The impact of ecotourism on vegetation cover in Almaty Nature Reserve

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Abstract — The results of a pilot research project to assess the impact of ecotourism on vegetation cover in Almaty Nature Reserve, Kazakhstan, are presented in this paper. Geobotanical, GIS, ground truth and statistical methods were used. The results proved that significant differences existed between the species richness, vegetation condition, vegetation cover and the mean height of grass stands in experimental quadrats compared to the control quadrat. The recommendations include strategies to mitigate the impact of ecotourism on vegetation in the Reserve.

Index Terms — Kazakhstan, Almaty State Nature Reserve, ecotourism, impact on vegetation.

1 Introduction

Almaty Nature Reserve, IUCN category 1a, was founded in 1964 and occupies a territory of 71,700 ha on the northern slope of Transili Alatau, one of the Tian Shan mountain ranges. The main purpose of the foundation and existence of the Reserve is to protect natural mountain complexes of the Transili Alatau, including its flora and fauna. The secondary purpose is conducting research on natural processes occurring in these complexes. Flora of the Reserve includes 1,100 species of higher plants, more than 50 species of rare plants including 26 listed in the Red Data Book of Kazakhstan, a publication similar to an endangered species list. Abundant species include wild apricot trees (Armeniaca vulgaris), Sivers' apple trees (Malus Sieversii), Kolpakovskiy tulips (Tulipa kolpakovskiana) etc. Fauna diversity is very rich with 2,000 species of identified invertebrates and 255 vertebrates, including 3 fish species, 2 amphibians, 6 reptiles, 177 birds and 42 mammals. Mammals include the Tian Shan brown bear (Ursus arctos isabellinus), snow leopard (Uncia Uncia) and stone marten (Martes foina) [1], [2]. The Reserve is an attractive destination from an ecotourism perspective due to its rich biodiversity, pristine ecosystems and proximity (25 km) to major metropolis of Almaty with its modern tourism infrastructure and international airport.

The impact of recreation and tourism on plants is well-studied in North America, Europe and Australia (e.g. Cole [3], Buckley [4], Bayfield [5], Liddle [6], Newsome, Moore and Dowling [7], Turton [8] to name just a few). However, in CIS countries, Kazakhstan in particular, there is a limited amount of research conducted on this issue. Kazanskaya [9] has identified and described 5 stages of recreational degradation of plants. Anthropogenic

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influence has also been noted in central European reserves, most notably the Karadagskiy and Mys Martyan Reserves, Ukraine [10], where high numbers of anthropophilous and introduced plant species are observed (41.5% and 58.8% of reserve floras, respectively) demonstrating significant abnormalities in aboriginal plant communities.

2 MATERIALS AND METHODS

In order to study the impact of ecotourism on vegetation cover in Almaty Nature Reserve, four experimental quadrats, each measuring 1m x 1m, were placed within an "ecocamp" site. At the site, 125 ecotourists (children and students) were accommodated, causing 24-hour recreation pressure for the duration of one month. The ecocamp has been held in the same location for 3 consecutive years. The same area was used by mountaineers and other visitors for 30 years prior to that, so an assessment of its sensitivity is vital for reserve management. One control quadrat was selected, using GIS layers derived from DEMs, satellite imagery and historical survey of the park, as representative of the geobotanical conditions within the ecocamp area. This quadrat had a comparable flora, both in terms of species assemblage and habitat condition, to the ecocamp area before ecotourism began. Seven days before the start, and seven days after the ecocamp, all quadrats were marked, measured, and photographed. All plant species were identified and projective cover was estimated for every species. The control quadrat was not physically impacted by visitors. Quadrat 1 was located at the side of the camp and was subjected to a *medium* degree of trampling, as was quadrat 3. Quadrat 2 suffered a *weak* degree of trampling, and quadrat 4 a *strong* degree of trampling, since it was located right in the middle of the campsite, where meals and outdoor games took place.

Assessment of species condition was conducted on a three-point scale, as follows: 'good' – the plant is in healthy condition, flowering and fruiting as expected; 'satisfactory' – plant growth is visibly suppressed with weak flowering and fructification; 'poor' – the plant is in extremely poor condition with only vegetative reproduction.

3 RESULTS

TABLE 1

STATUS OF CONTROL QUADRAT ON 24TH OF JULY, 2007. MEAN HEIGHTS IN ALL TABLES ARE IN CM.

Plant species	Mean height	Cover, %	Species condition
Dactylis glomerata	105	20	good
Helictotrichon pubescens	75	15	good
Carex sp.	40	10	good
Origanum vulgare	58	5	good
Crepis sibirica	100	5	good
Geranium pratense	55	15	good
Trifolium pratense	32	5	good
Orobus luteus	105	1	good
Geranium rectum	40	5	good
Alchemilla sp.	23	1-3	good
Prunella vulgaris	30	1	good
Taraxacum officinale	20	5	good
Urtica dioica	25	single	good
Ranunculus sp.	50	single	good
Vicia sp.	90	1-3	good
Polemonium caucasicum	65	single	good
Euphorbia sp.	32	single	good
Lamium album	77	single	good
miscellaneous herbs (not identified)	25	single	good
	30	single	good

Vegetation in the control quadrat (Table 1, Fig. 1) comprised 100% projective vegetation cover, composed of 60% graminoid and 40% mixed herb species. There were 20 species altogether, and no change in projective cover was noted across the study period.

Fig. 1. Control quadrat. Graminoid and mixed herb plant community in mid-mountain forest-meadow zone, absolute heights 1200-2600 m. July, 2007. All photos - Woodward D.B.

TABLE 2

Survey data for quadrat 1. For all tables, 'a' denotes 'before ecotourism. 'b' denotes 'after ecotourism'

	Plant species	Mean height	Cover, %	Species condition
a	*Plantago major*	19	40	average
b		6	30	poor
a	*Polygonum aviculare*	6	20	good
b		4	1	poor
a	*Poa pratensis*	12	single	average
b		10	single	average
a	*Potentilla reptans*	10	10	average
b		4	3-5	poor
a	*Taraxacum officinale*	5	5	average
b		5	25	poor
a	*Achillea sp.*	10	5	average
b		5	1	poor
a	*Fragaria vesca*	6	5	poor
b		–	0	–

TABLE 3

Survey data for quadrat 2

	Plant species	Mean height	Cover, %	Species condition
a	*Potentilla reptans*	9	20	average
b		9	0	average
a	*Trifolium pratense*	18	20	average
b		16	10	average
a	*Poa pratensis*	14	20	average
b		10	70	average
a	*Geranium sp.*	10	5	average
b		–	0	–
a	*Alchimilla sp.*	5	20	average
b		11	5	average
a	*Plantago major*	17	15	average
b		12	5	average

TABLE 4

Survey data for quadrat 3

	Plant species	Mean height	Cover, %	Species condition
a	*Poa pratensis*	15	90	average
b		9	90	average
a	*Trifolium repens*	15	10	poor
b		10	< 1	poor
a	*Stellaria sp*	7	single	average
b		7	single	average

TABLE 5

Survey data for quadrat 4

	Plant species	Mean height (cm)	Cover, %	Species condition
a	*Poa pratensis*	7	30	average
b		3	20	poor
a	*Trifolium repens*	1.5	5	poor
b		1	single	poor
a	*Taraxacum officinale*	10	25	average
b		7	20	poor
a	*Plantago major*	8	single	poor
b		5	single	poor
a	*Achillea sp.*	3	sinlge	poor
b		2	Single	poor

Quadrat 4 (Figs. 2 and 3) consisted of a ruderal plant community, with only 5 species identified and counted before the start of camping season. The quadrat was subjected to a strong degree of trampling, but, as in quadrat 3, no species were actually lost during the study period. However, in quadrats 1 and 2 the number of species decreased by 1.

Fig. 2. Quadrat 4 during the ecocamp.

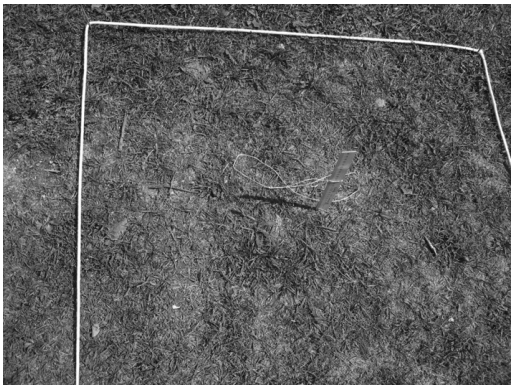

Fig. 3. Quadrat 4 after the ecocamp activities.

Total projective vegetation cover in the trampled quadrats was universally reduced by tourism pressure, as follows: quadrat 1 - 85% to 60%: quadrats 2 and 3 - 100% to 90%: quadrat 4 - 60% to 20%.

All species in the control quadrat remained in good condition throughout. In quadrat 1, which suffered medium trampling, initial species condition was 15% good, 70% average, 15% poor, but showed a decline after camping to 0% good, 17% average and 83% poor. In quadrat 2 (weakly trampled), all species were initially in average condition and in quadrat 3 (medium trampling) 66% of species were in average condition and 34% in poor – no significant change was observed in either quadrat after the camping visit. In quadrat 4, the most strongly trampled quadrat, 40% of species were initially in average condition and 60% poor - after camping, all species had declined to a poor state. Severe mechanical damages to vegetation were noted with all species in a highly depressed state.

A general decline in vegetation height was observed in trampled quadrats (see Table 6) with mean height of grass stands in the control quadrat exceeding the experimental quadrats by 43.8 cm at the end of the study.

TABLE 6

MEAN HEIGHT OF GRASS STANDS IN ALL FIVE QUADRATS BEFORE (A) AND AFTER (B) THE ECOCAMP

	Quadrat	Mean height (cm)
a	*Quadrat 1*	9.7
b		5.7
a	*Quadrat 2*	12.2
b		8.7
a	*Quadrat 3*	12.3
b		8.7
a	*Quadrat 4*	5.9
b		3.6
a	*Control*	53.85

4 CONCLUSION

Significant differences existed between experimental and control quadrats even before the start of the ecocamp, implying that ecotourism activity over the past 30 years has led to declines in species richness, vegetation condition and projective cover. The mean height of grass stands in experimental quadrats was greatly reduced, reflecting

a shift from native grass meadow to ruderal communities. Within the 6-week study period (during which mean vegetation height in the undisturbed quadrat increased by 20%, with no change in species number or vegetation condition) the trends noted above were exacerbated in all experimental quadrats. Based on the long-term and short-term comparisons, the rate of extinction of aboriginal species in Almaty Nature Reserve was estimated at 0.47 species per year.

It was also observed that quadrats 3 and 4, whose species communities were more characteristically ruderal, were more robust to species loss across the study period, though overall species condition was still damaged by recreation pressure. The implication, again, is that over a long period of tourism activity, these areas have already lost species which are most susceptible to trampling pressure. The total projective cover decreased in all experimental quadrats, with the highest decrease noted at the most strongly trampled site. The biggest changes were noted in condition of species, where strong trampling has caused consistent decline. Therefore, both long-term and short term ecotourism activity cause changes in the number of species, projective cover, mean heights of grass stands and species condition.

Hammitt & Cole [11] point out that control of visitor numbers will naturally fail to reduce ecological pressure while site access remains unrestricted. In fact, visitor numbers in Almaty Reserve are likely to rise in coming years, increasing the pressure on the camp site. If vegetation at the ecocamp site is to recover, some rotation or 'resting' of sites will be required. It is, therefore, proposed that future ecotourists be accommodated in the town of Talgar, while still participating in hikes along ecotrails within the Reserve. Alternatively, the ecotrails could be equipped and maintained in the same way as trails in American/Australian/Canadian/European national parks. The wooden coverings of the reserve's ecotrails would help to prevent erosion and mitigate trampling. Further studies on anthropogenic tolerance of different species, their biomass and spatial distribution changes under the impact of ecotourism in the given protected territory are recommended.

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