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Studies on population change dynamics of critically endanger Berberis species in Karakoram Mountain Ranges: An ethnoecological perspective

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Abstract

Current biodiversity extinction rate is 100-1000 times than its natural background depletion trend. Similarly, ignorance towards timely management of critically endangered wild medicinal plants is the real cause of their loss. *Berberis pseudumbellata* subsp. *gilgitica* is an endemic highly valuable medicinal plant found across Karakoram landscape has become critically endangered. Survey study revealed that there are only 3110mature plants of Berberis species and struggle for its survival under several adverse ethno-ecological factors. Community attitude recorded is Berberi-phobic (77.4 %, hostile).Moreover, 30.3% (N=373, n=113) population believes that over the last 50 years, Berberis population has declined significantly. Developmental process has been the principal cause (n=32, -30.77%) of population retardation followed by overgrazing (n=23, -22.12%). In sum, 94.23% change agencies are hostile towards its population. Present research was aimed at evaluation of various change factors and their relative impact on population change dynamics of Berberis spp. over the last 50 years in Karakoram Mountain Ranges. Declining population of Berberis is a total result of anthropogenic pressures and climate change. More conservation efforts are to save critically endangered Berberis spp. within the park, Naltar conservancy and adjoining areas.

Key words : Berberis, Population change, Ethnoecology, Critically Endangered

INTRODUCTION

Berberis is the most pronounced genus in family Berberidaceae. More than 650 Berberis species have been identified around the world. Members of this genus are mostly distributed across northern hemisphere[1,2] . Mountainous areas of South Asia including Pakistan, India, China, Japan and Iran are the most Berberis rich habitat on the globe. It is therefore, Berberis has been integral part of their healthcare systems including Eastern, Ayurvedic, Unani and now in modern allopathic medicines [3,4]. Berberis has been reported effective in treatment of cancer, diabetes, bone fractures, jaundice, enlargement of spleen, AIDS, osteoporosis, heart, ocular trachoma, hypertension, infectious diseases, cholera, diarrhea, dysentery, eye troubles and leprosy[5,6,7,8,9,10,11,12,13,3,4] .

Karakoram, Himalaya, Hindukush and Pamir Mountain Ranges are no more unaffected from rest of the global phenomenon. Wild geo-cultural landscapes across these ranges are facing continuous land cover changes[14]. Poor resource management systems in placed are no more responsive to deal with climate and anthropogenic behavioral changes taking place rapidly. Politically and vested-interest inspired natural resources management policies ignores scientific management and sustainable harvesting of such a vital resource base. In presence of such ignorance, speedy disappearance of natural resources is not an exceptional[15]. The main natural resources affected are soils, water, natural vegetation, and wildlife[16]. Climate change phenomenon is prominent among these fragile ecosystems and it is therefore, change detection and exploration on scientific basis is important and need of the time[17]

Along these mountain region ranges, natural resources and biodiversity are under pressure from local agro-pastoral communities and climatic change[18]. Modern climatic changes are reshuffling the geographic distributions of plant and animal species[19]. Similarly, several human induced adverse factors are negatively impacting natural resources in the regions are poverty, population growth, insecure land tenure, over grazing, cutting, hunting, collection and trafficking of valuable wildlife are evident[20,21]. Such a huge pressure exerted on the plant species may result in the extinction[20]. It is therefore, maintenance of wildlife populations is critical[22]. Central Karakorum National Park (CKNP) is the largest national park in the country with unique biodiversity and geomorphological features of global importance. Besides, many other plant and animal species in the park area, Berberis and Snow leopard have become critically endangered. Long-term conservation of genetic diversity, phylogenetic history and evolutionary potential of species and that their investigation and conservation deserve high priority[23,24,25,26] .

Comparing the behaviour of local populations across species' distribution ranges has a long tradition[27]. A major paradigm of this research is the 'centre-periphery hypothesis', which predicts that marginal populations are more prone to extinction and genetically less diverse than those from the centre, because they tend to occur in less favourable habitats and at lower and more variable densities[28,29].

Wild ecological balance across the Karakoram-Pamir landscape is disturbed as a result of, infrastructure construction, and unsustainable development, which has caused weakening of traditional land use practices and increased the socioeconomic vulnerability of the locals. The degradation of the landscape has been accelerated by climate change and increased populations of

both humans and their livestock[30].

Since its establishment in 1993, lack of resources and effective management, park plans and management have not been rigorously shaped and implemented[31]. Conservation plans will only be achievable when the traditional communities are heard and incorporated their voice[32]. Berberis species are facing hostile attitudes and behaviours of the local people[33].

Present study investigates community perceptions of population change dyanmics of Berberis species, role and relationship of various local human population induced factors which are impacting on the overall population of Berberis in eitherway. Results of this study will be helpful for informed decision for longterm conservation plans and their management across national parks in general and CKNP in particular.

MATERIAL AND METHODS

Geography: Present study was executed during 2012-14 across traditional landscape of Central Karakoram National Park (CKNP). It extends over 35°N-36.5°N (latitude) and from 74°E-77°E (longitude) covering an area of 10, 000 km^2. Three major valleys along western part of CKNP were focused viz; Bagrot, Rahimabad-Naltar and Rakaposhi (Nagar). It is unique for its biodiversity, geomorphological and socio-cultural aspects. It stretches over four administrative districts; Hunza-Nagar, Gilgit, Skardu and Ghanche. It is the largest national park in the country having biggest glacial mass in the world outside poles.

Climate: Climate is predominantly cold arid and temperate in the lower elevations[5]. Prevalent season is winter, occupying the valleys eight to nine months a year[34]. Area lacks significant rainfall, averaging in 120 to 240 millimeters (4.7 to 9.4 inches) annually[35]. Most of rainfall occurs during winter and early spring.

Ecology: Valleys are among the high land settlements in wild environment. People have inseparable interaction and exchanges with the forests, glaciers, wildlife and climate. Glacier melting is main source of irrigation. Traditional communities are heavily dependent on natural resources for their livelihood. There are 9-10 villages of 2000 souls on an average in each of the valley. Majority of the people live agro-pastoral life. Customary laws are more practical and applied rather than statutory laws in these valleys. Conservation practice and initiatives started in some villages and valleys across Karakorum and Hindukush Mountain Ranges have incorporated voice of local communities, which has been a success. Berberis is an integral part of phytosociology and ethnobotanical practices around these valleys. Berberis grow in sandy, loamy, gravel, calcareous, stony and silty soils[36]. *Hippophae rhamnoides* L. subsp. *turkestanica* is most commonly associated plant species along with Berberis[37]. Local communities use medicinal plants as firewood, medicine, fodder, food, fencing and commercial purposes.

Cultural landscape: Western part of the park is inhabited by 16 major tribes speaking four different dialects of distinct origins i.e. Shina, Brushaski, Gujari, Domaki. Settlements sparsely start from the river bed reach to sub-alpine zones (1300 m to 3500 m above sea level). With the construction of Karakoram Highway, several link roads also extended to connect remote mountainous villages. Most of the area has become accessible by jeep and some through pony tracts. Populations are heavily dependent on natural resources and folk wisdom plays vital role in traditional life among these mountain communities. Life style across these valleys and villages has undergone rapid transformation towards urbanization and commercialization.

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

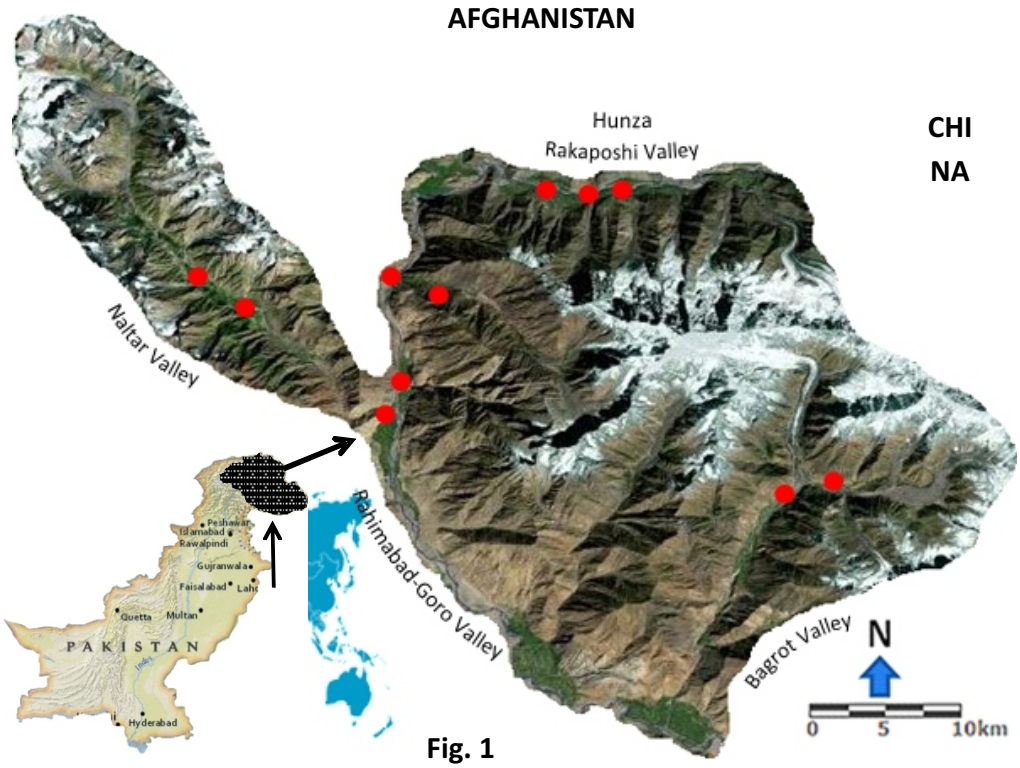

Fig. 1

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: 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: Following mathematical description was used to calculate sample size (ss). Moreover, this sample was rechecked with sample size calculator.

$$ss = \frac{z^2 \times (p) \times (1-p)}{c^2}$$

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)

Data collection: A detailed structured questionnaire was used to collect data. Personal observations were also recorded to supplement the responses to the questionnaire[38]. Questionnaire was quantity oriented to minimize qualitative responses[39].

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

Plant identification and vernacular name: Irrespective of age group, gender and geography, 100% people can identify the plant. Two vernacular names are commonly used in the area i.e. 'Ishkeen' and 'Churkuye'. Among 373 respondents, 81.0% (n=302) named it as "Ishkeen" and 19.0% (n=71) called it as "Churkuye". Some 8.0% (n=30) use 'Ishkeen' and 'Churkuye' equally.

Community perception of Berberis varieties: In response to a question, 'how many varieties do exist in the area?', 310 (83.1%) replied '1', 58 (15.5%) told '2' and 5 (1.3%) said '3'. No one went beyond 3. Those who believe in more than one variety of Berberis told that they differentiate verities due to floral morphology (n=5: 1.3%), plant size and height (n=6: 1.6%), number and size of thorn/spines (n=15: 4.0%) and 8.1 % (n=31) discriminate on the basis of their habitat i.e. Xeric or irrigated).

Habitat: According to majority population (n=356: 95.4%), Berberis is entirely wild species and not cultivated. Though it is very minor 2.4% (n=9) but Berberis has entered into cultivation (plantation) practices as. Similarly, a minor fragment (n=8: 2.1%) believes that it is wild as well as cultivated.

Access and availability: Out of a range of choices given in the questionnaire (very easy, easy, difficult, very difficult, unavailable and extinct), respondents went to choose only two options i.e. easy (n=353: 94.6%) and very difficult (n=3: 0.8%). Whereas only 4.6% (n=17) people said it is easy to access Berberis from irrigated areas but very difficult to find out from a dry place for medicinal purpose.

Population: There are 3110 mature Berberis plant in the study area i.e. Bagrot (n=1090, 35.05%), Rahimabad-Naltar (n=1590, 51.13%) and in Rakaposhi-Nagar valley there are 430 (13.83%) plants. On an average each valley has 1037 fruit bearing plants of Berberis (Fig. 2).

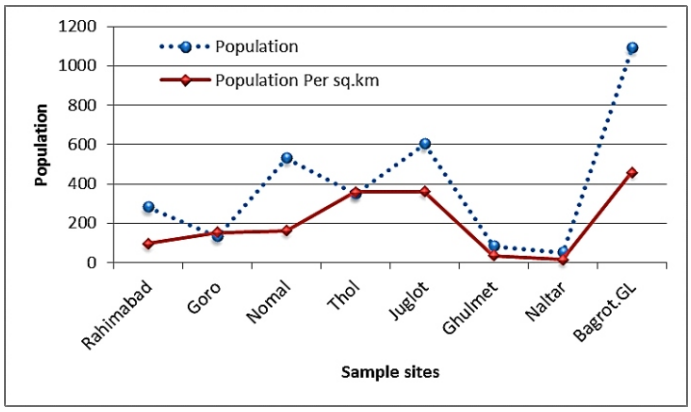

Fig. 2

Population change: Out of total number of respondents (n=373), 53.6% (n=200) said there is no change in the population of Berberis. However, 30.3% (n=113) believe that population has changed. Furthermore, 16.1% (n=60) people told that they do not know whether it has changed or not.

Population change direction: Change favoring respondents (n=113, 30.3%) are with the opinion of decline (n= 102, 27.4%) and increase (n=14, 3.7%) in population. Regarding a question on population change direction having five (5) options (i.e. increased significantly, slight increased, decreased significantly, slight decrease or any other), 12.9% (n=48) people Berberis population has decreased significantly. Similarly, 14.5% (n=54) people favored a slight decreased. Within the fragment of respondents who supported idea of increased population in the area, 2.1% (n=8) interviewee told that the population has increased significantly, however, a small number (n=6: 1.6%) choose slight increase option (Fig. 3).

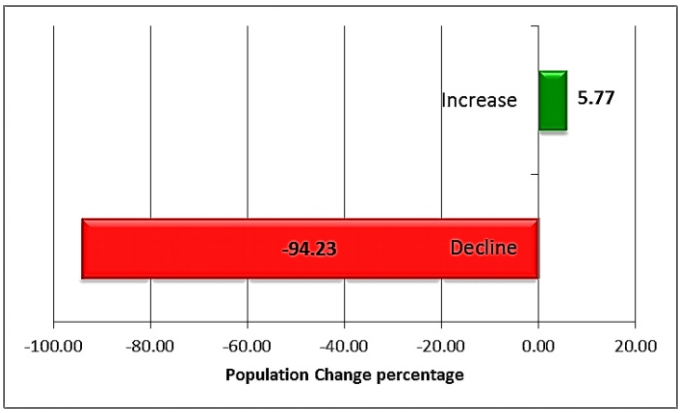

Fig. 3

Population change factors: Majority (n=269: 72.1%) of interviewee did not respond and left spaces (blank) given for choices (i.e. conservation, plantation, commercialization, over grazing, development activities, medicinal exploitation and any other option). Amongst these options, first two (conservation and plantation) were factors considered to contribute into increase in population (healthy factors) and remaining four factors were considered as unhealthy (i.e. commercialization, over grazing, development activities, medicinal exploitation) contributing into decrease in population. Option 'other' was given to give breathing space for respondents to tell any idea which has not been covered in the given options.

Remaining (n=104: 27.9%) respondents opted six (6) categories (options) out of seven (7) i.e. plantation (n=6:1.6%), 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%). Although population has a drastic decrease (fig population change) but no one in the study area has never thought of conserving Berberis for future. This may be due to lack of hard and reliable data on its population.

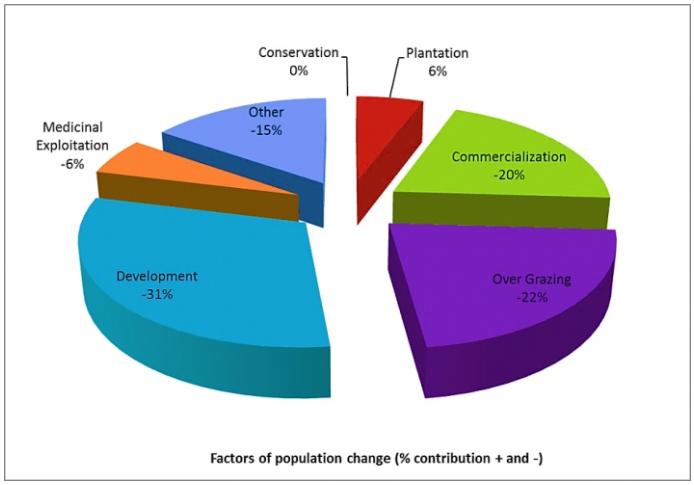

Fig. 4

Change factors and their percentage contribution: 70.2% (n=262) did not responded, however, 29.8% (n=111, SE±1.524) replied and assigned different percentage values against each factor of change except conservation. Contribution percentage (minimum 15% and maximum 80%) mean calculation shows average healthy (+) and unhealthy (-) contribution towards population change i.e. plantation (n=6, +5.77%), commercialization (n=21, -20.19%), over grazing (n=23, -22.12%), development activities (n=32, -30.77%), medicinal exploitation (n=6, -5.77%) and any other (n=16, -15.38%). 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. 4).

Conservation: 64.3% (n=240) feel there is no need of any conservation, however, 32.7% (n=122) believe in need of conservation of Berberis species. 2.9% (n=11) interviewee did not response to the question. Within the conservationist fragment of population 22.2% (n=83) recommended that government to take care of conservation. However, only 0.8% (n=3) were in favor of community to take lead in conservation efforts.

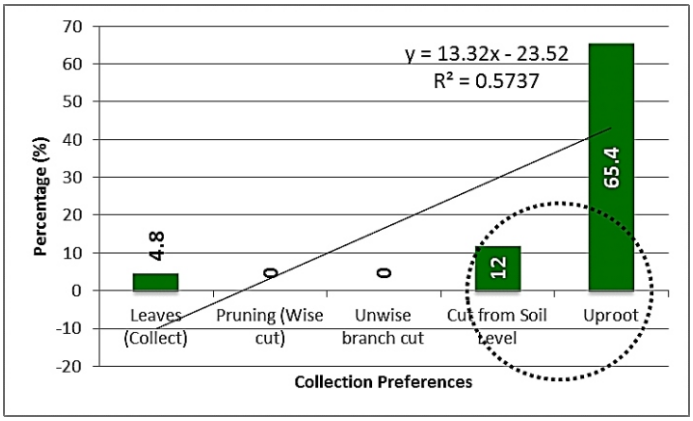

Fig. 5

Cutting preferences towards Berberis: Farmers, shepherded, women, children and other people who visit Berberis to collect it for various purposes show differential preferences towards the plant when collected. Respondents were given options viz; 1) collect leaves, 2) cut some unwanted branches wisely (pruning), 3) collect unwisely and cut branches irrespective of their fruiting, leaves and age; 4) cut from soil level; 5) uproot entire plant or any 6) other.

Among the masses in the study area there is a general trend of eradicating Berberis from their fields or even those growing in the barren lands. However, this trend is more prominent when it grows in the agricultural lands. Farmers, shepherded or any person visiting Berberis for collection shows a least preference towards wise collection and either cut from the soil surface (12.0%) or uproot (65.4%).

Data representation shows a relatively strong positive relationship between collection preferences and its frequency (%). Linear trend between the two aspects of parameter (cutting preference) are vividly climbing (growing) which expresses a general behaviour of the communities towards Berberis uprooting being their first choice when it is collected for any purpose. Most frequent choices are encircled with dots.

DISCUSSION

Berberis population in CKNP is under pressure of many factors which are human induced i.e. population growth, insecure land tenure, over grazing, cutting and collection, infrastructure construction and unsustainable development activities. This study is in consonance with the studies already been executed by earlier researchers[14,20,21,36,15,16,30].

Climate change detection is more prominent across these glaciated habitats of wild fragile ecosystems. This has not only reshuffled geographic distribution of plant communities and animals but also threatened their survival. These areas have remained away from scientific expeditions and exploration but now it is important and need of the time. The degradation of the landscape has been accelerated by climate change and increased populations of both humans and their livestock[30,19,17,18,22].

Cutting preferences of local communities towards Berberis is also a negatively significant attitude and behaviour commonly found in the area is a dangerous sign for its future existence. Our study supports previous scientific investigations[23,24,25,26,27] to plan a long-term conservation strategy for its population maintenance,

genetic diversity, phylogenetic history, evolutionary potential of species which deserve high priority.

CONCLUSION

Building on the results from our present results, which have exposed several active factors contributing towards population retardation of Berberis, needed to monitor and reduce pressures to save those species suffering from critically endangeredness along with giving due care towards other species and subspecies across Karakorum Mountain Ranges. Any ignorance and negligence may lead to extinction of highly medicinal, economic and ecological biotic element from nature.

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CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

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