Protected area network in Indian Himalayan region: Need for recognizing values of low profile protected areas

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In the aftermath of Convention on Biological Diversity and Caracas Congress on Parks (1992), maintenance and extension of the network of protected areas (PAs) has received impetus across the globe. India has also responded positively in this context. The network of legally designated PAs and other conservation sites (CSs) in India comprise 614 units covering over 7.3% of the total geographical area. The Indian Himalayan region (IHR), on account of richness and uniqueness of biodiversity elements, is represented fairly well (15 national parks and 59 sanctuaries covering 9.6% of the geographical area) within the PA network of India. The paper reviews the existing state of PAs in the IHR and identifies various gaps therein. It highlights the existing disparity in ranking the importance of PAs, wherein values of a few of them are often over-emphasized while, several others with a relatively higher stake of biodiversity remain unnoticed. This trend adversely affects the maintenance of biodiversity elements which deserve immediate attention. The potentials of such low profile PAs in IHR are discussed through a detailed review of biophysical values of hitherto lesser known PA – Askot Wildlife Sanctuary – in Kumaun, West Himalaya. The paper calls for an introspection by all concerned and recommends that efforts are urgently needed for a thorough evaluation of existing PAs in the IHR to redefine priorities on the basis of their biodiversity attributes.

THE Article 8 of the Convention on Biological Diversity (CBD) advocates the importance of promoting *in situ* conservation. As a result, international commitment to establish and strengthen protected area (PA) systems has received considerable attention from all the nations who were signatories to the convention. As the representative PAs/conservation sites (CSs) are expected to possess maximum representative biological diversity (*in situ*) of a biogeographical domain[1–3], their adequate maintenance and monitoring has become important. Further, CBD and Caracas Congress on Parks (1992) have marked a significant shift in the historical perception of PAs, which often exclude people from designated reserves. PAs are steadily being linked with issues related to people's concern on traditional knowledge, access to genetic resources, national sovereignty, equitable sharing of benefits, intellectual property rights and overall sustainable development[4]. The concept that reserves (PAs/CSs) should adequately represent the range of regional biophysical values[5,6] is still the most widely accepted theoretical basis for PA establishment. However, in practice, factors such as opportunity, aesthetics, administrative costs, local economic impacts, surrounding land uses, political support, etc. often become more important[7].

It has been observed that biases have often crept in to rank the importance of PAs (at national/regional levels). This has adversely affected the rational allocation of available resources. As a result, values for a few PAs are often over-emphasized while some others with relatively higher biodiversity richness and stakes remain unnoticed. Even in case of supposedly unbiased approaches of prioritization [Biodiversity Conservation Prioritization Project (BCPP)] of PAs in India, the inadequate database has led to incomplete process of prioritization, wherein several PAs do not figure in the list[8]. Biodiversity and conservation value of some of these PAs are undoubtedly high. This state of affairs, in our opinion, will defeat the national endeavour of strengthening PA network and eventually fail in achieving the goal of maintenance of representative biodiversity elements at different organizational levels.

In the context of the above, this paper briefly reviews the existing state of PA network in the Indian Himalayan region (IHR) and attempts to establish, through evidences of a case study of Askot Wildlife Sanctuary (AWLS) West Himalaya, that some low profile PAs have immense potential to enhance the components of biological representativeness, integrity and human sustenance in the PA network of IHR. In general, the following questions have been addressed to evaluate the potential of the AWLS: (i) Is the reserve large enough to maintain biological representativeness and integrity? (ii) Does it adequately represent the regional biodiversity pool? (iii) Does it contribute towards protection of

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sensitive biodiversity elements? (iv) Does it provide the required livelihood support for sustenance of the inhabitants including ethnic groups, if any? (v) Does it possess intrinsic appeal, in addition to direct values, to support eco-development activities? Before addressing these issues, a brief analysis is presented to highlight some of the major trends of PA system in IHR.

PA network in IHR: Present scenario

India has responded positively towards expanding the PA network in recent decades[9,10]. The network of legally designated PAs and other conservation sites (biosphere reserves, tiger reserves, world heritage sites and RAMSAR sites) comprises a total of 614 units covering approximately 24,0028 km^2; 7.3% of the country's geographic area[10]. The IHR encompasses two biogeographic zones – Trans Himalaya and Himalaya[11]. On account of richness and uniqueness of biodiversity elements and wide-ranging indigenous knowledge systems on use of bioresources coupled with increasing scale of degradation of bioresources, the region has emerged as a global conservation priority[12–14]. In response to this recognition, the Government of India (GOI), under its PA programme, has established 15 national parks (NPs) and 59 wildlife sanctuaries (WLS) respectively, accounting for 17.4% and 12.3% of the country's total. The PA coverage in the region (9.6%) is higher than the national average (4.66%) and is comparable to Western Ghats (10.12%) – another global priority biodiversity area. If the proposals of Wildlife Institute of India (WII) for PA establishment are implemented, the PA coverage in the region will increase to over 12%. This would correspond well with the acceptable realistic target of 10% coverage under PAs[15,16]. The existing figures of PAs and locally conserved/protected sacred groves and other protected units are apparently indicative of the satisfactory state of network system for conservation of representative ecosystems in the IHR. However, a more objective analysis of facts, particularly related to very fundamental issues of establishment of PA network and its current status, reveals the following features. Before explaining these features, it is imperative to mention that the undermentioned views on biological representativeness carry certain limitations in view of information gaps in relevant data sets of PAs in the IHR.

(1) To be a true representative of the regional biodiversity pool, the PA network of the IHR is expected to take care of simultaneously operating factors along three distinct transitions[12]: (i) longitudinal – east to west transition (cool, moist Arunachal to cold deserts of Ladakh); (ii) latitudinal – south to north transition (tropical – subtropical Gangetic plains to cold-dry Tibetan plateau); (iii) altitudinal – low-to-high altitude transition (tropical–subtropical valleys to alpine/arctic conditions). In this respect, random distribution of PAs, covering more than 5.5% area in each province [Trans – 7 PAs (9.2% of area); Northwest – 29 (5.88%); West – 18 (13.06%); Central – 8 (7.82%); and East – 12 (11.44%)], supposedly takes care of representative habitats and biota along longitudinal – east to west gradient. Whereas the representativeness along horizontal and vertical gradients needs to be looked into for individual provinces. In this regard it is expected that bigger PAs with adequate horizontal (south to north) and vertical (low to high) expanse will be better candidates. (2) Analysis on size of existing PAs in different provinces of the IHR reveals that both horizontal and vertical gradients are not well represented. Although compared to the country mean (270. 3 km^2, n = 566), the mean size of PAs in the IHR (512.07 km^2, n = 74) is larger. However, if relatively large PAs of Trans Himalaya are excluded (mean size 2428.9 km^2, n = 7), the mean size for the Himalayan zone drastically falls (311.8 km^2, n = 67) and comes closer to the country mean. Within this zone, East Himalayan province (mean size 798.6 km^2, n = 12) has relatively large PAs, followed by West (377.8 km^2, n = 18), Northwest (140.7 km^2, n = 29) and Central Himalayan provinces (53.4 km^2, n = 8). These figures need to be viewed for wider conservation implications, particularly considering the fact that small PAs (< 300 km^2), common in the entire Indo-Pacific region, are inadequate to preserve viable populations of large, key stone species such as top carnivores and large herbivores and frugivores[17]; (3) Keeping aside the statistics of (1) and (2) above, it is reported that in terms of land use practices most of the PAs in the IHR do not differ from non-protected areas[18]. Many of these have extensive peripheral and internal human populations[9,19], giving rise to serious issues of subsistence use of reserve resources, particularly in the wake of the Wildlife (Protection) Act, India (Amendment 1991). The act prohibits any resource exploitation (including subsistence use by local inhabitants), which has accelerated the incidence of hostile clashes between PA managers and the people. The eco-development initiatives in PAs[20], to some extent, appear to have had positive response to combat such situations. However, in practice, such programmes have not been implemented to desired levels. The Great Himalayan National Park is perhaps the only PA in the IHR where some initiatives in this direction have taken-off[21]. Also, some beginning has been made in the PAs of Uttaranchal [erstwhile Uttar Pradesh (UP) hills] under the recently launched UP Forestry Project (Sameer Sinha, pers. commun.); (4) Nevertheless, disparity in concerns and conservation inputs continue unabated in PA system of the IHR. A few PAs, with designated high-priority status, enjoy maximum management interventions. Also, most of the research inputs have gone into these reserves. For instance, Namdapha National Park in the East, Kanchendzonga National

Park in Central, Nanda Devi National Park and Valley of Flowers National Park in the West, Great Himalayan National Park in the Northwest, and Hemis National Park in Trans Himalaya, are most frequently sought after PAs. Similarly, due to non-availability of information, the BCPP list of national priority considers only 50% (37 PAs) of the total existing PAs in the IHR on priority at the national level[8]. Therefore, the remaining 50% of PAs do not figure anywhere as national priority. This is a practice which largely ignores the values of many lesser recognized PAs (hereafter referred as low profile PAs). Most of these, in spite of their conservation value, have remained and will continue as unknown and unattended PAs. This is a self-defeating practice in the long term.

In an ideal situation, a systematic evaluation of representative biophysical values of PAs in the IHR, which form the basis for prioritization, can address the above issue (point 4). Such efforts are considered as cost-effective for allocating limited conservation resources to achieve greatest benefits[22,23]. In this context, some progress has been made in recent years. For example, evaluation of representativeness in PA systems of Sweden[24,25], Costa Rica[26], Uganda[27], Washington State[23], etc. have contributed towards the identification of conservation-worthy areas/reserves. Also, a simple cost-effective system of biological monitoring, based on the preliminary lessons learnt from PAs in the Philippines, has been developed for implementation, with desired modifications, in developing countries of Asia, Africa and Central and South America[28]. However, as mentioned earlier, availability of incomplete data sets for PAs in the IHR is a major impediment to initiate this process. Given the constraints of our limited resources (human and economic), we do not expect to complete even the species presence/absence list for all PAs in the near future. In such a situation, possibilities of attempting probabilistic species distribution data method[29,30], wherein incomplete information is handled for making certain assumptions for presence/absence, is perhaps one of the options. This, however, calls for a debate. Assuming that the selective allocation of resources continues without any change and the systematic evaluation and prioritization does not take-off, it would be, in our opinion, worthwhile to initiate the process of recognizing the inherent value of some representative low profile PAs (with high biodiversity stakes) in different provinces to focus on adequate conservation measures. We have discussed this possibility by citing a case in West Himalaya.

Low profile but high value PAs: Case study of AWLS

Our assumption is that many low profile PAs have the potential to address the major issues (1–3 above) in the PA system of the IHR. Consider AWLS as a case – the sanctuary, nearly one and half decade old (notified by Government of UP, July 1986), was established for the conservation of regional flora and fauna[31], but could not receive adequate management attention, perhaps due to its remoteness and difficult terrain. The reserve remained almost unknown until recently when G. B. Pant Institute of Himalayan Environment and Development, Almora initiated systematic studies (from 1995 onwards). Also, the report of the scientific team to Panchchuli Multidimensional Expedition 1998, highlights biophysical and cultural significance of the reserve. A review of these studies is presented here to establish our assumption and to address the issues (i–v stated above) identified to evaluate the potential of the reserve.

Geophysical values

Size, locale, and geophysical considerations: In spite of the fact that smaller PAs are more in number across the globe, there is a common consensus that the bigger reserve is a better option to protect a variety of habitat types and withstand the external pressures[17,32–34]. In this respect, AWLS, with an area of 600 km^2, is considerably larger in size compared to regional mean (zone Himalaya – 311.8 km^2; province West Himalaya – 377.8 km^2). The sanctuary qualifies as a representative large reserve in view of the fact that over 50% of PAs in the Himalayan biogeogrphic zone are below 100 km^2 and more than 85% below 500 km^2. Furthermore, on a wider scale, over 75% of PAs in India[10] and 68% of PAs in the Indo-Pacific region cover less than 300 km^2 of land area[17].

The sanctuary represents a wide range of elevational gradients (< 800–6700 m asl). Except a few (e.g. Kedarnath Wildlife Sanctuary), no other reserve among large and high profile PAs in the IHR match this elevation range (Table 1). Moreover, the unique biogeographic location, i.e. at the juncture of western and central (Nepal) Himalaya, and its proximity with Tibet, through passes on the northern border, is unmatched. The sanctuary covers three major watersheds in the easternmost sector of West Himalaya, viz. Kali, East Dhauli and Gori, falling in a geologically active zone of Central Crystalline, which comprises low to medium grade rocks of the Lower Crystalline–Munsiari formation; low to medium grade rocks of Upper Crystalline–Rungling formation; and medium to high grade rocks of Upper Crystalline–Vaikrita group[35]. All these features qualify it to be indispensable (*sensu* Ratcliffe[36]).

Biodiversity

Habitat and community representation: AWLS, by virtue of its special position in east to west (longitudinal)

Table 1. Comparative account of important features of biophysical diversity in Askot Wildlife Sanctuary and selected high profile PAs in IHR

PA	Bio-geographic province	PA status/ priority	Area (km^2)/ (altitude m asl)	Representative biomes	Represents high profile taxa	Remark
Hemis	Trans	NP/national	4100/ (3000–6400)	Cold steppe-scrub Cold grassland Glacier/moraines	Snow leopard, wolf, urial, argali, bharal, ibex	Strong hold of Ladakh's mammals
Great Himalayan	North west	NP/national	754/ (1500–6100)	Temperate broadleaved Temperate conifer Subalpine–alpine	Brown bear, bharal, ibex, musk deer, west tragopan	Prolific pheasant population
Nanda Devi	West	NP/national	630/ (3500–7800)	Temperate conifer Subalpine–alpine	Bharal, musk deer, tahr, serow, snow leopard	Large ungulate populations
Kedarnath	West	WLS/national	957/ (1300–7000)	Subtropical pine Temperate broadleaved Temperate conifer Subalpine–alpine	–do–	Representative populations of mountain ungulates and pheasants
Askot	West	WLS/not defined	600/ (800–6700)	Subtropical sal, mixed deciduous and pine Temperate broadleaved, Temperate conifer Subalpine–alpine	–do–	Representative of East and West Himalayan forest types and sensitive floral elements, especially orchids
Khanchendzonga	Central	NP/national	1784/ (1800–8000)	Subtropical deciduous Temperate broadleaved Temperate conifer Subalpine–alpine	Clouded leopard, Musk deer, tahr, red panda, takin, wild dog	Impressive wild population of clouded leopard, red panda, musk deer, snow leopard
Namdapha	East	NP/national	1985/ (300–4500)	Valley evergreen Hill evergreen Moist deciduous Temperate broadleaved Temperate conifer Subalpine–alpine	Leopard, tiger, snow leopard, clouded leopard	Refuge for hoolock gibbon and unique assemblage of carnivores

NP, National Park, WLS, Wildlife Sanctuary.
For more details see refs 11, 77, 78.

transition, shares biodiversity elements of both east and west (*sensu lato*) Himalaya. Among others, the salient features of habitat and community representation can be summarized as under: (1) The sanctuary on the one hand shows dominance of typical West Himalayan forest communities (e.g. chir pine and West Himalayan oaks) and on the other, exhibits western-most limit for East Himalayan communities like *Tsuga* and *Macaranga*[37]. (2) The wide horizontal – south to north (over 80 km width, 29°45′ to 30°25′N) and vertical expanse (< 800 to 6700 m asl) of the reserve has resulted into exceptionally high habitat/community diversity. For example, (i) AWLS is probably the only PA in India to possess habitats ranging from subtropical sal (*Shorea robusta*) to alpine meadows[38]. (ii) The reserve possesses (Table 2) adequate representation (> 85%) of reported forest communities (dominant types) of Kumaun – West Himalaya[39]. (iii) *Tsuga dumosa* and *Macaranga pustulata* communities reported in this reserve[37,40] are exclusive for the entire West Himalaya. (iv) A considerable share (10–15%) of reserve area falls under alpine conditions characterized by both moist and dry alpine habitats[41]. Thus representative elements of both the conditions are present. (3) The forest communities of the reserve are representative of 7 (64%) forest formation types of the Himalaya[42]. (4) The sanctuary includes forests of both pioneer and climax stages and compositionally forests of the reserve correspond well with comparable types of Kumaun[37].

Species richness and life-form diversity: As expected from range of habitat/community representation, AWLS is rich in species diversity. A detailed inventory of vascular plants[43] suggests presence of over 1262 species (Angiosperms – 1112 spp, 641 genera, 136 families; Gymnosperms – 7 spp, 7 genera, 4 families; Pterido-

Table 2. Kumaun-West Himalayan forest types and their representation in AWLS

Forest type (altitude range– m)	Kumaun*		AWLS**		
	Tree density (tree/ha)	Formation† type	Presence (altitude range – m)	Tree density (tree/ha)	Extent of availability
Shorea robusta (300–900)	610–1670	02	Gori valley (< 900)	586	Small stands
S. robusta–Pinus roxburghii (900–1200)	480–1610	02/04	–do–	–do–	–do–
P. roxburghii – mixed broad leaf (1200–1500)	670–1660	04	Gori valley (900–1900)	616	Large continuous stretches
P. roxburghii (1600–1700)	350–590	04	–do–	–do–	–do–
Quercus leucotrichophora (1500–2100)	320–1560	07	Gori valley (1300–1800)	1100	Sparse to dense patches
Alnus nepalensis–mixed broad leaf (2000–2400)	520–1600	06	Darma valley (1800–2000)	680	Large stands in gorges
Quercus floribunda (2000–2400)	320–1960	07	Darma valley (1900–2300)	600	Small mixed stands
Aesculus indica–mixed broad leaf (2100–2200)	300–560	09	Darma valley (2200–2400)	360	Large stands
Rhododendron arboreum dominated (2100–2900)	440–1180	07	Gori valley (1800–2400)	–	Represented in degraded oaks
Cupresus torulosa (2100–2300)	425–599	–	–	–	–
Quercus lanuginosa (2100–2300)	1380–1720	07	Gori valley (1600–2400)	1100	Large continuos stretches
Pinus wallichiana (2200–2600)	540–690	08	Darma valley (2600–2900)	832	Small pure patches
Abies pindrow–mixed (2300–2800)	420–680	08	Darma valley (2700–3000)	520	Large mixed stands
Hippophae salicifolia (2300)	780	–	Darma valley (2200–2800)	–	Small patches
Acer cappadocium–mixed (2300–2500)	260–700	09	–	–	–
Quercus semecarpifolia (2400–3000)	650–2070	07	Gori and Darma valley 2500–3000	665	Large mixed stands
Salix–mixed broad leaf (3000–3200)	650–880	10	Darma valley (3000–3200)	620	Small mixed stands
Betula utilis–mixed broad leaf (3100–3300)	160–360	10	Gori and Darma valley (3000–3400)	570	Large mixed stands
B. utilis–Rhododendron campanulatum (3200)	500	10	Darma valley (3000–3400)	1140	Large patches
Rhododendron campanulatum (3100–3600)	300–880	11	Gori and Darma valley (3100–3600)	–	Small stands

For more details see refs 39, 79*; refs 37, 40**; †ref. 42.

phytes – 143 spp, 59 genera, 33 families). Distribution in life forms indicate availability of 155 trees, 193 shrubs, 771 herbs and 142 ferns. The species richness varies considerably across elevational range, with a maximum diversity between 1000 and 2000 m asl (860 : 68.1%).

Among taxonomic groups, species richness in family Orchidaceae (120 species) is revealing and represents 62.5% of Kumaun[44] and 50.8% of the entire NW Himalya (includes West and NW Himalaya of present classification)[45]. Considering estimates of Singh and Hajra[46] for West Himalaya (includes West, Northwest and Trans Himalaya of present classification), representation in other species-rich families is as follows: Poaceae (81 : 18.5%), Fabaceae (68 : 18.9%), Asteraceae (67 : 12.4%), Rosaceae (45 : 24.4%) and Ranunculaceae (37 : 29.4%).

Detailed information on the reserves' faunal species richness is not available; however, a preliminary survey[38], in a part of AWLS indicates the presence of 29 mammals (28.4% of West Himalaya)[47] and 120 birds (24.2% of West Himalaya[48] and 51.7% of Kumaun[49]).

Biological integrity and sensitive elements: Of the representative floristic elements in the reserve, over 40% are Himalayan in origin/distribution (native). Previous investigation[37] has revealed that the richness and relative dominance of native species, in all growth forms, increase significantly with elevation, thereby suggesting that the higher elevation zones of the reserve are rich in

native elements. This has significant implication, particularly when the preservation of biological integrity is being recognized as the most comprehensive norm in conservation[50] and native species populations, with their natural interactions in naturally structured communities, are considered as a best indicator of such integrity[51].

Moreover, AWLS with nearly 21% of its flora (234 near-endemic, 24 endemic) representing Himalayan endemics (*sensu* Dhar and Samant[52]), holds great promise for conservation biologists and managers, particularly in view of the fact that the (i) extent of sensitive elements such as endemics, reflects complexity in the structural, functional and evolutionary units of a system[53]; (ii) biotic endemism has emerged as an effective tool for setting conservation priorities[54–56] and designing conservation units[57]; and (iii) information on plant endemics in the IHR is being utilized for identification of target areas/taxa for conservation initiatives[52,58–60].

Further, since the incidence of rarity and threat of endangerment among endemic/native taxa sharpens focus on priority elements[60,61], ten plant species (Table 3) listed in the national list of endangered taxa are reported in low densities within the reserve[43]. A more objective analysis of plant resources of the reserve[62] has identified eleven other plant species (exhibiting small population, narrow geographic range and high use pressure) as top-ranking sensitive species. Further, richness of orchids, especially the epiphytic ones[63], is the most remarkable feature of the reserve. It is pertinent to point out that the family Orchidaceae has been included in CITES negative list of export in view of potential threats of endangerment.

Considering the faunal elements, over 82.7% of the representative mammalian fauna of the reserve falls under various protected categories. However, twelve of these are listed endangered Himalayan taxa (Table 3). Also, the

Table 3. Representation of sensitive Himalayan taxa in AWLS

Taxa	RDB status/Schedule	Presence in AWLS: Elevation range (m)	Presence in AWLS: Frequency
Mammals*			
Canis aureus (jackal)	E/IV	< 2400	O
Capricornis sumatraensis (Mainland serow)	E/I	2500–3300	S
Hemitragus jemlahicus (Himalayan tahr)	–/I	2000–3500	O
Lutra lutra (common otter)	V/II	< 2000	S
Martes flavigula	I/I	1800–3600	S
Moschus chrysogaster (Himalayan musk deer)	V/I	2500–4000	S
Nemorhaedus goral (goral)	V/III	1800–3300	S
Panthera pardus (common leopard)	T/I	< 300	S
Petaurista petaurista (red flying squirrel)	–/I	2500–3200	S
Selenarctos thibetanus (Himalayan black bear)	T/I	1600–3500	O
Uncia uncia (snow leopard)	E/I	3600–5000	S
Vulpes vulpes (red fox)	T/IV	3400–4500	S
Birds*			
Carteus wallichii (cheer pheasant)	–/I	2600	S
Lophophorus impajanus (Himalayan monal)	–/I	3000–3500	O
Tragopan satyra (satyr tragopan)	–/I	3000–3500	S
*Plants***			
Athyrium duthiei	V	3000–3500	O
Acer caesium	V	2800–3200	S
Cymbidium eburneum	V	1000–1400	O
Cypripedium cordigerum	R	2600–3000	S
C. elegans	R	3000–3500	S
C. himalaicum	R	3000–4000	S
Dioscorea deltoidea	V	1500–2800	O
Eria occidentalis	R	1400–1600	S
Nardostachys grandiflora	V	3300–4200	O
Picrorhiza kurrooa	V	3300–4200	F

O – occasional; S – sparse; F – frequent.
For more details see refs. 38*; ref. 43**.

reserve provides shelter to three critically endangered birds, viz. cheer pheasant, Himalayan monal, and satyr tragopan.

Departing from species-centred considerations of sensitivity, representation of some critically important habitats/communities need special mention. For example, while considering cumulative biodiversity values, the Timber Line Zone (TLZ) of Panchachuli basin (within AWLS) and Ralam valley (neighbouring AWLS) was identified among ten top-ranking priority sites in West Himalaya[64]. However, in view of naturalness, endemicity and use value of biodiversity elements, these two sites assume highest uniqueness scores. In the context of biological integrity (nativity), these areas support high proportion of native plant species – trees/shrubs 100%; herbs 70% (ref. 37). While considering the overall value of West Himalayan TLZ in maintaining regional pool of biodiversity and its sensitivity to climate and anthropogenic changes[60], the existence of most unique TLZ sites within the reserve makes conservation of this representative tract in West Himalaya imperative.

Moreover, on a broader perspective among vulnerable eco-regions of the Himalaya[65], AWLS supports considerably large areas of West Himalayan broadleaf forest (145 km^2) and Himalayan subtropical pine forest (78 km^2). The importance of protecting such large tracts can be viewed for overall maintenance of biological integrity of the Himalaya. However, it is alarming to note that the intensity of anthropogenic pressures in these tracts within the PA is such that nearly 5% of pine, 6% of oak and 10% area of mixed broadleaf forests in the reserve have been reduced between 1988 and 1996 (ref. 41). Also, the non native proliferation in herbaceous layer of these forests is a serious threat to native plants[37]. All these issues deserve priority attention. As such, protection of sites that are directly threatened and those of high biological value deserve priority[8].

In the context of overall biological potential of the reserve, it should be emphasized that there are suggestions that the value of the reserve may increase substantially through extensions of reserve boundaries in adjacent biodiversity-rich/unique areas[38,66,67].

Ethnic diversity and other human considerations

Human dimensions in PA network of India, including the IHR, assume great significance on account of the following two contrasting situations: (i) There is a global change in mindset of policy planners who now realize that biodiversity of PAs cannot be understood in isolation from ethnic groups that have historically occupied these areas[3]. This realization largely satisfies the need of indigenous people. In fact, the recent focus on need of people-responsive strategies for conservation in the PA network of India is an outcome of this change, resulting in strengthening of buffer zone concept[20,68]. (ii) The PA laws (as described under the 1991 Amendment to Wildlife-Protection Act, India) strictly prohibits the resource exploitation (including subsistence use by local inhabitants), and thus divesting any possibilities of developing people-responsive buffer zones within a WLS[10]. This change addresses the concerns of the conservationists. Unfortunately, both the issues are incompatible and advocating one adversely affects the other. However, a balance of both is a pressing need of the day. In this context, the concept of internal zonation[20,68] emerges as a viable option.

As such, it is beyond the scope of this article to discuss detailed implications of park–people relationship, especially its legal aspects. However, it is pertinent to highlight peculiarities of people of the reserve, especially to address the issues (iv) and (v) raised in the beginning of the article.

Indigenous people: The ethnic identity of AWLS is unique and embedded into two culturally-distinct tribal groups – the Bhotiyas and the Rajees. Lifestyle of both the groups is well knit with existing natural resources of the area. The Rajees, one among the most primitive tribes of India[69], were forest-dwellers for centuries and still largely rely on wild forest resources for their livelihood[62]. Besides primitiveness and their failure in assimilating the benefits from modern developmental initiatives, the group deserves attention due to: (i) declining growth rate, high mortality; (ii) dwindling economy, indebtedness; and (iii) disappearance of traditional art and craft [69]. In this context, it is important to note that the reserve and its adjacent areas support the largest population of this tribe in the region[69].

Another tribal group – the Bhotiyas, of this area have been traders for generations and their dependence on wild bioresources is mainly for income generation. This group has undergone considerable transformation in lifestyle, mainly in the aftermath of Sino-Indian conflict (1962). In general, a peculiar periodic movement (transhumance) which incorporates a unique blend of agriculture and pastoralism has always remained an actual way of their livelihood, economic reliance and survival[70]. However, in recent decades, a considerable decrease (70%) in transhumance population (between 1961 and 1991) and shift in other occupational structures of these tribes has been noticed[71].

Indigenous knowledge base: The ethnic/cultural diversity prevailing in and around AWLS has strengthened optimal use of existing resources through traditional systems. Such knowledge base has been evolved through ages of experimentation. While attempting a documentation[62], a total of 172 plant species (13.6%) were found to be utilized by the inhabitants (medicine: 69, edible : 72, fodder: 57, fuel : 31, house-building: 9,

religious : 7, and fibre : 2). A large proportion (69.2%) of these wild useful plants are Himalayan in origin. Among the two ethnic groups, the Rajees have better understanding of wild, edible plants, whereas the Bhotiyas exhibit knowledge on income-generating resources, e.g. medicinal plants[43]. According to an estimate, about 14% of the Bhotiyas' income is obtained through sale of medicinal herbs[72]. Traditional knowledge system of animal husbandry, particularly among the Bhotiyas is another strong component[73].

These deep-rooted societal links with bioresources have been effective in maintaining and managing reserve resources. Inhabitants have also promoted conservation through religious sentiments. For example, an area (approx. 10 km^2) known as Chiplakedar (considered to be an abode of Lord Shiva) above 2800 m asl, located almost in the core of the reserve, has been designated as a sacred site for centuries. Any type of intervention (except religious ceremonies around the sacred lake – Chipla kund) within this area is socially prohibited. This has contributed in the maintenance of a natural site in the reserve.

Intrinsic appeal and potential for eco-development

As in most of the hilly regions, AWLS is full of panoramic sites, especially in the Darma valley. Besides, the following hitherto under-exploited potentials for eco-tourism/adventure-tourism have been described for the reserve[74], which need special mention: (i) Dugtu and neighbouring slopes in Panchchuli basin of the reserve are ideal for mountaineering, paragliding, and skiing; (ii) Kali and Gori rivers are ideal for white-water rafting.

Eco/adventure tourism has gained popularity in PAs of Nepal[75]. Possibilities of such initiatives in GHNP of Indian Himalaya have also been highlighted[21]. Moreover, the traditional skill and adaptability of the tribal people to inhabit tough hilly terrain would enable them to successfully assume responsibilities associated with income-generating ventures like nature guides, porters, etc. Also, the traditional relationship of inhabitants with medicinal plants can easily promote cultivation of high value medicinal plants as a part of eco-development measure[38]. Initiatives of value addition in traditional technology/knowledge such as handicraft, fermented food/beverages, apiculture and cattle breeding can upgrade the income of the inhabitants[70]. Such initiatives are in tune with the proposals for other PAs in the Himalaya[21].

Undoubtedly, the importance of harnessing income-generating potential of the reserve without harming wilderness, would assume higher significance in the wake of the creation of the new state of Uttaranchal.

Conclusions

The aforementioned description goes in favour of our assumption that low profile PAs – like AWLS, may have the potential to address issues (i–vi) raised in beginning of this article. Unfortunately, these potentials have not been harnessed and the reserve remains neglected in terms of management inputs and establishing fruitful links between reserve and inhabitants. This is a sad state of affairs and is responsible for (i) indiscriminate destruction of natural forest habitats in low (< 2500 m asl) altitude areas[37], – posing a serious threat to biological integrity of the area; (ii) illegal trans-boundary (Indo-Nepal) trade of medicinal plants, musk and bear bile[76], leading to threatened status of many of them. Also, the inhabitants are neither aware of the PA proclamation nor are their rights settled. This is creating an atmosphere of mass resentment (authors' personal observations). All these issues are deleterious to the overall objectives of preserving PA values. It may be a similar situation for other low-profile PAs in the IHR.

We feel that it is high time for introspection by all concerned. Efforts should be made so that the values of low-profile PAs do not remain underestimated. In this context, it is recommended that a thorough evaluation and review of the potentials of existing PAs in the IHR be undertaken. This exercise would enable us in redefining priorities and improving the effectiveness of PA network in the IHR. Moreover, issues related to judicious sharing of resources among PAs can also be addressed.

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