEA Medicine: TEA (stomach) Other: ECO, SYM, VET, REP	7	12	33	0.825
Chamaenerion augustifolium	MEA, WD, FOR, POL, (GAR)	Medicine: TIN, TOP Other: ECO, TOX, SYM	5	12	32	0.800
Amanita muscaria (Fungi)	FOR	Medicine: TEA (restorative) Other: ECON	5	10	32	0.800
Pinus cembra	FOR, POL, ALP	FOOD: REC (syrup) Medicine: TEA, TIN (bronchitis) Other: ECO, SYM	6	7	29	0.75
Arcostaphylos uva-ursi	TOL, WD	FOOD: TEA Medicine: TIN (kidneys) Other: ECO, ECON	7	12	27	0.675

* Plants that show consistent use on both sides of the border of the Ukrainian-Romanian border, as well as the historical region of Hutsulshchyna;
Bold – Species with a food use
NU- Number of uses; FC- Frequency of citation; UR- Use report; CI index- Cultural importance index. Habitats – Roadside-RD, pastures -PAS, toloka - local family pasture land -TOL, meadows -MEA, woodlands -WD, forests -FOR, fields -FIE, polonyna- summer shepherding pastures -POL, alpine areas -ALP, gardens -GAR. Species noted as (GAR) show extended and observed ranges for typically wild plants seen growing in gardens. This exemplifies their potential extended range.* (Asterisk) denotes plants that show consistent use on both sides of the border of the Ukrainian-Romanian border, as well as the historical region of Hutsulshchyna

3.2 Use Categories: “Food is Medicine”

The highest use category was medicinal (30.8%) (discussed thoroughly in Chapter 2), followed by food use (30.6%), along with subsequent subcategories (Table 3.3). (96% of culturally important species exhibit at least two or more uses). Fifty-eight percent of culturally important species exhibit a food use, while 49% of species serve as food uses either as their primary or secondary use, as determined by fidelity level calculations (Appendix A, Tables A3, A4, A5). Primary and secondary uses of each species were based on the fidelity level calculations (FL), which calculates the percentage of informants who use the plant for the same purpose as compared to all uses of all plants (Friedman et al. 1986), signifying use consensus among community members.

The phrase, “food is medicine”, came up continually in discussions related to environmental changes occurring in the region; community members described impacts of pollution on habitat health, gathering practices and ultimately peoples’ health. Areas exhibiting high areas of pollution, or disturbance tend to be avoided, since species gathered there have deleterious properties, impacting human health. Many of the highest ranked culturally important food species were also noted for their medicinal qualities, such as bilberry (*Vaccinium myrtillus*), raspberry (*Rubus ideas*), and various mushroom species. Thirty-point six percent of species shared both medicine or food use categories as either their primary or secondary use. Thirty-five-point two percent of species shared both medicinal and “ecological uses” as either their primary or secondary use. As noted in Chapter 2, “ecological use” denotes TEK significance surrounding a particular species. Species that are primarily gathered for medicinal purposes were continually noted by interviewees to be gathered in higher, remote areas, therefore exhibiting ecological significance. Gathering species from various culturally important ecosystems that are directly used as medicine or food reinforces the clear tie between ecosystem and human health.

Table 3.3. Percentages by Use Category

Use Category	**Percent**
Medicinal	30.8 %
Food	30.6%
- Tea	13.9 %
- Fruit	6.6 %
- Vegetable/Mushrooms	3.1 %
- Recreational beverages	2.8 %
- Seasoning	2.6 %
- Alcoholic beverages	1.6 %
Ecological	23.7 %
Symbolic	9.7 %
Toxic	2.3 %
Economic	1.8 %
Veterinary	0.4 %
Textile	0.4 %
Repellant	0.3 %

Use category percentages of cultivated and wild plants, lichens, and mushrooms. Some species have multiple uses, falling into more than one category.

In addition to calculating the cultural importance of species and use category percentages, an understanding of human interaction with various gathering sites emerged. There is a gradient of human interaction across habitats (from most to least): roadside, forest, garden, *toloka*, *polonyna*, field, pasture, meadow, woodland, and alpine area (Figure 3.4). Many of the same culturally important species are found in a variety of habitats with different degrees of human interaction, providing accessibility in times of need or disturbance. If for example, a particular habitat becomes impacted (flooding, logging, pollution), there are other habitats to find that same species. No specific habitat harbors all or even a majority of culturally important species, which provides a layer of resilience within the community.

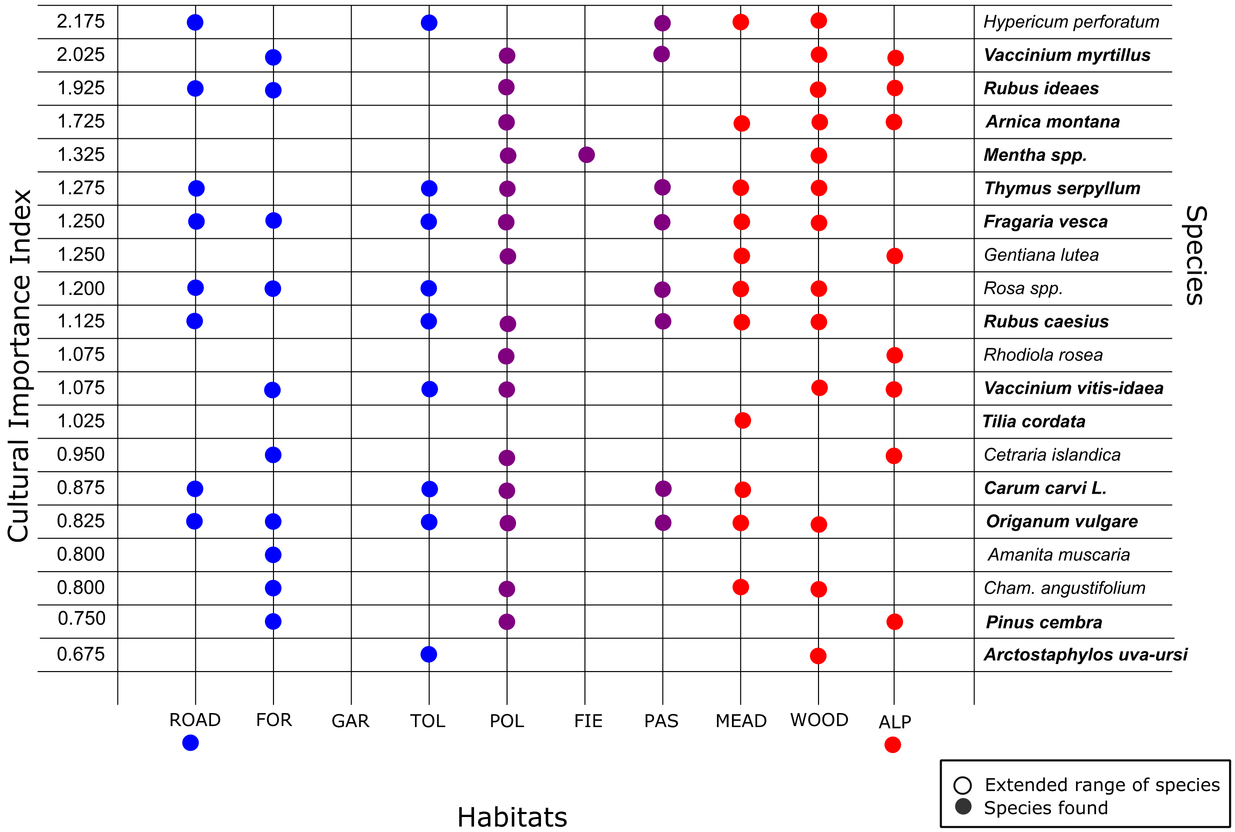

Figure 3.4. Top twenty culturally important species (according to the CI index) and the habitats found from most impacted (blue) from human structuring to least impacted (red). (ROAD – roadside FOR – forest GAR – garden TOL – toloka POL – polonyna FIE – field PAS – pasture MEAD- meadow WOOD – woodland ALP – alpine). **Bold** – Species with a food use.

3.3 Regional Environmental Changes

Discussion of regional environmental change and its impacts on maintaining resilience arose through participatory observation, conversations, interviews, and informal discussion groups. Ecosystem, climatic and cultural changes are testing local and regional resilience; there are specific factors impacting culturally important plants in the region (Table 3.4) as stated by local Hutsul community members. Colonial legacies documented from the 1700s up until 1991 have impacted the landscape, including plant grass and forest communities and with it culturally important medicinal species. Commercial harvesting, a more recent development in recent years, threatens accessibility for local gathering of medicinal species such as Vaccinium myrtillus, *Arnica montana*, *Cetratria islandica, Gentiana lutea*. Additionally, flooding and accompanying erosion have increased in frequency and severity because of extensive clear-cutting logging practices. Lastly, the continuing impacts of climate change have caused more dysregulation of phenological plant cycles as well an increased the uptick of pest infestations.

Table 3.4. Community observations of factors impacting culturally important species in Hutsulshchyna

Factors impacting culturally important species	**Observations**	**Predicted Effects**
Socio-ecological consequences of historical colonial policies	• Soviet policies (1939-1991) - Mass aerial fertilizing of land changed structure of grass cover (*Trifolium pratens* dominates) (3) • Austrian-Hungarian empire (1772-1918) - Excessively logging of culturally and ecologically important, endangered species (*Pinus cembra*) - Planting of monoculture pine species (E)	• Slow recovery of grass plant communities (Example: *Thymus serpyllum* has recovered; *Matricaria chamomila* still recovering) (E) • Impacts cultural use of species (weddings) (1) • Limits ecosystem functioning of forests (2) • *Pinus cembra* stays endangered status/reaches extinction (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)
Commercial Harvesting	• Improper harvesting techniques (*Arnica montana*) (1) - Not leaving root behind - Gather flower before seed release • Mass harvesting (*Cetraria islandica*) (2) - No recovery growth of slow-growing lichen	• Culturally important plants become rarer; less accessible to local Hutsul populations (1)
Logging	• Legal/illegal logging practices on mountainsides (1)	• Impacts succession of species (berries and mushrooms) (1) • Increase of regional flooding (1)
Climate Change	• First mowing of hayfields occurring earlier in the season (2) - Plants of importance are being cut down before reseeding occurs (*Carum carvi*, *Centaurium erythraea*) • Elevation shifts of plant habitats (*Arnica montana, Rhodiola rosea, Veratrum album*) (1) • Extreme weather conditions (shortened time frames between flooding events) (1)	• Dysregulated phenological cycles of plant communities (1) • Stay at endangered status (*Gentiana spp., Allium ursinum, Orchis mascula, Platanthera bifolia*)(1) • Increased incidence of pests (*Leptinotarsa decemlineata*) on cultivated crops (1) • Increase in pine dieback (*Pinus sylvestris*) due to pine bark beetles (1)

Observation rankings: 1 = widely shared (many observations and expert generalizations across villages), 2 = place specific (well-accepted within a particular community), 3= somewhat common (various participants), 4=less common (one or a few local experts), E=observation mainly reported by elders.

3.4 Species of Economic Importance

In the calculation of ethnobotanical indices, one of the use categories listed was economic use (Table 3.3). Out of 108 culturally important species, 9 species are consistently mentioned as sold or traded in small markets, personal contacts, or pharmacies. They include *Cetraria islandica* (moss), *Arnica montana, Cantharellus ciborium* (mushroom), *Boletus edulis* (mushroom), *Vaccinnium myrtillus, Rubus idaeus, Rubus caesius, Rhodiola rosea*, and *Gentiana lutea*. As noted in in Table 3.5, seven of nine economically important species are in the top twenty culturally important species in Hutsulshchyna. Fifty-five percent of economically significant species are food, while 77% of species are used medicinally. It is also worthwhile to note that two root species, *Gentiana lutea* and *Rhodiola rosea* are listed as endangered species and are significantly impacted by external commercial harvesting efforts.

Bilberries (*Vaccinium myrtillus*), are one of the most culturally important plants in Hutsulshchyna, (according to the CI index) and are the most popular product for sale and household consumption. Along with bilberries, mushrooms (specifically *Boletus edulis* and *Cantharellus ciborium*) are also traditional forest foods for which demand is consistent and their price remains stable. Fresh mushrooms are sold continuously from summer until fall, while dried mushrooms are sold during the winter months. The variance in price is dependent on yearly harvests. However, the demand for these species is continual and does not change, due to their importance as traditional foods. Berries and lichen are typically sold in the summer, while roots and mushrooms are sold all year round in dried or fresh.

Table 3.5. Species of Economic Importance in Hutsulshchyna

Plant Species *(Most commonly cited first) [CI index Ranking]*	**Part Sold**	**Uses**	**Seasons sold**	**Preparation**	**Units of measure**	**Price Dollar ($) / hryvnia (₴)**
Arnica montana [4]	Roots	MED, ECO	All	Dried Fresh	1 kg 1 kg	$56/ ₴1550 $4.30-5.70/ ₴120-160
	Flowers	MED	All	Dried	1 kg	$53.60/ ₴1,498
Gentiana lutea [7]	Roots	MED, ECO	All	Dried	1 kg	$26.80/ ₴750
***Boletus edulis* [42]**	Mushroom	FOOD	All	Dried Marinated Fresh	1 kg 1 liter 1 kg	$35.80/ ₴1,000 $9/ ₴250 $2.50/ ₴70
***Vaccinium myrtillus* [2]**	Berries	FOOD, MED	Summer, Fall	Fresh	1 kg	$1.60-3.20/ ₴45-90
***Cantharellus ciborium* [69]**	Mushroom	FOOD	All	Dried Fresh	1 kg 1 kg	$21.40/ ₴600 $4.30/ ₴120
Rhodiola rosea [11]	Roots	MED, ECO	All	Dried	1 kg	$43/ ₴1,202
Cetraria islandica [14]	Moss	MED, ECO	Summer, Fall	Fresh	1 kg	$2.50/ ₴70
***Rubus caesius* [10]**	Berries	FOOD	Summer	Fresh	1 kg	$2.50/ ₴70
***Rubus idaeus* [3]**	Berries	FOOD, MED	Summer	Fresh	1 kg	$4.30/ ₴120

Data derived from collaboration with the Hutsulshchyna National Park. * Listed as endangered species* Uses – Med – Medicinal use, Eco – Ecologic use, Food use – Food, Econ – Economic use; **Bold** – Species with a food use.

3.5 Fallback Foods: Then and Now

Two well-known Polish ethnographers, Adam Fischer and Jan Falkowski, led several Carpathian Mountain expeditions in the 1930s (Patsai, 2018), tangentially addressing wild food use during scarcity in Hutsulshchyna in the last century. In one study, Adam Fischer sent out a total of 235 ethnobotanical questionnaires; 70 of them were sent to primary school teachers in three counties of the Hutsul areas in the Carpathian Mountains (Kujaska et al. 2015; Łuczaj, 2008). The questionnaires contained one question asking about wild plant consumption during periods of food shortage. The most common cited taxa in Hutsul counties were the leaves of *Chenopodium album*, *Rumex acetosa*, *Urtica dioica* and *Tussilago farfara*. In a later study led by Jan Falkowski (1938), the same plants including *Chenopodium album*, *Rumex spp* and *Urtica dioica* were also mentioned. Also noted in Fisher's earlier study were mushrooms that grow on beech (although no species was listed). Coltsfoot leaves (*Tussilago farfara*) were used for wrapping cabbage rolls (a traditional food called *holubtsi*) and often mentioned in Hutsul villages. Unique to Falkowski's study was the mention of berry gathering for holiday and personal sale. Here, the convergence of berries as fallback traditional foods, contributing to a diverse local economy is recognized. These studies provide a mention of a few fallback foods used in times of food shortage and colonization in Hutsulshchyna.

Interestingly, some of these same plants mentioned by Adam Fischer, a Polish ethnographer, in his 1934 questionnaire are still used today, not necessarily noted as fallback foods, but for other uses including food and medicine by scholars (Mattalia et al., 2020; Mattalia et al., 2021a; Mattalia et al., 2021b; Pieroni and Soukand, 2017; Soukand and Pieroni, 2016; Stryamets et al., 2021b). By referring to Fisher's list of fallback foods used in 1934, there are certain plants that still hold significance and importance in the region today (Table 3.6). C*henopodium album, Ribes sp.*, *Rumex acetosa, Thymus spp., Tussilago farfara,* and *Vaccinium vitis-idaea* showed prevalence as fallback foods in the 1930s and are still used today in all current studies in Hutsulshschyna (both Romania and Ukraine). *Chenopodium album* as well as *Rumex acetosa* are still used in soups in all studies. In our study, young shoots are noted to be fried with onion. *Ribes sp. (*including *R. nigrum* and *R. rubrum)* are used in the fermentation of cucumbers, as well as in various recreational drinks (i.e, juice, tea, and wine), jam and marmalade. Additionally, both species have medicinal value (Mattalia et al., 2020; Pieroni and Soukand, 2017; Soukand and Pieroni, 2016). *Thymus spp.* (specifically *Thymus serpyllum)* are used as seasoning in soups and traditional foods as well as medicine for cold-related ailments like coughing.

Tussilago farfara is primarily used medicinally today in syrups, tinctures, and teas to treat colds, bronchitis, and coughs. Interestingly, it was also noted to be used only during famine times as traditional food in cabbage rolls (*holubtsi*) (Pieroni and Soukand, 2017), like Fischer's observations in 1934. However, in this study, coltsfoot is still occasionally used today to make *holubtsi*. This plant's use in foods could have been reserved to times of scarcity since it can exhibit latent liver toxicity (Chen et al., 2020). Typically eaten as a berry, *Vaccinium vitis-idaea* is used as a food in jam, juice, tea, and medicine to treat blood pressure. These wild species are not simply reserved for times of scarcity; they are actively culturally important species of importance, prevalence and use in traditional foods and medicine.

Table 3.6. Comparative uses of fallback foods as noted by Adam Fischer's questionnaires in Hutsulshchyna (1934) and current studies

Noted Species used in Hutsulshchyna according to Fischer (1934)	**Uses noted from current studies** Soukand and Pieroni 2016* Pieroni and Soukand 2017** Mattalia et al. 2020***	**Fontana, Pasailiuk, Pohribnyi (2021)**
Allium ursinum	Food (*Allium spp.*) - soups and omelets (*; **)	CI index: 0.625 Food - raw, salads Medicine - tincture (cholesterol) Veterinary - snake bites (Noted: endangered)
Carlina acaulis	X	CI index: 0.125 Food - humans, cows (Noted: people used to gather it more)
Chenopodium album – 42 people (leaves boiled/fried as greens/soup)	Food – boiled and eaten in soup (**); Eaten with sour cream (*;***)	Infrequently mentioned (3 people and therefore not included in the CI index calculation) Food - Used to cook soup (grandmothers made this)
Cirsium oleraceum	X	X
Crataegus spp.	Food – fruit (tea) - good for heart (***) Medicine - flowers (tincture) - good for blood pressure (***)	CI index: 0.575 Food - fruit (tea) – good for heart Medicine – flowers (tincture) - regulates blood pressure
Fagus sylvatica (leaves, bark pulp as bread ingredient)	Used for smoking pork meat by Romanian Hutsuls (***)	Infrequently mentioned (not included in the CI index calculation) Food -inner part of the part of young trees, roasted seeds (Mentioned use during time of famine/food shortage)
Lamium spp.	Medicine (*Lamium album*) – tea (used for heart problems) (*) Medicine (*Lamium album*) – tea (blood pressure, heart, nerves (***)	X
Malus domestica	Medicine – fruits boiled with onion (cough) (***)	*Malus spp.* CI index: 0.525 Food – recreational drinks (uzvar, compote) Medicine – good for teeth

Noted Species used in Hutsulshchyna according to Fischer (1934)	<u>**Uses noted from current studies**</u> Soukand and Pieroni 2016* Pieroni and Soukand 2017** Mattalia et al. 2020***	**Fontana, Pasailiuk, Pohribnyi (2021)**
Oxalis spp.	Food (*Oxalis acetosella*) – snack, salad (**; ***)	X
Pyrus sp.	Medicine – tea and tincture (salt in joints) (***)	CI index: 0.275 Food -compote, fresh fruit, jam, compote, jam, marmalade Medicine -Vitamin C, nerves
Ribes sp.	*Ribes nigrum* Food – added to lacto-fermented cucumbers; leaves – recreational tea; (**) Medicine – fruits (high blood pressure) (*; **) tea(cough), juice (blood pressure), jam (food for hemoglobin), jam (eyes), raw (blood pressure) (***) *Ribes rubrum* Medicine – raw (kidney stones), tea (fever, flu) (***)	CI index: 0.175 *Ribes nigrum*, *Ribes rubrum* Food – Fruit, jam, wine; recreational drink (juice); seasoning (fermenting of cucumbers and added to *kulesh* (traditional food)
Rumex spp. (14 people) – both raw and cooked in soup	Rumex acetosa Food – Soup - borshch (leaves – fresh/dried) (*); Green borshch but only a few people use it; salad (**); Ingredient in soups/leaves (soup, snack, salad) (***)	CI index: 0.150 Food - Soup in spring, cooked with *Urtica dioica*, cooked with eggs, snack (fresh leaves)
Thymus pulegiodes/ *Thymus spp*. – exchanged for parsley	*Thymus serpyllum* Food – seasoning for soups (*); recorded as used in the past as seasoning for soups (**) Medicine – tea (cough/cold) (*;**) tea (stomach aches)(**) *Thymus serpyllum, Thymus vulgaris*	*Thymus serpyllum* CI index: 1.275 Food -added to *holubtsi* (*Holubtsi* are a traditional food consisting of cabbage rolls), soup, tea Medicine – tea (cough/colds, digestion, inflammatory processes, traditional rites)

Noted Species used in Hutsulshchyna according to Fischer (1934)	**Uses noted from current studies** Soukand and Pieroni 2016* Pieroni and Soukand 2017** Mattalia et al. 2020***	**Fontana, Pasailiuk, Pohribnyi (2021)**
	Medicine – tea (cough, stomach, lung, alcoholism) seasoning; syrup and tea (cough) (***)	
Tussilago farfara – 14 people, wraps for cabbage rolls/soup	Food – *holubtsi* (*); only during famine times – cabbage rolls (holubtsi); - in the past (**) Medicine - flowers (tincture) for rheumatic pains (*); tea (cough) (*; **; ***); syrup (throat), whole plant boiled (cough) (***)	CI index: 0.425 Food – *holubtsi* (traditional food – cabbage rolls) Medicine – syrup (colds/bronchitis/respiratory system)
Urtica dioica – 18 people, leaves (fried/cooked)	Food – soup (borshch), tea (*; **; ***), snacks (**), salad, seasoning (***) Medicine – washing hair (shine) (*; ***), fever (*; **); soup (blood cleansing), tea (blood pressure, good for heart, stomach, and others) (***)	Infrequently mentioned (not included in the CI index calculation) Eaten in conjunction in soups with *Chenopodium album*
Vaccinium vitis-idaea	Food – fruit (*), jam, juice (*; **; ***); recreational tea (**; ***), kvass, compote, syrup, snack (***), Medicine - juice (diarrhea, high blood pressure), tea (high blood pressure, heart problems) (*), diabetes (*; **; ***), eye diseases, stomachache (**) juice (kidney problems) (*; ***), fruit (blood pressure), tea (panacea) (***)	CI index: 1.075 Food- berries, recreational drinks (juice, kvass), tea Medicine – tincture (blood pressure, liver)
Armoracia rusticana	Food (*Armoracia spp.*) – leaves: seasoning (fermented cucumbers), sauerkraut (*;**; ***), fermented tomatoes (**; ***), roots (salads), whole plant (seasoning) (***)	Infrequently mentioned (not included in the CI index calculation) Food – fermented foods (Used during time of famine), horseradish eaten with beets during holidays (traditional food)

Noted Species used in Hutsulshchyna according to Fischer (1934)	**<u>Uses noted from current studies</u>** Soukand and Pieroni 2016* Pieroni and Soukand 2017** Mattalia et al. 2020***	**Fontana, Pasailiuk, Pohribnyi (2021)**
	Medicine – topical application (toothaches) (*; **); topical application (joint pain and rheumatic pains) (***)	
Mushrooms growing on beech as well as other mushrooms not specifically identified	X	9 species of mushrooms (food and medicine)

X – No uses noted

Species mentioned in Fischer's study that continue to exhibit cultural importance today include *Vaccinium vitis-idaea* (CI index: 1.075), *Allium ursinum* (CI index: 0.625), and *Crataegus spp.* (CI index: 0.575), *Tussilago farfara* (CI index: 0.425), *Rumex spp.* (CI index: 0.150). These species exhibit a diversity of uses in addition to serving as nutrient-dense foods during times of scarcity. Elders also mentioned many additional common and prolific species including *Elytrigia repens, Typha latifolia*, *Elymus repense*, *Fagus sylvaticus*, *Quercus robur, Orchis mascula*, *Plantanthera bifolia*, *Rhodiola rosea Plantago major*, *Taraxacum officinale, Trifolium pratens, Carduus natuns*, *Armoracia rusticana* (Soukand and Pieroni, 2016; Pieroni and Soukand, 2017) and *Urtica dioica* (Soukand and Pieroni, 2016; Pieroni and Soukand, 2017; Mattalia et al., 2020). Most importantly is the continual reliance of berries (Vaccinium species (*V. myrtillus, V. Vitis-idaea*), Rubus species (*R. idaeus*, *R. caesius*), Ribes species (*R. nigrum*, *R. uva-crispa*), *Fragaria vesca, Sambucus nigra*, *Aronia melanocarpa*, and *Sorbus aucuparia)* and mushroom species (particularly *Boletus edulis* and *Cantharellus ciborium*). Mushrooms, specifically within the family of Boletacea, contain proportionally high amounts of protein (Turner et al., 2011). The grounded importance of wild berries and mushrooms in Hutsul traditional foods, while not specifically mentioned by interviewees (unless asked), is an integral part of culture and survival.

4. Discussion

Culturally important species of the historical heart of Hutsulshchyna include a total of 108 species (including plants, fungi, and lichen) from 79 genera, 48 families commonly found in a total of ten different habitats. Food use (30.6%) is the second highest use category cited by Hutsul community members, with the common phrase, "food is medicine." Many highly ranked culturally important food species are also noted for their medicinal qualities (with medicinal use being ranked first in use category (30.8%)). Culturally important species are found in a variety of habitats, with different degrees of human interaction, providing accessibility during times of need or disturbance. Various regional changes, including lasting reverberations of colonial policies, commercial harvesting, illegal logging, and climate change are impacting the landscape with its effects cascading to culturally important species, which also have economic importance (*Arnica montana*, *Gentiana lutea*, *Rhodiola rosea*, *Cetraria islandica*). Comparing ethnographic data to our findings on a species-by-species basis of noted fallback foods of the past show that many fallback foods have maintained cultural importance in the day-to-day lives of Hutsul community members, exhibiting a diversity of uses, while also serving as nutrient-dense foods in times of scarcity, uncertainty, and regional disturbance.

It is this deep emergent response to disturbances, resultant of years of tumult seen through world wars, food shortages, shifting borders, colonialism, that drives resilience-thinking and action. The term resilience was first framed within boreal ecosystem functioning, attributed to Crawford Holling (1973). Ecosystems retain a type of cyclical nature with an emphasis on persistence, change and unpredictability - elements embraced by modern adaptive management philosophy (Sterk et al., 2017). Socio-ecological resilience became defined as the "capacity of a [social-ecological] system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Holling, 2001; Berkes et al., 2003; Folke, 2006). Socio-ecological resilience, as it emerged in both discourse and reality, became a community of practice that engages both ecological and social sciences.

A resilience-based approach includes mitigating disturbances by strengthening and encouraging the self-healing capacity of ecosystems. Resilience looks directly into the face of change, crisis and uncertainty, as embedded parts of life. Ecosystems continually adapt to disturbances at various scales and cannot be managed formulaically to maintain optimal levels of functioning (Bottom et al. 2009). It is the coupling and intertwining of both spheres, social and ecological, that elicits the complexity in understanding the dynamics of resilience in the region. In this case, the question is: how do Hutsul communities maintain livelihoods and self-determination in acquiring healthy and culturally appropriate food (culturally important species) in the face of these disturbances?

4.1 The Role of Traditional Ecological Knowledge

Traditional ecological knowledge (TEK) in the region informs adaptive capacity through short-term (coping mechanisms) and long-term responses (adaptive strategies). As noted in the methods, interviews were conducted in Ukrainian, while participants responded both in Ukrainian and Hutsul. Language is a critical part of memory formation; culturally distinctive values, knowledge, meanings, and worldviews transit and emerge through language (Simpson, 2004). How do Hutsul names relate to the environment? In Table 3.7, names allude to plant phenology, habitat, physical characteristics, medicinal qualities, gathering cues, taste as well as stories of colonial invasions, and historical land uses. A more extensive look at Hutsul ecocultural names is in Appendix C.

Table 3.7. Ecocultural meanings of 10 Hutsul, local names.

Names	Hutsul Names - Translation	Ecological Context	Cultural Context
Common Name: Sweet flag Scientific name: *Acorus calamus* Hutsul name: татарске зілля; аїр болотний Standard Ukrainian name: Аїр тростиновий	"Татарске зілля" - Tatar potion/herb	Tatars, a Turkic ethnic group, relied on sweet flag to purify water and for this reason was carried on their conquests. Current research explores sweet flag's purification properties.	The story behind the introduction of this marsh plant in this region coincides with Tatar invasion of Ukraine, beginning in 1200s. It is used in tinctures, and helpful for treating stomach issues.
	"Аїр болотний" - marsh plant	Sweet flag grows in marshy areas.	
Common name: Bearberry Scientific name: *Arctostaphylos uva-ursi* Hutsul name: толокнянка Standard Ukrainian name: ведмежі вушка; мучниця звичайна; вапянка	"Толокнянка" - toloka	*Toloka* has two definitions: 1) a pasture for livestock near a home 2) collective mutual assistance within the community. This plant can be found on the toloka.	Toloka is rapid voluntary work done by community members on a toloka (pasture). In addition to having economic value, it is commonly used in tinctures to treat kidney problems.
Common name: Burr marigold Scientific name: *Bidens tripartite* Hutsul name: бабині воші; жидики Standard Ukrainian name: череда трироздільна	"Бабині воші" - lice	This name refers to the latching quality of the plant burrs on clothing.	The second term goes deeper, addressing the historical local, Hutsul xenophobic sentiment of Jewish populations present in the region in the 1930s. The term implies a similarity between Jewish populations and the quality of burr marigolds. Burr marigold is used to bath babies as an antiseptic.
	"Жидики" – little Jewish people (*diminuitive*)	The presence of Jewish populations in Hutsulshchyna.	
Common name: Fireweed Scientific name: *Chamaenerion angustifolium.* Hutsul name: іван чай,	"Іван чай"/ "Чайок" – John's tea	There is convergence of the feast day of a St. John the Baptist with the phenological timing of fireweed blooming	Fireweed is prepared as a medicinal tea and exceedingly more so in recent years due to its popularity on the internet.

Names	**Hutsul Names - Translation**	**Ecological Context**	**Cultural Context**
чайок, димник Standard Ukrainian name: хаменерій вузьколисти	“Димник” – little smoke (*diminuitive*)	This refers to the blooming characteristics of fireweed – “When it blooms, it comes up like smoke – so quickly and it spreads!” (Ivan R., 2018).	Since it is a pioneer species, Hutsuls note that fireweed grows were there was recent logging. This provides a gathering cue.
Common name: Icelandic moss Scientific name: *Cetraria islandica* Standard Ukrainian name: ісланских мох Hutsul name: полонинський грань, золотинь мох, гарячий камінь, вананец, баранчики	“Полонинський грань”- on the face of polonynas	Icelandic moss is found on the face of alpine pastures (called *polonynas*) and when the sun hits it, the moss is blinding. This quality is used as a sensory cue to find gathering places.	*Polonynas* are an important place in the Hutsul landscape. This lichen is considered a natural antibiotic and has great economic value.
	“Гарячий камінь” – hot stone	This name alludes to growing conditions. This moss grows on exposed (hot) rocks.	It also refers to its medicinal quality – treating fevers. It is used to make tea and helps with bronchitis.
Common name: Reindeer lichen Scientific name: *Cladonia rangiferina* Standard Ukrainian name: ягель Hutsul name: кашлянек, оленячий мох, баранець	“Кашлянек” – coughs	–	This lichen is a source of medicinal tea which facilitates coughing.
	“Оленячий мох” – deer moss	Deer eat this lichen as a source of nutrition.	
Common name: Horsetail Scientific name: *Equisetum arvense*. Standard Ukrainian name:	“Падиволос” – hair falls off	This name refers the plant’s anatomical characteristics. The leaves of the plant come off like hairs.	Culturally it is gathered and medicinally, it is used externally for the treatment of boils and sepsis.

Names	Hutsul Names - Translation	Ecological Context	Cultural Context
хвощ полевой Hutsul name: падиволос			
Common name: Alpine avens Scientific name: *Geum montanum* Standard Ukrainian name: сиверсія гірська Hutsul name: підойма, вівсик	"Підойма" – uplift	There is a story that highlights the timing of gathering, as well as preparation of tea.	Medicinally, alpine avens is uplifting, relieving tired muscles (inflammation).
Common name: Early-purple orchid Scientific name: *Orchis mascula* Standard Ukrainian name: зозулинець Hutsul name: люби мене, не покинь	"Люби мене, не покинь" – Love me, don't leave me	–	This name addresses its medicinal use entirely. Its romantic connotation aligns with its usage as an aphrodisiac for men.
Common name: Wild pear Scientific name: *Pyrus pyraster* Standard Ukrainian name: дика грушка Hutsul name: дичка; гнилички	"Дичка" – little wild one (diminutive) "Гнилички" – little rotten one" (diminutive)	Wild pear species is hardy – disease and frost resistant. Wild pears are the tastiest (sweetest) when they become overripe/rotten.	The wild species is valued over the cultivated species, hence its diminutive name – 'little wild one'. The relationship joining gathering time with taste preference is shown in the name – little rotten one.

Plants such as *Acorus calamus* and *Orchis mascula* (endangered) are culturally important naturalized plants brought to Hutsulshchyna through the Mongol invasions of the 1200s. The story behind the introduction of *Acorus calamus* in this region coincides with Tatar invasion, illuminating the ecological placement of this plant in Hutsul culture, as expressed in the local name, which translates to "Tatar potion/herb."

Other local species names are connected to landscape elements that are prevalent and distinctive in Hutsul lifeways, including "toloknyanka" (*Arctostaphylos uva-ursi*) and "polonynskyi hran" (*Cetraria islandica*). These plants are found, respectively, on *tolokas* and *polonynas*; culturally and biologically cultivated areas for centuries. As described in Table 3.1, *tolokas* are traditionally held pastures located typically on a nearby hillside from the home, and passed down from one generation to the next, ensuring both connection and access to land. *Polonynas* are summer alpine meadows, providing grazing for communal livestock, which produce culturally important dairy products. All livelihoods of Carpathian highland people are somehow tethered culturally or economically to the maintenance of *polonynas* (Geyer et al., 2011). This ecocultural memory is embedded in language and practiced through maintenance of *polonyna*s.

In forest-dependent communities, human interdependence with the land is nurtured and recognized daily – whether it is going to the communal hillside (*toloka*) to milk the cows, or to gather mushrooms for a religious meal in the surrounding conifer forests. Hutsul communities in the Carpathian Mountains have maintained and passed down many ecocultural memories, forming the foundation of traditional ecological knowledge. Ecocultural memory guides day-to-day practices, embedding TEK (traditional ecological knowledge) to place and culture.

TEK is embedded not only in the spoken language or words that are used to describe plants or landscapes; it is practiced through the acts of gathering and interacting with the local ecology.

Holidays, songs, traditional foods, embroidery, dance keep this memory living through practice. For example, memories are nested in family recipes of traditional foods derived from the landscape. The direct reliance and interactions with abundant ecosystems prove the importance of maintaining regional biodiversity, while community structure facilitates a self-reliant, socio-economic stability in the region.

Memories become lived experiences through practice and through active acknowledgement. A memory that fades, no longer exists in said reality. Additionally, a practice without memory also faces risk of extinction. Due to regional ecosystem, climatic and cultural changes, TEK can present itself in disjointed, incomplete ecocultural memories; memories that are not continuously or completely passed down from one generation to the next. For example, placing boughs of a sweet flag (*Acorus calamus),* branches of *Quercus robur* or branches of *Carpinus sp.* at the entrances and gates of houses on a holiday without knowing why, is an example of expressing an active, practice upheld by disjointed memory without context. Without TEK recognized and nurtured, contextualizing the past to forge a future can ultimately be challenging, ultimately leading to threats of TEK loss. TEK forges the coping mechanisms and adaptive strategies that emerge in maintaining a food system that culturally ties people, health, and land; TEK is the thread that unites ecosystem health and resilience to regional sustainability.

4.2 Adaptive Capacity in the Short-term: Coping Mechanisms

There are two distinctive responses to mitigate disturbances and support adaptive capacity: short-term (coping mechanisms) and long-term (adaptive strategies). TEK informs these responses, providing a basis for supporting food sovereignty. Two important coping mechanisms include: 1) modifying subsistence activity patterns, or changing how, where, and when to gather culturally important plants, and 2) incorporating a diversity of species use intensities at various landscape levels. These are adaptive, immediate responses based environmental changes mentioned above. They include shifts in climate patterns and logging practices, compounded by land degradation seen continuously through erosion (57.5% of territory), pollution (20% of territory) and flooding (12% of territory) (Dovbenko, 2014).

4.2.1 Modifying subsistence patterns

Increased seasonal variability and logging have caused local communities to adjust the timing of their seasonal gathering and garden planting. Phenological shifts in flowering, and extended rainy seasons as described by local experts have resulted in shifts in gathering practices of culturally important plants. Waiting has become a common coping strategy for community members as they inform one another on the status of flowering or fruiting of economically important species. Another response has been following plant communities, especially medicinal species, as they climb in elevation. Due to climatic shifts, certain species are now found at higher elevations (like *Arnica montana*), causing community members to hike to higher elevations to gather. The question of accessibility arises in response to climatic shifts impacting distance and time need to gather cultural important medicinal species for community members (See Chapter 2).

In addition to climatic changes, illegal logging remains a significant regional challenge, causing increased flooding and erosion in the last decade (Geyer et al., 2010; Soloviy et al., 2011). WWF Ukraine has determined that 44% of the timber harvested from the Carpathian Mountains and exported to the EU is illegal (2018), reinforcing the fact that sanctions for committing forest crimes remain unenforced. The use of multi-time satellite images, DNA and isotope analyses of wood and local activism has recently helped combat illegal logging in the region (Associação Natureza Portugal, 2020). In a recent study in Northern Bukovina in Ukraine, Hutsul knowledge holders stated that exploitation of forest resources is driven by immediate economic return, with logging companies harvesting timber year-round (Mattalia et al., 2021b). The impacts of illegal logging, as stated by Hutsul locals, encourages succession of species such as *Rubus idaeus, Rubus caesius, Vaccinium myrtillus, Chamaerion angustifolium, Orchis macula*, and *Aronia melanocarpa*. These culturally important species are used, appreciated, and gathered fairly frequently, for personal use and sold. However, community members note that species such as *Rubus caesius* can hinder forest growth and regeneration, and the gathering of these species helps manage forest health. Illegal logging also weakens mushroom growth and nutrient cycling, impacting cultural gathering of mushrooms. By modifying and continually adapting to both climate change and logging impacts within the region, coping mechanisms arise such as waiting, communicating with other community members, and shifting gathering practices to higher elevations.

4.2.2 Diversity of species use, intensity, and landscape use

Another coping mechanism includes varying the intensity of habitat use (temporally) as well as gathering culturally important species in various habitats (spatially). Communities are reliant on the diverse landscapes for their nutritional needs, spatially radiating from homes to gardens (whereby agroforestry techniques are employed), pastures, fields, *tolokas* (where grazing ensures plant diversity), meadows, woodlands, forests (providing firewood, plants, mushrooms), alpine meadows as well as culturally-tended alpine meadows called *polonynas* (which provide communal grazing and medicinal root plants), and more recently the incorporation of local, convenience stores. These radiating layers of habitats nest spatially, and vary in use intensity temporally. Some landscape levels (like gardens, pastures, woodlands, alpine meadows, meadows, *toloka*s, fields, and *polonynas*) are used more intensely in targeted seasons, ensuring time for regeneration and growth. Other levels (like forests and grocery stores) are used at a constant low intensity and require accounting of time and distance to resource. Each of these nested habitats provides a layer of redundancy, ensuring a societal effort to live sustainably within the limits of the environment, while actively monitoring habitat changes from season to season. Additionally, most culturally important species are found in a range of habitats with varying levels of human structuring, ensuring availability to communities (Figure 3.4). Diversification is a well-known risk-spreading strategy used to mitigate unexpected events and uncertainty (Kelly and Adger, 2000; Berkes and Jolly, 2001), by increasing system complexity (Sterk et al., 2017). By identifying potential food and medicinal resource redundancies and spreading out use intensities in a variety of habitats, coping mechanisms emerge, helping to secure both ecosystem and community survival.

Reliance on local forests, *tolokas*, fields, meadows, woodlands, and pastures requires observation of conditions and vegetative states of preferred plants. If family pastures are maintained (*tolokas*), grazing and milking of livestock requires interaction with landscape and observation of ecological and weather changes. Dialogue between locals and their surrounding forests occurs ritualistically with sharing traditional meals (made from culturally important species) as well as observation of specific Holy days that integrate blessing of these species (Stryamets et al. 2021b). For example, August is a particularly important month for the blessing of healing herbs, plants, flowers, and grain, which coincides with the time where most herbs, flowers, stems, leaves, and roots are collected. Among many observed holy days, there are four holy days that occur in the summer that integrate plant use into Christian church ritual (August 9, August 14, August 19, August 28). There is acknowledgement of the importance of the environment in daily nourishment as seen through community gatherings on church holy days (Figure 3.5). These coping mechanisms are crucial for building socioecological resilience within food systems. They address community needs to maintain diversity, redundancy of species' uses and landscape types, while managing connectivity of culturally important species and people through holidays, song, and traditional food; Ultimately, holidays act as mechanisms to maintain ecocultural memory, keeping TEK alive.

4.3 Adaptive Capacity in the long-term: Adaptive Strategies

While coping mechanisms play an immediate, responsive role in maintaining resilience, Hutsul communities have also integrated long-term adaptive strategies. These strategies include modifying rules and institutions to ensure livelihoods (specifically access to culturally appropriate and healthy foods). Adaptive strategies are grounded in TEK (tested and adapted ecocultural memories), slowly changing, and emerging at larger spatial scales. In their work in Arctic communities, scholars including Krupnik and Jolly (2002) among others present two adaptive strategies including 3) inter-community trade as well as 4) social networks to provide mutual support (Krupnik, 1993; Freeman, 1996; Berkes and Jolly, 2001; Galappaththi et al., 2019). In the context of this study, intercommunity trade is expressed through the economy of gathering, and the interdependence of social networks in the integration of fallback foods.

4.3.1 An Economy of Gathering

The act of gathering plants (specifically berries) and mushrooms for personal use in Ukraine is embedded in seasonal and holiday rhythms, with harvesting carried out mainly from spring until autumn. With the rise of the COVID-19 pandemic, there has been an uptick of families picking and selling mushrooms (Yarmosky, 2020). In the forests of Ukraine, 25 tons of birch juice are harvested annually, 150 tons of commercial honey, more than 7,000 tons of dried mushrooms, 7 thousand tons of wild fruits and berries, as well as 5 thousand tons of medicinal plants (FAO, 2008). Hutsulshchyna is considered one of the most economically depressed regions of Ukraine and the gathering and selling of medicinal roots and berries is common. Gathering and selling of wild species has intensified since the collapse of the Soviet Union in 1991 (Stryamets et al., 2015). With current high unemployment rates in the region exacerbated by the pandemic, locals continue to rely on gathering and selling wild food species. More than half of local Hutsuls in interviews described the economic and cultural value of gathering plants - an *economy of gathering*.

Species that are culturally, nutritionally, and economically valued can be split into the following categories: mushrooms, lichens, berries, and roots. Many of these species are found on *polonynas*, alpine meadows and forests. The more remote a village is from roadsides and grocery stores, the more gathering for personal use (medicinal and food purposes) is practiced. Often these species are also collected for further sale. Not only does gathering provide food and medicine; it is also a cultural activity that upholds personal and community wellbeing through religious ceremonies, harvesting, and processing, while building and maintaining community relationships (Lynn et al., 2013). These types of food systems not only provide medicinal and nutritional needs, but also present an active opportunity to connect with the land, which in turn allows community members to, quite literally, nourish one another.

As mentioned earlier, gathering at different seasons diversifies the timing of impacts on landscape, allowing for regeneration and growth. Additionally, there is an understanding that each year's harvests will be variable and subject to change based on impacts of externalities (weather, commercial harvesting, pests, phenology, etc.) In terms of providing supplemental income, the sale of all these species helps subsidize costs to buying other food items, school supplies, clothing, and household cleaning supplies. Forest species are used primarily for filling income gaps, which is a continuous cycle. In a recent study analyzing Hutsul forest use in Northern Bukovina (Ukraine) versus Southern Bukovina (Romania), Hutsuls in Ukraine expressed more dependence on forests, stating that selling berries and mushrooms was a primary source of income (Mattalia et al., 2021b).

In this collaborative study, the *economy of gathering,* as an adaptive strategy, also underlines Hutsul forest dependence, promotes trade within and beyond communities, and allows for the supplementation of income while also recognizing the variability of local markets based on seasonal cycles of harvest and resource use.

While the *economy of gathering* provides a local flow of income, is important to note an external force in the region - commercial harvesting. Locals noted a rise of commercial berry (*Vaccinium myrtillus*) and medicinal plant harvesting in the Carpathian Mountain region. *Arnica montana*, a plant prevalent in local markets, is also noted to have suffered a population decline due to the over-harvesting. In addition, there has been a rise of commercial harvesting of endangered plants such as *Rhodiola rosea* and *Gentiana lutea*. *Rhodiola rosea* has been greatly impacted due to industrial production, with tinctures being very popular. However, as noted by elders, *Rhodiola rosea* roots need 3-4 years to mature and, because of early harvesting, local plant populations have diminished. In addition, international medicinal plant companies have shown a growing interest in harvesting medicinal plants in the Carpathians and target vulnerable plant species. To address the demand for medicinal plants, various national parks have integrated the development of medicinal plant plantations to offset the endangered status of native medicinal plants such as *Arnica montana* and *Rhodiola rosea*. As stated by a local park authority, these plants are grown in controlled outdoor environments and, for tinctures to be as effective, proportions need to be amplified by 20-30% in tinctures to be just as effective as wild plant harvests. External commercial harvesting of culturally relevant plants such as *Arnica montana, Rhodiola rosea* and *Gentiana lutea* in Hutsulshchyna, in addition to regional impacts of illegal logging and climate change present layers of complexity in retaining local social resilience.

There is a tension between local economies (an *economy of gathering*) and external economies (including but not limited to commercial harvesting). As explained by numerous elders, "once gathering becomes a business, there [also] appears a consumer and corporate interest." Most elders in the region adamantly oppose putting medicinal plants in the rank of industrial production due to accompanying habitat destruction. Intensive commercial harvesting in the region began 20-30 years ago and has impacted the region and endemic plant populations. There is a local saying, "After me, [there will be] a flood," reflecting the business-driven aspect of over-harvesting. It implies that environmental destruction is an inevitable result of corporate presence. Both logging and increased mean temperatures increase erosion, causing an uptick of hydrological events such as flooding in the region (Farley et al., 2009; Geyer, 2011). In terms of maintaining resilience, the local economy of gathering is reliant on a broad range of species inhabiting a range of environments both temporally and spatially, and invites a constant dialogue between communities and the landscape. Additionally, local gathering is based upon gathering methods that are selective and specific to the species. Yearly harvests of locally gathered species are variable and reflective of the current state of ecosystem functioning. This knowledge is embedded within the local communities and serves as a participatory method of resource monitoring. Local, place-based economies are resilient by nature, while extractive economies tend to be divorced of the immediate needs, values, and ecocultural memories of locals reliant on those landscapes.

4.3.2 Fallback Foods: Reinforcing traditional ecological knowledge (TEK) and traditional foods

Fallback foods are yet another adaptive strategy. Fallback foods consist of mostly plant species that serve as nutritional support during times of restricted movement during war, crop failure, weather (flood), and disease. Many of these species are still culturally important and provide a variety of functions in the nested habitats in the Carpathian Mountains for at least the last century. During the famines of the 19th and 20th centuries, gathering of wild species provided a source of medicine and food for Ukraine (Komendar, 1971).

Hutsulshchyna has experienced social and environmental disturbances due to the impacts of war, colonial occupations, and violence. This region has experienced battles with invasions from the Tartar hordes (1000s), the Polish regime (1340), and the Austrian-Hungarian Empire (1780s-1918). In the interwar period, Hutsulshchyna was divided at the borders with the central part belonging to Poland, the southern and eastern part under Romania, and the western part under Czechoslovakia (Figlus, 2009). The part of Hutsulshchyna in this study was under Poland (1919-1939), then German occupation (1939-1943) and then Soviet Union (1943-1991).

Political boundaries running through the territory have had less effect on Hutsul unity since it is the mountains that form the natural boundary among states, not the artificial lines drawn through it (Domashevsky, 1985). The geography of the Carpathian Mountains served as a buffer up until late 1930s against political terrors, war, genocide, and violence waged in Ukraine by German Nazis, Soviet Communists and Russian czars. The Austrian-Hungarian colonization of Hutsulshchyna meant that this region was spared from the Holodomor (meaning 'death by starvation') of 1932-1933, a Soviet-Russian orchestrated genocide in Central and Eastern Ukraine (Klid and Motyl, 2012; Bezo and Maggi, 2015). However, in interviews, elders mentioned that another Soviet famine of 1946-1947 affecting Ukraine, Moldova, Russia, and Belarus (Gráda, 2015), caused an influx of Moldovans to migrate to the Carpathian Mountains. These demographic shifts caused more reliance on neighboring ecologies and plant usage.

Many fallback species documented during famine or war in the early 20th century are still embedded in use today. While literature highlights a deep history of berry and mushroom reliance during times of scarcity in Ukraine, finding information on fallback foods in Hutsulshchyna is both scattered and primarily written in Polish. Hutsulshchyna, along with Western Ukraine, was under Polish Republic rule from 1918-1939 and books by Ukrainian authors were censored (Gráda, 2015) and scholarly ethnographic works were mainly published in Polish. In the postwar years, literature surrounding Hutsulshchyna was written but there is practically no focus on foods. Finally, most Hutsul TEK is passed down generationally and infrequently documented in written form. It is important to note that there is rich knowledge embedded in the daily rhythms of life that cannot be captured in an extensive literature review or interviews. This knowledge has survived and thrived despite colonization, famine, and war. Here, we offer a sliver of ecocultural memory of fallback foods in Hutsulshchyna.

Many of the species mentioned as fallback foods by Polish ethnographers in the early 20th century are still used in diverse ways (Table 3.6). It is frequently during times of scarcity that species use transitions from a medicine or seasoning to a food. Knowledge of plant use transformation is embedded in ecocultural memory. Interestingly, according to Lukasz' analysis of Fischer's work, as early as 1934, memory of wild plants used in times of shortage was fading and respondents spoke about using fallback foods in both past and present tenses (2008). However, in Hutsul counties of 1934, the people talked about fallback foods being used presently in 94% of places. Many of these same plants are still used today. Past uses inform present formation and retention of ecocultural memory, thus propelling and ensuring future sustainability. In this case, there is little distinction between specific fallback foods used only during times of scarcity and those used today. Instead, these critical species are nested within everyday cultural uses of medicine, seasoning and food, thereby ensuring a long-term adaptive strategy.

4.4 Proof of Food Sovereignty: Presence of Traditional Foods

Short-term responses (coping mechanisms) and long-term responses (adaptive strategies) result the cultivation of food sovereignty as seen in traditional foods in the region. In rural Hutsulshchyna, households produce most of their own food, relying on various ecosystems. In Ivano-Frankivsk province, which encompasses the area of the Hutsulshchyna in this study, 42.8% of average monthly monetary expenditure is spent on food and non-alcoholic drinks (Babych and Kovalenko, 2018). In addition to gathering wild species from a range of multi-functional landscapes, livelihood is also composed of community-derived resources including agricultural animals (primarily cattle, cows, pigs, goats, and chickens), supplying both dairy and meat. Rivers and ponds provide opportunities for fishing. Beekeeping is a common activity, with the endemic Carpathian bee (*Apis mellifera carnica*) providing honey. Grazing occurs on pastures, fields, *polonynas*, *tolokas*, gardens and forests. Gardens typically contain a variety of trees including sweet cherry, cherry, plum, apricot, apple, pear, nut trees along with perennial bushes including strawberry, raspberry, currant, gooseberry and grape. In the Carpathian Mountains, home gardens provide a source of food and medicine. These microenvironments within the agroecosystem create another function and layer of resilience in a larger ecosystem. They act as centers of experimentation, introduction, and crop improvement. In some cases, elders mention transplanting wild plant species into their own home gardens including *Fragaria vesca* and medicinal root species such as *Rhodiola rosea a*nd *Arnica montana*. Hutsul dialogue with diverse habitats is maintained seasonally; during times of harvest of wild plants and mushrooms (typically summer and early fall) as well as during plowing, sowing, and harvesting of home gardens. It is the maintenance of traditional foods that reaffirm both sustenance and cultural connections to various ecosystems for Hutsuls, forest-dependent communities in the Carpathian region.

Culturally important species are used in a variety of traditional foods. Many commonly gathered berry species are traditional foods including Vaccinium species (*V. myrtillus, V. Vitis-idaea*), Rubus species (*R. idaeus, R. caesius*), Ribes species (*R. nigrum, R. uva-crispa*), *Fragaria vesca, Sambucus nigra, Aronia melanocarpa,* and *Sorbus aucuparia*. Berries are eaten fresh, frozen, and dried, or cooked into jams, jellies, fillings for traditional dumplings, syrups, and sauces, or used in recreational drinks including fermented kvass, as well as juice, uzvar (a compote), and wine. The culturally important bilberry (*Vaccinium myrtillus*) is cooked into *varenyky* (dumplings), and used as a flavoring in alcoholic tinctures, fruits, and juice. In terms of health benefits, there are diverse phytochemicals present in berries, specifically wild berries of the *Vaccinium* genus, which are seasonally harvested. Wild *Vaccininum* berry species are renowned for their high concentrations of phenolic and polyphenolic compounds that interact to improve human health (Grace et al., 2014). In addition to berries providing a source of vitamins and medicine, they also infuse an array of flavor to teas, recreational drinks, jams, and jellies. Raspberries are consumed recreationally, and their leaves, stem, and berries used as a medicinal tea. Wild raspberries have slightly better medicinal properties, taste, and aroma than garden raspberries. Chokeberry (*Aronia melanocarpa*) has a wide range of uses including consumption as a fruit, tea, kvass, wine and as a medicinal tincture.

Hutsul traditional dishes incorporate an important dairy product from *polonynas,* (*polonynska bryndza*), a cheese made from Carpathian cows or sheep, and as well as many mushroom species (particularly *Boletus edulis* and *Cantharellus ciborium*). Mushrooms are used traditionally in cooking and in holiday meals (Figure 3.5). Most people and families go out and gather mushrooms in summer and fall, a recreational and seasonal intergenerational activity. For example, one elder mentioned, “I take my grandson and we go together to pick mushrooms. I show him the place where mushrooms grow." [Mykola (L.)] Mushrooms also serve as an important food source, being very popular during winter holidays, where large quantities of marinated mushrooms, and mushroom dishes are made. Mushrooms are added to traditional dishes including *banosh* and *kulesha*. The main components of *banosh* and *kulesha* are corn flour (*Zea mays*) and *polonynska bryndza* (cheese made from *polonyna*) (Figure 3.5). Both traditional dishes serve as a base to add either berries or mushrooms, depending on the holiday. Forest mushroom soup is also a very common first course and has long been a part of the Hutsul, traditional diet. During specific Christian holidays, fasting is a practice and "it is important for people to stock with dried mushrooms." [Katya (K).] Mushroom hunting is embedded in Ukrainian culture overall (seen in traditional foods) but even more so in the Carpathian forests, where these mushrooms grow.

Figure 3.5. A – Local gathering trip (summer 2018) Mushrooms seen in this photo include red pine mushroom (*Lactarius deliciosus)*, birch bolete *(Leccinum scabrum)* and Bare-toothed Russula (*Russula vesca*). (Photo: N. Fontana). B –Traditional celebration basket with fruits, berries (*Rubus fruticosus*) and flowers on August 19th, Apple Spas, an Eastern Slavic folk holiday. (Photo: Mariia Pasailiuk). C – Traditional Food: *Kulesh* prepared from corn flour and *polonynska bryndza* (cheese made from sheep on the *polonyna*). (Photo: Oleh Pohribnyi). D –Traditional Food: Holubtsi – stuffed cabbage rolls (Photo: Mariia Pasailiuk).

4.5 *Polonynas*: The Link between Ecology and Traditional food

The role of *polonynas* (transhumance) in Hutsul landscape is intertwined with traditional foods, specifically in the making of sheep's cheese (Figure 3.5). *Polonynska bryndza* is made during the summer months (June through September) and obtained from milk of local Carpathian sheep or cows. The process of making bryndza is at least a 600-year-old tradition, and is deeply intertwined with traditional food and landscape, specifically high meadows, called *polonynas* (at least 700 meters above sea level). This tradition, passed down from generation to generation, preserves ecocultural memories tied to plant and lichen species found in *polonynas* as well the process of making *polonynska bryndza*.

As noted in the introduction, the decline of *polonynas* is linked to cattle population decline after the collapse of the Soviet Union, when keeping cattle became economically difficult and expensive. Due to this decline, it is synergistically changing the landscape and its floral diversity, leading to overgrowth. Without grazers and active tending of the land, this biocultural reservoir faces loss. The decline of livestock numbers and *polonyna* pasture use is directly related to intergenerational decline of interest and low economic competitiveness, as well as the time constraints on working populations (Bitter and Bomba, 2008). This has rippled down to demographic shifts and work migration seen Hutsulshchyna. Migration was observed in many of the villages visited, where residents migrate seasonally to work in Poland, Russia or Western Europe with predominant sectors being seasonal agricultural work, construction, and service (Zhyla et al., 2014). Government subsidies to uphold Hutsul pastoral traditions are nonexistent in Ukraine. One recent positive development in 2020 that works to preserve *bryndza*, and by proxy, *polonynas*, is the European Union's incorporation of bryndza as a geographical indicator. The EU states use a system of protected geographical indicators, which include names that are applied to products made within a specific area (like "champagne" in Champagne, France) (Druzhuk, 2020). It is the ecological processes within the landscape, climate, and soil that ensures the tradition, and its perpetuation of local economy within the region and unique taste. This is the first product in Ukraine with this geographical indication mark, ensuring its authenticity, promotion on the economic market, and guaranteeing its quality.

Traditional foods in Hutsulshchyna are tethered to the landscape and the various habitats that species are found. Many berry species provide critical nutrition in the form of food, as well as medicinal, economic, and ecological importance. Bilberry (*Vaccinium myrtillus*) and raspberry (*Rubus ideaus*) are considered the most culturally important plants. Mushrooms, such as penny bun and chanterelles, are highly sought after and a critical food source, especially during the winter religious season. *Polonynas*, as a critical and culturally significant habitat in Hutsulshchyna, are concretely linked to the traditional food of *bryndza*, as well as many other culturally important plants (Figure 3.5); their survivals interlinked. The significance of the EU's incorporation of *bryndza* as a geographical indicator provides a layer of resilience in maintaining these practices and thus ensuring food sovereignty.

5. Conclusion

Attributes of socio-ecological resilience include adaptive capacity, which consists of both short-term, immediate responses (called coping strategies) and long-term, culturally valued responses (called adaptive strategies). TEK, formed through ecocultural memories, is an active reflex of acknowledging rootedness to place through language, practice, and local ecologies, ultimately sustaining the adaptive capacity of Hutsul communities to survive world wars, food shortages, shifting borders, long-lasting impacts of colonialism as well as current environmental challenges. Ecocultural memories thread together to form a dynamic knowledge base called TEK, which provides a continual opportunity for knowledge sharing within communities. It can be seen as a time-tested, repeated, readjusted knowledge base resulting in resilience. Coping strategies include gathering a diversity of foods (culturally important species) from a diversity of habitats, mitigating the possibility of food scarcity by redistributing reliance on any one habitat type or food source. Another coping strategy includes modifying and continually adapting harvesting of where, when, and how of culturally important species are gathered, dependent on disturbances and climatic changes. Adaptive strategies include an *economy of gathering* which provides a diversified way of supplementing income and personal needs, while providing trade between communities. Additionally, fallback foods used in the early 20th century are still used today, with uses transforming from medicine or seasoning to food, under times of stress. Fallback foods provide a built-in coping capacity to overcome future adversities. It is the integration of coping mechanisms and adaptive strategies that provide the pathway to maintaining traditional foods in the region, which explicitly connect people to place through religious holidays, meal sharing, and customs. Food sovereignty is an emergent characteristic of community-driven, sustainably maintained ecosystems that provide culturally relevant sustenance, nurturing both community and landscape.

6. References

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