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Investigation into anthropogenic pressures and assessment of ethnobotanical insights regarding *Berberis* spp. across traditional landscape of Karakorum Mountain Ranges

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Key words: Berberis, Anthropogenic pressure, Natural resources, Medicinal Plants, Ethnobotany, Karakoram, Critically endangered.

Abstract

Present study was aimed at assessment of anthropogenic pressures and documentation of ethnobotanical wisdom regarding Berberis species in traditional landscape of Karakoram Mountain Ranges. Cultural transformation has drastically declined ethnobotanical wisdom and human negligence and increasing pressures have made Berberis threatened (n=102; 27.3%). Using a stratified random sampling tools and techniques, 373 people were interviewed. 92.2% (SE±0.057) people use Berberis for medicinal purpose. Similarly, 19.3% (SE±37.375) for firewood, 2.41% (SE±1.692) commercial, 2.41% cultural, 16.08% fodder (SE±11.474), 19.03% fencing (SE±6.895) and 100% grazing (SE±1.035). Every year a total of 19.428 metric tons (MT) of Berberis is used for medicinal, firewood, commercial, fodder and fences purposes. Descriptive and inferential techniques were employed to analyze data. Rampant unwise developmental activities(-30.77%) and unchecked grazing (-22.12%) are key depressing forces against Berberis population. Berberis species have become critically endangered in the area. Moreover, community perceptions are also beriberi-phobic (anti-Berberis). Negligence on this part may potentially ruinous for its existence.

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Introduction

Berberis is one of the important medicinal plant used as a very common ingredient in herbal medication systems viz; Eastern, Ayurvedic, Unani and modern system of medicines (Sing *et al*., 2008, Chopra *et al*., 1981; Chandra and Purohit, 1980). It has been reported useful in treatment of cancer, diabetes, jaundice, enlargement of spleen, AIDS, osteoporosis, cardiovascular ailments, ocular trachoma, hypertension, infectious diseases, cholera, diarrhea, dysentery, eye troubles, leprosy and bone fractures etc. (Khan *et al*., 2013; Sing *et al*., 2008; Asif *et al*., 2007; Fatehi *et al*., 2005; Caraballo *et al*., 2004; Kuo *et al*., 2004; Villinski *et al*., 2003; Janbaza and Gilanib, 2000; Hwang *et al*., 2002; Ivanoska and Philipov, 1997; Koo and Seang, 1996; Chopra *et al*., 1981; Chandra and Purohit, 1980).

Genus Berberis is the most pronounced among other 13 established genera of the family, Berberidaceae. It has more than 650 species (Khan et. al. 2014; Perveen and Qaiser 2010; Bottini *et al*. 2007; Duke *et al*. 2002; Loconte, 1993; Loconte, 1984). There are 29 Berberis species have been reported from Pakistan. Berberis predominantly distributed across Northern hemisphere (Perveen and Qaiser 2010; Loconte, 1993). Since 1935 several Berberis species have been reported from Karakoram Range and rest of Gilgit-Baltistan. However, most of the reports are contradictory and need detailed investigation (Khan *et al*. 2014). *Berberis pseudumbellata* subsp. *gilgitica* is endemic to Gilgit-Baltistan and has become critically endangered (Alam and Ali 2010).

Ethnobotanical investigation is important to understand socio-cultural significance of plant species (El-Hilaly *et al*. 2003; Sheng-Ji 2001; Phillips and Gentry 1993; Sher and Hussain 2009). However, these studies require more detailed, focused and quantified, revealing important and reliable insights (Deil *et al*. 2005; Taylor *et al*. 2001). Such a study will help to establish and build on multifaceted aspects viz; ecological, economic, cultural, social and academic advancement in creation of alternatives towards health care practices (Garrity 2004; Roe and Elliott 2004; Scherl 2004; Reynolds *et al*. 2005). Rural life along these naturally variegated landscapes is integrally intertwined with plants. Living close to wild nature is a wealth bestowed upon these traditional communities and therefore, they rely on indigenous resources for their medicinal, food, shelter, economic and other livelihood needs (Ali *et al*. 2008; Khan and Khatoon 2007; Pie and Manandhar 1987).

Folk wisdom around the world is on decline (Khan *et al*. 2013; Sheng-Ji 2001; Begossi *et al*. 2002; Case *et al*. 2005; Lozada *et al*. 2006; Monteiro *et al*. 2006; Ferguson and Messier 1997; Pieroni *et al*. 2004; Shanley and Rosa 2004; Anderson 2005; Zent 2001; Turner and Turner 2008; Khan *et al*. 2013; Hamayaun 2005) and Karakorum ranges are not an exception to this. Khan *et al*. (2013) reported that people in Hunza Valley currently show extremely low (1.4%) dependency on traditional medication practices in contrast to Hocking's report of 1958 revealing that people among these traditional communities were heavily (84%) dependent on their indigenous folk medication. It is therefore, in prevailing situations, these cultures under rapid transition need special attention to explore them scientifically (Qureshi *et al*., 2006). Any delay on this part can lead to their annihilation in the hands of weathering forces of globalization.

Study was intended at documentation of ethnobotanical knowledge of Berberis, exploration of different perceptions, investigation of diverse practices and looking at potential prospects of Berberis species among cultural communities of Karakoram Mountain Ranges.

Material and methods

Geographical scope

Study was carried out in three major valleys of Central Karakoram National Park (CKNP). These valleys are Bagrot, Rahimabad-Naltar and Rakaposhi (Nagar). Out of several other valleys in CKNP, study

area constitutes western part of the park covering at least 30-35% of total buffer zone settlements (Fig. 1). Study was conducted during 2012-14. It is the largest protected area (10,000 km²) in Pakistan having unique biotic, geological and glacial features of global importance. It extends over 35°N to 36.5°N (latitude) and from 74°E to 77°E (longitude) (Khan *et al*. 2014).

Cultural landscape

In the study area, there are at least 16 major tribes speaking four different vernaculars i.e. Shina, Brushaski, Gujari, Domaki. Shina is most widely (70-75%) spoken dialect across study area. There are sparsely distributed settlements of small (less than 100 households) and medium sized (more than 100 and less than 1000 households). Settlements stretch along elevation starting from 1300 m and reach up to 3500 m above sea level. Most recently, communication networks are reaching to remote villages but there are some villages which are inaccessible with cars of any type. However, forces of globalization and commercialization have already started their social transformation phenomenon. Livelihood preferences and social dynamics are changing every day. Synthetic products replace indigenous naturally customized products and practices too.

Fig. 1

Sampling

***Sample frame*:** Sample frame was consisting upon three (3) major valleys stretched over 27 villages with 5480 households. A total of 52,048 souls are living in the study area. Population is living in small and medium sized settlements (villages) with dense or sparse distribution.

***Sample size*:** Using following mathematical calculations and sample size (ss) calculator a total of 382 (male 197, 52.81%; female 176, 47.18%) sample size was calculated. However, during the course of study only 373 individuals were interviewed. This makes 97.6% of the total sample size drawn. Sample size (both male and female) was divided into three age groups each making a total of six (6) different groups i.e. below thirty (≤30 = 130, 34.85%), in-between 31 and 60 (≥31≤60 = 143, 38.33%) and above 61 (≥61 = 100, 26.80%).

Sample size calculations

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

where

Z = Z value (e.g. 1.96 for 95% confidence level)

p = percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

c = confidence interval, expressed as decimal (e.g., 0.04 = ±4)

***Sampling type*:** During the survey, stratified random sampling technique was employed across purposefully categorized geographic, gender and age strata.

Data collection: A detailed structured instrument was used to collect uniform data from different strata of sample. Personal observations were also recorded to supplement the questionnaire data collection (Kvist *et al*. 2001). Questionnaire was oriented to maximize quantification of responses (Fraser and Junqueira 2010).

Data processing and analysis

Data gathered using instrument was digitized into MS Excel 2010 and then transferred to SPSS v.16.1. Various descriptive and inferential techniques were applied to analyze data including frequencies, standard error of mean, Pearson correlational coefficient, student t-test and regression analysis were performed.

Results and discussion

Ethnobotanical consumptions categories

Communities in the study area use Berberis for various reasons and purposes. These needs can be categorized into at least six (6) broad classes viz; medicinal, firewood, fencing, grazing, fodder, commercial and cultural. Culture use in negligible and infrequent (n=9; 2.41%). Research did not find any use of Berberis for construction. Details of remaining five categories are given below;

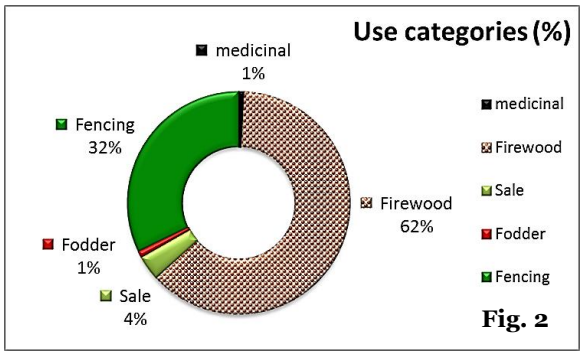

Fig. 2

Ethnomedication

Interviewee identified 28 distinct quantities used differentially as medicine. Most frequent annually used quantities are; 1.4 kg (n=119, 33.9 %), 1.0 kg (n=54, 15.5%), 0.25 kg (n=47, 13.4%) and 0.5 kg (n=25, 7.1%). Remaining 24 varied categories ranging from 0.019 kg to 6.8 kg, which are uncommon. On an average each household in the area uses 1.17 kg annually (fig. 2).

Firewood

During the study 19.3% (n=72) responded to the question regarding Berberis quantities use for firewood purpose at household level. Respondents mentioned 11 different quantities. Among these 11 quantitative categories, 36 kg (n=24, 6.4% and valid % = 33.3) is the most frequent quantity used among the communities followed by 10 kg (n=19, 5.1% and valid % = 26.4) and 15 kg (n=9, 2.4% and valid % =12.5). Remaining quantitative categories used have less than 1% (n ≤ 3, and valid % ≤ 4.2) for each. Data representation shows that people most commonly use quantities in-between 10 kg and 36 kg for their fire purpose at houses (Fig. 3). In the valley of Bagrot a total of 2244.8 kg (2.244 MT, 34.02%) is used as firewood at household annually. Similarly, in Rahimabad-Naltar total quantity is 4311.6 kg (4.311 MT, 65.34%) and in Rakaposhi it is only 42 kg (0.63%).

Sale (Income generation)

Out of total (n=373) respondents, only 2.4% (n=9) interviewee replied to the question 'what quantities of Berberis they sell every year on an average?' 97.6% (n= 364) left this question without any reply, which was considered as missing data when processed using SPSS for calculations and analysis. These mottled quantities range in-between 1 kg and 12 kg. Moreover, these quantities are categorized into three (3) groups i.e. 1 kg, 3 kg and 12 kg. Out of total respondents which are more or less involve in sale of Berberis hold equal share of only 0.8% (n=3). A total sale during 2012-13 was only 48 kg. Among three major valleys, Bagrot 16 kg (33.33%) and Rahimabad-Naltar 32 kg (66.67%). This study did not record any sale in Nagar Valley (Fig. 3).

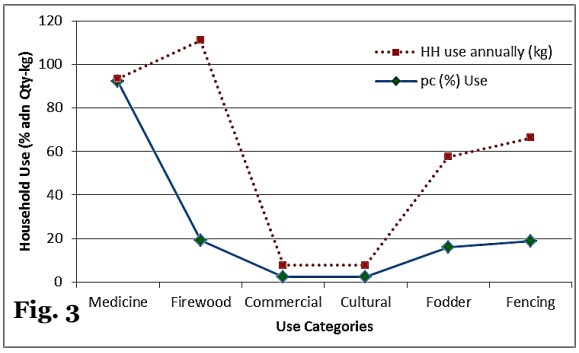

Fig. 3

Fodder

During the study only 16.1% (n=60) responded to the question. Amongst different quantities used, 150 kg (n=21, 35.0%), 180 kgs (n=6, 10%) and 300 kgs (n=6, 10%) per annum. Remaining categories were less common used by only 5% (n=3) each. A total of 8724 kg (8.724 MT) Berberis is collected every year for fodder purpose. Every year in Bagrot, 2908 kg (2.908 MT, 33.33%) and Rahimabad-Naltar 5486 kg (5.486 MT; 62.88%) is being collected. Nagar (Rakaposhi) valley as compared to others shows a least trend of

using Berberis as fodder i.e. 330 kg (3.78%) annually. Statistical presentation shows a positive but very weak correlation between fodder quantitative ranks and their use frequency. Communities more frequently use quantities ranging between 150-300 kg per annum (Fig. 3).

Fencing

Berberis use for fencing purpose is one of the major consumption sites. Out of total sample size (n=373) only 19.0% (n=71) responded on the question about Berberis quantities used for fencing. Ten different quantities so expressed range between 12 kg and 300 kg. among all 20 kg (n= 26, 7.0%; Valid percent 36.6%) is the most frequent consumption quantity followed by 72 kg (n= 15, 4.0%; Valid percent 21.1%), 25 kg (n=9, 2.4%; Valid percent 12.7%) and 15 kg (n=5, 1.3%; Valid percent 11.3%). Remaining six (6) categories showed lesser frequency (< n= 3, < 1.0%; Valid percent < 4.2%) of use. A total of 3352 kg (3.352 MT) is used annually in the area. Each major valley has a varied consumption of Berberis for fencing annually. Rahimabad-Naltar showed highest quantities used for this purpose (1680 kg=1.68 MT; 50.12%) followed by Bagrot Valley with second highest quantity (1164 kg = 1.164 MT; 34.73%). Nagar (Rakaposhi) Valley showed the least utilization of Berberis for fencing with a per annum quantity of 508 kg (0.508 MT; 15.16%).

Analysis shows a declining linear trend between consumption categories and their respective percentage frequency utilization. Moreover, there is a weak relationship between the two aspects of the parameter under discussion (Fig. 3).

Population change

For the last fifty (50) years, there is no change in Berberis population (n=200, 53.6%). However, 30.3% (n=113) still believe that population has changed. Furthermore, 16.1% (n=60) people told that they do not know whether it has changed or not.

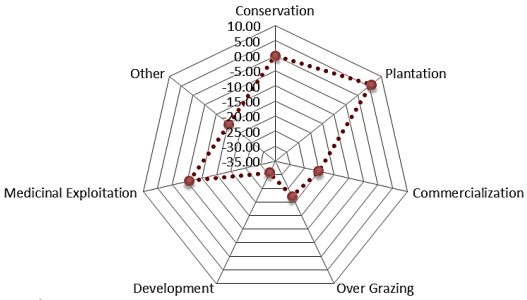

Fig. 4

Change direction: Out of change believers 12.9% (n=48) told that population has decreased significantly (Fig. 7). However, 14.5% (n=54) favor a slight decreased. Whereas, 2.1% (n=8) interviewee told that the population has increased significantly, for 1,6% (n=6) there is a slight increase in the population.

Factors of population change

Only 27.9% (n=104) respondents said that plantation (n=6:1.6%) has healthy contribution towards population growth. However, commercialization (n=21: 5.6%), over grazing (n=23: 6.2%), development activities (n=32: 8.6%), medicinal exploitation (n=6: 1.6%) and other (n=16: 4.3%) factors have negative impact. Population change factor analysis shows that developmental activities are the most ruinous factor followed by over grazing and commercialization, to name top three ones. This change has occurred across all varieties (general) and not to a specific variety. Moreover, this change is 94.23% unhealthy and only 5.76% healthy (Fig. 3).

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References

Alam J, Ali SI. 2010. Contribution to the red list of the Plants of Pakistan. Pakistan Journal of Botany **42(5),** 2967-2971

Ali M, Malik AR, Sharma KR. 2008. Vegetative propagation of Berberis aristata DC. An endangered Himalayan shrub. Journal of Medicinal Plants Research **2(12),** pp. 374-377.

Anderson TR. (2005). Plankton functional type modeling: running before we can walk? Journal of Plankton Research **27**, 1073-1081

Asif A, Kabub G, Mehmood S, Khunum R, Gulfraz M. 2007. Wound healing activity of root extract of Berberis Lyceum Royle in rats. Phytother. Research **21**, 589-591.

Begossi A, Hanazaki N, Tamashiro JY. 2002. Medicinal plants and the Atlantic Forest (Brazil): knowledge, use and conservation. Human Ecology **30**, 281-299.

Bottini MCJ, De Bustos A, Sanso AM, Jouve N, Poggio L. 2007. Relationships in Patagonian species of Berberis (Berberidaceae) based on the characterization of rDNA internal transcribed spacer sequences. Botanical Journal of the Linnean Society, **153(3),** 321-328. DOI: 10.1111/j.1095-8339.2007.00586.x

Caraballo A, Caraballo B, Rodríguez-Acosta A. 2004. Preliminary assessment of medicinal plants used as antimalarials in the southeastern Venezuelan Amazon. Revista da SociedadeBrasileira de Medicina Tropical **37(2),** 186–188.

Case RJ, Pauli GF, Soejarto DD. 2005. Factors in Maintaining Indigenous Knowledge among Ethnic Communities of Manus Island. Economic Botany **59**, 356–365.

Chandra P, Purohit AN. 1980. Berberine contents and alkaloid profile of Berberis species from different altitudes. Biochemical Systematics and Ecology **8(4),** 379–380.

Chopra M, Chatterji A, Pakrashi SC. 1981.The treatise on Indian medicinal plants CSIR, New Delhi, pp. 33-35.

Deil U, Culmsee H, Berriane M. 2005. Sacred Groves in Morocco: A Society's Conservation of nature for spiritual reasons'. Silva Carelica, **49**, 185-201.

Duke JA, Godwin MB, Decellier J, Duke PA. 2002. CRC- Hand Book on Medicinal Plants. Taylor and Francis. Inc pub.SBN-13, Edition 2, pp 821

El-Hilaly J, Hmammouchi M, Lyoussi B. 2003. Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). Journal of Ethnopharmacology, **86(2),** 149-158.

Fatehi M, Saleh TM, Fatehi-Hassanabad Z, Farrokhfal K, Jafarzadeh M, Davodi S. 2005. A pharmacological study on Berberis vulgaris fruit extract. Journal of Ethnopharmacology **102(1),** 46–52.

Fraser JA, Junqueira AB. 2010. How important is a use? Critical reflection on the conceptualization of use and importance in quantitative ethnomedicine In: UP Albuquerque, N Hanazaki (Eds.): Recent Development and Case Studies in Ethno medicine. Brazilian Society of Ethno-biology and Ethno-ecology: Publication Group of Ecology and Applied Ethno-medicine NUPEEA, pp. 113-126.

Ferguson M, Messier F. 1997. Collection and analysis of traditional ecological knowledge about a population of Arctic tundra caribou. Arctic, **50**, 17–28.

Garrity DP. 2004. Agroforestry and the achievement of the Millennium Development Goals. Agroforestry Systems, **61(1-3),** 5-17.

Hamayaun M. 2005. Ethnobotanical Studies of some Useful Shrubs and Trees of District Buner, NWFP, Pakistan. Ethnobotany leaflets.

Hocking GM. 1958. Pakistan Medicinal Plants I, Qualitas Plantarum Et. Material Vegetabiles., **5**, 145-153.

Hwang, Jin-Ming, Wang, Chau-Jong, Chou, Feu-Pi, Tseng, Tsui-Hwa, Hsieh, Yih-Shou, Lin, Wea-Lung, Chu, Chia-Yih. 2002. Inhibitory effect of Berberine on tert-butyl hydroperoxide induced oxidative damage in rat liver. Archives of Toxicology **76(11),** 664-670.

Ivanoska N, Philipov S. 1996. Study on the anti-inflammatory action of Berberis vulgaris root extracts, alkaloid fractions and pure alkaloid. International Journal of Immunopharmacology **18(10),** 553–561.

Janbaza KH, Gilanib AH. 2000. Studies on preventive and curative effects of Berberine on chemical-induced hepatotoxicity in rodents. Fitoterapia **71(1),** 25–33.

Kvist LP, Gram S, Cácares A, Ore I. 2001, 'Socio-economy of Flood Plain Households in the Peruvian Amazon', Forest Ecology and Management, **150**, 175–86

Khan SW, Khatoon S. 2007. Ethnobotanical Studies on useful trees and shrubs of Haramosh and Bagrot valleys, in Gilgit Northern Areas of Pakistan. Pakistan Journal of Botany **39(3),** 699-710.

Khan T, Khan IA, Ahmed K, Rehman A. 2014. Differential levels of susceptibility of Berberis species to insect attack at various altitudes in Karakoram Ranges. International Journal of Biosciences **4(5),** 92-101. DOI: http://dx.doi.org/10.12692/ijb/4.5.92-101

Khan T, Khan IA, Rehman A, Alam J, Ali S. 2013. Exploration of near-extinct folk wisdom on medicinally important plants from Shinaki Valley Hunza, Pakistan. International Journal of Biosciences **3(10),** 180-186.

Koo L, Seang K. 1996. Inhibitory effect of protoberberine alkaloids from the roots of Coptis japonica on chatecolamine biosynthesis in PC12 cells. PlantaMedica **62(1),** 31-34

Kuo CL, Chi CW, Liu TY. 2004. The anti-inflammatory potential of Berberine in vitro and in vivo. Cancer Letters **203(2),** 127–137.

Loconte H. 1993. Berberidaceae. The Families and Genera of Vascular Plants. II. Flowering Plants-Dicotyledons.(Eds.): K. Kubitzki, J.G. Rohwer & V. Bittrich. Springer-Verlag: Berlín.

Loconte H, Blackwell Jr WH. 1984. Berberidaceae of Ohio. Castanea, 39-43.

Lozada M, Ladio A, Weigandt M. 2006. Cultural transmission of ethnobotanical knowledge in a rural community of northwestern Patagonia, Argentina. Econ. Bot., **60**, 374ñ385.

Makkar HPS, Francis G, Becker K. 2007. Bioactivity of phytochemicals in some lesser-known plants and their effects and potential applications in livestock and aquaculture production systems.

Monteiro JM, Albuquerque AP, Lins-Neto EMF, Araújo EL, Amorim ELC 2006. Use patterns and knowledge of medicinal species among two rural communities in Brazil's semi-arid northeastern region. J Ethnopharmacol **105**, 173-186.

Perveen A, Qaiser M. (2010). Pollen flora of Pakistan–LXV. Berberidaceae. Pakistan Journal of Botany, **42(1),** 1-6.

Phillips O, Gentry AH. 1993. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany, **47(1),** 15-32.

Pie SJ, Manandhar NP. 1987. Sources of some local medicine in the Himalayan region. Himalayan Ecosys. p. 97-112.

Pieroni A, Quave C, Santoro R. 2004. Folk pharmaceutical knowledge in the territory of the Dolomiti Lucane, inland southern Italy. Journal of Ethnopharmacology **95**, 373–384.

Qureshi RA, Ahmah I, Ishtiaq M. 2006. Ethnobotany and phytosociological studies of Tehsil Gugar Khan district Rawalpindi, Pakistan. Asian J. Plant Sci., **5(5),** 890-893.

Reynolds SG, Batello C, Baas S, Mack S. 2005. Grassland and forage to improve livelihoods and reduce poverty. Grassland: A global resource. Wageningen Academic Publishers, Wageningen, the Netherlands, 323-338.

Roe D, Elliott J. 2004. Poverty reduction and biodiversity conservation: rebuilding the bridges. Oryx, **38(02),** 137-139.

Scherl LM. (Ed.). 2004. Can protected areas contribute to poverty reduction?: opportunities and limitations. IUCN.

Shanley P, Rosa NA. 2004. Eroding knowledge: An ethnobotanical inventory in eastern Amazonia's logging frontier. Economic Botany **58**, (2)135–160.

Sheng-Ji P. 2001. Ethnobotanical approaches of traditional medicine studies: some experiences from Asia. Pharmaceutical biology, **39**(s1), 74-79.

Sher H, Hussain F. 2009. Ethnobotanical evaluation of some plant resources in Northern part of Pakistan. African journal of Biotechnology, **8(17).**

Taylor JLS, Rabe T, McGaw LJ, Jäger AK, Van Staden J. 2001. Towards the scientific validation of traditional medicinal plants. Plant Growth Regulation, **34(1),** 23-37.

Turner NJ, Turner K. 2008. "Where our women used to get the food": cumulative effects and loss of ethnobotanical knowledge and practice; case study from coastal British Columbia. Botany **86**, 103–115.

Villinski RJ, Dumas ER, Chai HB, Pezzuto JM, Angerhofer CK, Gafner S. 2003. Antibacterial activity and alkaloid content of Berberis thunbergii, Berberis vulgaris and Hydrastiscanadensis. Pharmaceutical Biology **41(8),** 551-557.

Zent, S. 2001. Acculturation and ethnobotanical knowledge loss among the Piaroa of Venezuela: Demonstration of a quantitative method for the empirical study of traditional ecological knowledge change. In On biocultural diversity: Linking language, knowledge, and the environment. Maffi, L., editor. 190–211.Washington, D.C Smithsonian Institution Press.