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Vegetation structure of *Plectranthus rugosus* dominated communities in Tehsil Kabal district, Swat

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Abstract

The present study aimed to investigate the status of *Plectranthus rugosus* dominated communities in Kabal swat. Various phytosociological attributes of all the recorded species were obtained. For quantitative analysis of vegetation a 4x4 m2 quadrat was used and a total of ten stands were sampled. Five quadrats were taken randomly per stand. Descriptive information altitude of the sampling site was recorded. For classification and ordination of vegetation data Ward's Cluster Analysis and Nonmetric Multidimensional Scaling (NMS) ordination was applied using PC-Ord software which results into the formation of four communities groups at 50% remaining information of the species. The highest values IVI, density/ha and cover/ha of *Plectranthus rugosus* was recorded in communities' group I while lowest value of ivi, density/ha and cover/ha was recorded in community group 3 which is due to the anthropogenic disturbance as observed during field survey.

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Introduction

Plecterenthus rugosus is an aromatic branched shrub of family Lamiaceae. Its leaves are opposite ovate having notched margin and covered with dense small hairs on ventral side distributed throughout the northern region. The flowering period of this species is July to September and the ripening of seeds occurs from august to October (Nasir and Ali, 1972). *Plectranthus rugosus* is medicinal and ecologically an important plant species and locally used for different types of diseases such as antiseptic, germicidal and cardiac stimulant (Singh1994). In Pakistan this species is locally used for toothache hypoglycemic, antidiarrheal, bronchodilator fever (Ajmal *et al*. 2012), hypertension (Akhtar *et al*., 2013), antifungal (Rauf *et al*., 2012), antibacterial, phytotoxic (Rauf *et al*. 2012) and antioxidant (Janbaz *et al*., 2014). Besides various medicinal properties, it is also be used for phytoremediation of heavy metals polluted soil (Muhammad *et al*., 2013). Plants association may be defined as stable plants groups in equilibrium with surrounding environment characterized by a certain dominant species which revealed a particular ecology. The presence of dominant species represents major trends in the local vegetation of an area and allowed ecologist to evaluate the dynamics of the community (Barkatullah, 2012).

Beside the soil chemical composition, topography, climatic condition and elevation man made disturbance also exert a great impact on the distribution and reshaping of plants communities (Cousin and Eriksson 2002; Chuangye *et al*., 2009). Due to anthrophogenic activity plant community are also disturbed. More over this plant is highly used for Honey bee for the recovering and good quality of Honey is produce due to it. Documentation of such a valuable shrub in the area like Kabal swat is very important because anthrophogenic pressure and conservation of wild land into agriculture land is very high and the plant becoming rare Documentation of the present status of *Plectherentus rugosus* community will be helpful in future planning or rehabilitation of that species.

Methods and materials

Study Area

Kabal is the administrative subdivision of District Swat. It is situated in North West of Mingora of Swat. Kabal is 10 Km away from Mingora city. It contains sub wards and union counsels. Climate of the study area is variable; the area is very cold in winter and pleasant in summer season. The study area is diverse in vegetation having species of different plants families. Different researchers have reported on the communities of different species of different species of trees as well as shrubs though there is not found any communities' structure and natural dynamics of *Plectranthus rugosus* in Kabal Lower Swat, Khyber Pakhtunkhwa, Pakistan.

Field Survey

In the spring of 2015, regular trips were arranged for sampling of *Plectranthus rugosus* dominated communities in kabal Lower Swat. The visited areas are Dokat (St. 1), Ghakhay (St. 2), Maranj poora (St. 3), Samai (St. 4), Mahak (St. 5), Asharay (St. 6), Dardyal (St. 7), Zaorrha (St. 8), Manja (St. 9) and Qalagay (St. 10). Standard procedure was applied for sampling of communities following (Cottom and Curtis, 1965).

Data Collection

Data was collected using a 4m x 4m quadrat and 5 quadrats were placed per stand. Inside each quadrat cover of individuals of every species was measured in cm and their number of individuals was counted. Elevation and aspect of the sampling site was also noted. The collected species were identified with the help of Pakistan (Nasir & Ali, 1972) and their dried specimens were deposited in the Herbarium, Govt: Post Graute Jahanzeb College Saidu Sharif swat, Pakistan

Data Analysis

The data obtained were analyzed for phytosociological attributes like frequency, relative frequency (F3), density, relative density (D3), cover, relative cover (C3) and Importance values (IVI) following Mueller-Dombois and Ellenberg, 1974; Curtis and McIntosh, 1950).

Statistical Analysis

The IVI data of the recorded species correspond to the environmental variables was subjected to PC-Ord (version 5.10) for classification (Ward's Cluster Analysis and NMS ordination) which results into the formation of four vegetation association.

Results

Classification of vegetation (Ward's Cluster Analysis)

The Wards cluster analysis separate the data in to various clusters and four distinct plants communities are made at 50% remaining information of the species (Fig. 1).

The distribution of species in the sampled stands is shown in the two way cluster Dendrogram (Fig. 2). Based on the IVI mean values of the species the detail of resulted communities is summarized below.

Plectranthus rugosus- Rumex hastatus community

This group consists of 39 species in which the leading dominant species is *Plectranthus rugosus* (18.3%) while the co-dominant specie is *Rumex hastatus* (9.6%). Among the other species of the IVI of Berberis *lyceum* was (9.6%), *Avana sativa* (5.5%), *Carbenia benedicta* (4.1%),

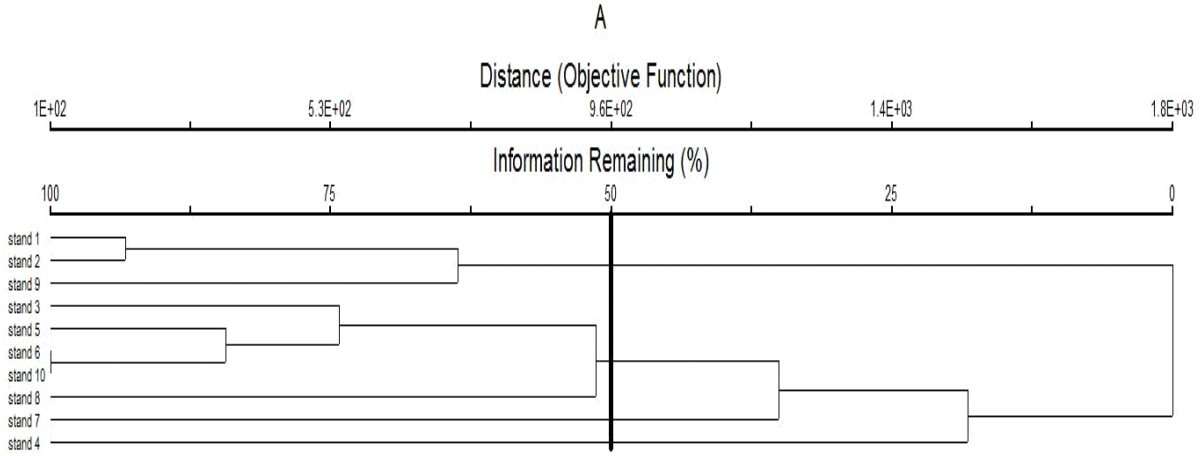

Fig. 1. Dendrogram results from Ward's Cluster Analysis communities made on 50% information remaining.

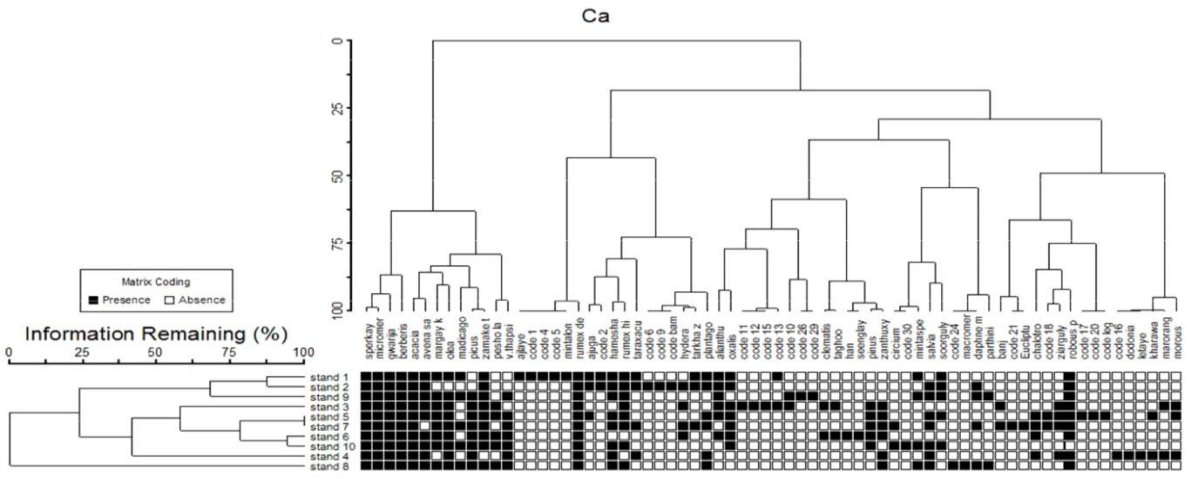

Fig. 2. Two way cluster dendrogram the dots showing the presence species in different plants communities.

Micromeria biflora (4.1%), *Plantago Major* (3.4%), *Indegofera geradiana* (3.2%), *Tagetes minuta* (2.6%), *Acacia modesta* (2.4%), *Rumax dintatus* (2.1%), *Ailanthus altissima* (2%), *Jasminium humlie* (2%), *Rubous protouses* (1.9%), *Fragaria vesca* (1.4%), *Debregeasiasalici folia* (1.4%), *Olea ferruginea* (1.3), *Ajuga bracteosa* (1.2%), *Dephne mucronata* (1.2%),

Salvia moorcroftiana (1.2%), *Hederane palensis* (1.1%), *Medicago sativa* (1.1%), *Oxalis corniculata* (1.1%), *Coixla chyma* (1.1%) the remaining species of this group shows les contribution.

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Dephne mucronata (1.2%), *Salvia moorcroftiana* (1.2%), *Hederane palensis* (1.1%), *Medicago sativa* (1.1%), *Oxalis corniculata* (1.1%), *Coixla chyma* (1.1%) the remaining species of this group shows les contribution.

Plectranthus rugosus- Berberis lycium community

This community comprised of 49 species in which the leading dominant is *Plectranthus rugosus* with a (17%) while the co-dominant specie is *Berberis lyceum* (9.4%). Among the other species of this community, the IVI of sativa is (6.3%),

Robous fruticous (4.7%), *Inula grandiflora* and *Micromeria biflora* (4.2%), *Olea ferruginea* (3.2%), *Acacia modesta* and *Daphne mucronata* (3%), *Astragalus graveolens* (2.6%), *Delphinium roylei* (2.5%), *Jasminium humlie* (2.5%), *Rumax hastatus* (2.3%), *Fragaria vesca* (2.3%), *Zanthoxylum armatum* (2.2%), *Ajuga parviflora* (2.1%) while the remaining species contributed less than 2% IVI to this community.

Plectranthus rugosus- Berberis lycium community

In this community, a total of twenty nine species were found in association with *Plectranthus rugosus*. In which the ivi of the *Plectranthus rugosus* is (16.1%) while the co-dominant specie, *Berberis lycium*. contributed (12.7%) followed by *Robus fruiticosus* (4.4%), *Micromeria biflora* (4.3%),

Olea ferruginea (4.1%), *Rumex hastatus* (3.3%), *Tagetesminuta* (3.1%), *Zanthoxylum armatum* (2.8%), *Plantago major* (2.3%), *Vicia sativa* (2.3%), *Fragaria vesca* (2.1%), *Echinops echinatus* Roxb (2.1%), *Medicago sativa* and *Calenduala arvensis* (2.0%).

The remaining species which are found in this community and shared less ivi are given in table (1).

Plectranthus rugosus- Chenopodium botrys community

This community is represented by a single stand and comprised of 24 species in which the leading dominant species is *Plectranthus rugosus* (16.9%) followed by *Chenopodium botrys* (13.0%). Among the remaining 22 species of this community the IVI of *Cotinus coggyria* is (7.0%), *Micromeria biflora* (6.4%), *Robus fruiticosus* (5.1%), *Plantago major* (4.4%), *Berberis lyceum* (4.4%), *Myrsineafricana* (3.9%), *Inula grandiflora* (3.8%), *Olea ferruginea* (2.8%), *Dodonaea viscosa* (2.4%), *Acacia modesta* (2.3%), *Salvia moorcroftiana* (2.1%), *Avena sativa*. The remaining species of this community contributed less than 2% IVI.

Ordination of vegetation communities

The data analyzed through ward's cluster analysis was also subjected to NMS for ordination in order to know about the pattern of vegetation associated with *Plectranthus rugosus* in different sampling stands. As the NMS ordination was run on the same data of IVI of the species and similar groups were obtained which are summarized in (Fig. 3). The results verify that Ordination and Cluster Analysis are two different methods though used for the same purposes. The NMS ordination plot showing the rotation of different stands between the two axis of NMS ordination (axis 1, axis 2). Group 1 which comprised of three zones is positioned toward axis 2, while group 2 which is comprised of five stands is positioned in the lower portion of the plot toward axis 1. Similarly group 3 which comprised of a single stand is present in the top of ordination plot toward axis 1. Group 4 is also positioned toward axis 1 in the middle portion.

The rotation of *Plectranthus rugosus* dominated stands showing irregular rotation between the ordination axes. The original data of altitude of the site and aspect was correlated with the NMS ordination axis (Axis 1, Axis 2) but it did not yield any significant relation with ordination axis at the given probability level (table 1-3).

Table 1. IVI mean values of *Isodon rugosus* and associated species.

	G 1			G 2		G 3		G 4	
Species	Mean	±	SE	Mean	±SE	Mean	±SE	Mean	±SE
Acacia modesta Wall.	2.4	±	0.1	3	±0.6	0.8	±0	2.3	±0
Achyranthes bidentata Blume.	0	±	0	0.5	±0.5	0	±0	0	±0
Ailanthus altissima (Mill) Swingle.	2	±	0.7	1.2	±0.5	0	±0	0	±0
Ajugabracteosa Wall. ex Benth.	1.2	±	0.6	0.3	±0.3	0	±0	0	±0
Ajuga parviflora Bth.	0	±	0	2.1	±0.5	0	±0	0	±0
Alnus nitida Endl.	0.5	±	0.5	0	±0	0	±0	0	±0
Androsace baltistanica Y. Nasir.	0	±	0	0.2	±0.2	0	±0	0	±0
Artimesia scoparia Waldst. & Kit.	0.6	±	0.6	0.4	±0.4	0	±0	0	±0
Asparagus gracilis Royle.	0.4	±	0.4	0	±0	0	±0	0	±0
Asparagus officinalis L.	4.1	±	4.1	0	±0	0	±0	0	±0
Astragalus graveolens Buch.- Ham.	0	±	0	2.6	±2.6	0	±0	0	±0
Avena sativa L.	5.5	±	1.1	6.3	±1.1	0	±0	2.1	±0
Berberis lyceum Royle.	5.6	±	2.4	9.4	±1.4	12.7	±0	4.4	±0
Calendula arvensis L.	0	±	0	0.7	±0.5	2	±0	1.8	±0
Calotropis procera (Wild) R.Br.	0	±	0	0.4	±0.3	1.1	±0	1.2	±0
Cannabis sativa L.	0	±	0	0.3	±0.3	0	±0	0	±0
Carbenia benedicta (L) Benth. Hk	0	±	0	0.2	±0.2	0	±0	0	±0
Celtis australis L.	0	±	0	0.4	±0.2	0	±0	0	±0
Chenopodium botrys L.	0	±	0	0.8	±0.8	0	±0	13	±0
Cirsium arvense (L.) Scop.	0	S	0	0.7	±0.7	1.1	±0	0	±0
Clematis connate	0	±	0	0.4	±0.3	0	±0	0	±0
Coixlachryma L.	1.1	±	0.2	0.7	±0.4	0	±0	0	±0
Cotinus coggyria Scop.	0	±	0	0	±0	0	±0	7.4	±0
Cynanchum arnottianum Wight.	0	±	0	0.4	±0.4	0	±0	0	±0
Daphne mucronata Royle.	1.2	±	0.7	3	±3	1.1	±0	0	±0
Debregeasia salicifolia (D. Don)	1.3	±	1.3	0	±0	0	±0	0	±0
Delphinium vestitum Wall.	0.5	±	0.5	0	±0	0	±0	0	±0
Odonaea viscosa (L.) Jacq.	0	±0	0	±0	0	±	02.4	± 0	
Daphne papyracea Wall, Ex. Steud.	0	±0	0.3	±0.3	0	±	00	± 0	
Echinops echinatus Roxb.	0	±0	0	±0	2.1	±	00	± 0	
Ficus carica L.	0.6	±0.6	1.8	±0.4	0.7	±	00.8	± 0	
Fragaria vesca L.	1.4	±0.5	2.3	±0.6	2.1	±	00	± 0	
Hedera nepalensis K. Koch	1.1	±1.1	0.5	±0.3	0.7	±	00	± 0	
Hypericum patulum	0	±0	0.2	±0.2	0	±	00	± 0	
Incarvillea emodi	0.3	±0.3	0	±0	0	±	00	± 0	
Inulagrandiflora Willd.	3.2	±0.8	4.2	±0.3	1.2	±	03.8	± 0	
Isodonrugosus Wll ex, Benth,	18.3	±1.9	17	±1.9	16.1	±	016.9	± 0	
Jasminium humlie Linn.	1.6	±1.2	0	±0	1.9	±	00	± 0	

Maytenus royleanus Wall.	0	±0	0	±0	0	±	01.3	± 0
Maytenus wallichiana	0.5	±0.5	0	±0	0	±	00	± 0
Medicago sativa L.	1.1	±0.5	0.9	±0.6	2	±	00	± 0
Mentha longifolia (L.) Huds.	0.3	±0.3	0	±0	0	±	00	± 0
Menthaspicata L.	0.6	±0.3	0.7	±0.5	0	±	00	± 0
Micromeria biflora (Ham.) Bth.	4.1	±0.3	4.2	±0.9	4.3	±	06.4	± 0
Morus alba L.	0	±0	0.2	±0.2	0	±	01.1	± 0
Myrsine africana L.	0	±0	0.2	±0.2	0	±	03.9	± 0
Oleaferruginea Royle.	1.3	±0.7	3.2	±0.4	4.1	±	02.8	± 0
Oxalis corniculata L.	1.1	±0.6	2.1	±0.7	1.2	±	00	± 0
Parthenium hytserophorus L.	0.3	±0.3	0.2	±0.2	0	±	00	± 0
Pimpinella stewartii Dunn. Nasir.	0.4	±0.4	0	±0	0	±	00	± 0
Pinus roxburghii Sargent.	0	±0	1.9	±0.9	1.1	±	00	± 0
Plantago major L.	3.4	±2.4	0.8	±0.6	2.3	±	04.4	± 0
Quercus baloot Griff.	0	±0	0.1	±0.1	0.7	±	00	± 0
Robus fruiticosus L.	1.9	±0.3	4.7	±1.5	4.4	±	05.1	± 0
Rubus sanctus Shreber.	0	±0	0.4	±0.4	0	±	00	± 0
Rumex dentatus L.	2.1	±1.2	0.9	±0.1	0.6	±	01.1	± 0
Rumex hastatus D. Don.	9.6	±1	2.3	±0.7	3.3	±	00	± 0
Salvia moorcroftiana Wall. ex Bth.	1.2	±0.6	0.9	±0.5	1.2	±	02.1	± 0
Tagetes minuta L.	2.6	±0.9	0.8	±0.3	3.1	±	01.3	± 0
Taraxacum officinale Web.	0.9	±0.5	0	±0	1.6	±	01.6	± 0
Verbascum thapsus L.	0.6	±0.6	1.8	±0.6	1.2	±	01.1	± 0
Verbena officinalis L.	0.2	±0.2	0.2	±0.2		±	00	± 0
Vicia sativa L.	2	±1.1	2.5	±0.3	2.3	±	00	± 0
Zanthoxylum armatum Steud.	0	±0	2.2	±1	2.8	±	01.7	± 0

Table 2. Correlation of ordination axis with aspect and altitude.

	axis I	Remarks	axis 2	Remarks
Altitude	0.051262	Ns	0.214322	Ns
Aspect	0.362334	Ns	0.156392	Ns

Table 3. Density/hector and cover /hector mean values of *Pecrenthusrugosus* and associated species.

	Density/ ha								Cover/ha							
	G 1		G2		G3		G4		G1		G2		G3		G4	
	Mean	±S E	Mean	± S E	Mean	±E S	Mean	±S E	Mean	±S E	Mean	±S E	Mean	±S E	Mean	±S E
Acmo	117	± 8	100	± 22	25	±0	125	± 0	2608	± 561	4644	± 767	3360	± 0	2320	± 0
Acbi	0	± 0	33.3	± 33	0	±0	0	± 0	0	± 0	1116	± 1116	0	± 0	0	± 0
Aial	83	± 36	45	± 20	0	±0	0	± 0	3600	± 616	4828	± 2037	0	± 0	0	± 0
Ajbr	225	± 113	55	± 55	0	±0	0	± 0	232	± 118	89	± 89	0	± 0	0	± 0
Ajpa	0	± 0	205	± 40	0	±0	0	± 0	0	± 0	720	± 28	0	± 0	0	± 0
Alni	67	± 67	0	± 0	0	±0	0	± 0	87	± 87	0	± 0	0	± 0	0	± 0
Anba	0	± 0	25	± 25	0	±0	0	± 0	0	± 0	154	± 154	0	± 0	0	± 0
Arsc	0	± 0	50	± 50	0	±0	0	± 0	0	± 0	384	± 384	0	± 0	0	± 0

Asgr	25	± 25	0	±	0	0	±0	0	± 0	231	± 231	0	± 0	0	± 0	0	± 0
Asof	150	± 0	0	±	0	0	±0	0	± 0	658	± 658		± 0		± 0	0	± 0
asgra	0	± 0	55	±	55	0	±0	0	± 0	0	± 0	81	± 81	0	± 0	0	± 0
Avsa	542	± 65	515	±	77	0	±0	150	± 0	2555	± 185	2669	± 331	0	± 0	2600	± 0
Bero	317	± 116	840	±	283	525	±0	250	± 0	5798	± 1544	4115	± 1126	7295	± 0	4584	± 0
Caar	0	± 0	115	±	83	225	±0	200	± 0	0	± 0	267	± 164	836	± 0	730	± 0
Capr	0	± 0	50	±	29	100	±0	100	± 0	0	± 0	264	± 164	880	± 0	920	± 0
Casa	0	± 0	87.5	±	88	0	±0	0	± 0	0	± 0	137	± 137	0	± 0	0	± 0
Cabe	0	± 0	250	±	0	0	±0	0	± 0	0	± 0	2	± 2	0	± 0	0	± 0
Ceau	0	± 0	15	±	10	0	±0	0	± 0	0	± 0	616	± 378	0	± 0	0	± 0
Chbo	0	± 0	43.75	±	44	0	±0	200	± 0	0	± 0	2434	± 2434	0	± 0	0	± 0
Ciar	0	± 0	100	±	100	75	±0	0	± 0	0	± 0	268	± 268	1893	± 0	0	± 0
Clco	0	± 0	40	±	24	0	±0	0	± 0	0	± 0	464	± 284	0	± 0	0	± 0
Cola	225	± 0	225	±	0	0	±0	0	± 0	101	± 101	76	± 76	0	± 0	0	± 0
Coco	0	± 0	0	±	0	0	±0	625	± 0	0	± 0	0	± 0	0	± 0	1341	± 0
Cyar	0	± 0	68.75	±	69	0	±0	0	± 0	0	± 0	147	± 147	0	± 0	0	± 0

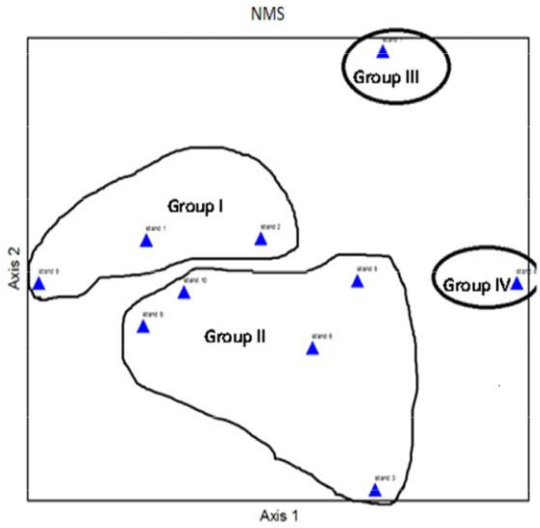

Fig. 3. NMS ordination plot showing the distribution of *Plectrenthusru gosus* dominate communities.

Density/ha and Cover/ha of Plectranthus rugosus dominated Communities

Group 1: Plectranthus rugosus- Rumexhastatus community

In this group the density/ha of *Plectranthus rugosus* was recorded as (2075 ± 288) individual/ha with a mean cover/ha of (2437±803) cm, the density/ha of the co-dominant species *Rumex hastatus* was (1175 ± 210) individuals/ha and 1602±213 cm cover/ha.

Among the remaining species of this community the density/ha of *Micromeria biflora* was (583±58) individuals/ha while its cover/ha was 893±21 cm.

Group 2: Plectranthus rugosus- Berberislycium community

Basedon density/ha the dominant species of this community is *Plectranthus rugosus* (1820±176) individual/ha and 1846±147 cm cover/ha followed by *Berberis lycium* (840±283) individuals/ha. The cover/ha of this species is 4115±1126cm.

Group 3: Plectranthus rugosus- Berberislycium community

In this community group 3 the density/ha of *Plectranthus rugosus* is (1500±0) and cover /ha is 1869-cm while that of the co-dominant species *Berberis lycium* is (525±0) individual/ha with a mean value of 4584 cm cover/ha.

Group 4: Plectranthus rugosus -MicromeriaBiflora community

Out of 24 species of this community the mean value of density/ha of *Plectranthus rugosus* (1775) and cover/ha is 1500-cm while the co-dominant species is *Micromeria biflora*. The mean density of this species is 625 individual/ha and 1386cm cover/ha.

Discussion

In the present study Ward's agglomerative technique was used for the analysis of *Plectranthus rugosus* dominated communities in Kabal (Lower Swat). Based on importance values of species cluster analysis separated data into four vegetation groups at 50 % remaining information of the species. All communities were dominated by *Plectranthus rugosus*. The co-dominant species in community 1 was *Rumex hastatus*, in community 2, 3 Barbers lyceum while, in community 4 the co-dominant species was *Micromeria biflora*. Similar study was conducted by Hussain *et al*. (2010) while studying the vegetation of central Karakoram national park and reported six plants communities. Ahmed *et al*. (2009) found 10 communities while studying *Olea ferruginea* forests in District Dir (Lower). Ahmed (2009) recognized 4 vegetation communities of herbaceous plants by the application of advance multivariate techniques in Margalla Hills National Park, whereas Shaheen *et al*. (2011) used these techniques for the determination of structure diversity, vegetation dynamics Bagh (Kashmir). Shaheen and Shinwari (2012) studied the phyto diversity and endemic richness of Karambar Lake vegetation of Chitral using TWINSPAN and DCA ordination for analysis. Khan *et al*. (2011) used multivariate methods for the analysis of structure diversity of *Monotheca buxifolia* and associated vegetation of District Dir (Lower).

The results obtained through Ward's cluster analysis also superimposed on NMS ordination axes. Our results is supported by Grieg-Smith (1983) and Shaukat (1985) who stated that that ordination and clustering are two basic techniques complementary to each other though applied fundamentally for different purposes. In the present study a total of 70 species were found in *Plectranthus rugosus* dominated communities which shows that the vegetation of study area is diverse, though their distribution and importance values in different communities' groups was different. The IV of *Plectranthus rugosus* was found high in community group 1, followed by community 2, while in community 3, 4 it was found similar but a large difference is observed in the species composition in different groups.

As in community 2, 52 species were found in association with *Plectranthus rugosus*. In community 1 it was 41, while 24 associated species were found in community group 4. Some species which found in all communities in association with *Plectranthus rugosus* are *Barberis lyceum, Indegofera geradiana, Tagetesminuta, Micromeria biflora, Olea ferruginea, Ficus carica, Plantago major, Rubus fruiticosus, Rumexdentatus, Rumex hastatus, Salvia moorcroftiana, Verbascum thapsus* are widely distributed in the study area. Other species which are found rarely in the *Isodon* dominated communities require proper management for their conservation otherwise they will be loss in the future. Similar to the number of species composition the importance values, density/ha and cover/ha of *Plectranthus rugosus* was also different in different sampling stands.

The importance value, density/ha and cover/ha of *Plectranthus rugosus* was high in community 1. Similarly the d/ha of *Plectranthus rugosus* was low in community group 3 and the lowest cover/ha was found in group 4. Some of the most important species which are found in association with *Plectranthus rugosus* are *Berberis lyceum, Indegofera geradiana, Accacia modesta, Ailanthus altissima, Rubus fruiticosus, Olea ferruginea, Dephne mucronata* and *Parthenium hyterophorus*. Among these species berberis lyceum is an important medicinal plant used for the treatment of different types of diseases. Other species such as *Indegofera geradiana, Tagetes minuta*, and *Olea ferruginea* are other important species used by the people of the area for fuels and other purposes purpose (Khan *et al*., 2011). Similarly *Ficus palmata* is also an associated species with *Plectranthus rugosus* that yield edible fruits but was rare in the forest. On the other hand *Dodonaea viscosa* was part of the associations that is the dominated s

pecies in open and hilly areas on lower elevation of Malakand division. *Partehnium hysterophorus* is also found in Isodon dominated communitie's

which is an invasive species and is a threat to the natural flora and particularly to isodon and other important medicinal plants and their reduction can be controlled by an active but scrupulous intervention like enrichment and improvement planting (Khan *et al.* 2010; Siddique *et al.*, 2012).

The forest of *Plectranthus rugosus* were dominated by low growing, light loving species replacing upper canopy trees with high timber value i.e. *Oleaferruginea, Ficuscarica*. These species is declining due to their timber and fruit value resulting in low species evenness and lower economic value of the forest. In the present study different important trees and shrubs were found in association with *Plectranthus rugosus* with very low ivi, density/ha and cover/ha. The less contribution of these trees and shrubs species may be due to the highest demand for fuels and other purposes as reported by Khan *et al.*, 2011; Shariatullah, 2013. It is suggested that elevation is one of the most important and basic controlling factor prevailed in the vegetation structure. In the present study the altitude and aspect data of different stands was correlated with the NMS ordination axis in order to know about the effect of altitude and aspect on the distribution of *Plectranthus rugosus* in different sampling stands but it did not yield any significant relationship with the NMS ordination axis. Hill and Gauch (1980) and Mc Cune and Grace (2006) stated that the ordination is capable of yielding at least one basic gradient associated with the vegetation. Similar study was conducted by Rahman (2012) and found significant relation of DCA ordination axis 1 with altitude. Shariatullah (2013) found significant relationship of altitude with ordination axis while studying the community structure of *Justicia adhatoda* in Malakand division. Khan *et al.* (2011) found significant correlation of Ordination axis with altitude, organic matter, soil pH, and nitrogen and magnesium contents while studying the vegetation of subtropical dry temperate forests of Pakistan. However our finding is in correlation with Khan (2011) who reported the effect of environmental variables (topographic, edaphic and soil variables and did not found any significant correlations with the DCA ordination axes and argued that anthropogenic effect is responsible for the differences in the distribution of species in different communities. As the IVI, density/ha and cover/ha of *Plectranthus rugosus* was high in community the difference in the altitude was low in different community.

So the high density may be the less anthropogenic disturbance which was observed during field survey as compared to other communities. Beside the anthropogenic disturbance there are some other important environmental variables, for example, water holding capacity (WHC), soil moisture, calcium, magnesium, conductivity, salinity and soil depth, to be considered to explain the variability as reported by Palmer (2005) and was not studied in the present study. Beside this slope, soil texture, available nitrogen, potassium, organic matter, lime and soil moisture differences are also responsible for the differences in density, ivi, and cover as well as the distribution of the vegetation Zare *et al.* (2011).

Conclusion and Recommendation

Plectranthus rugosus dominated communities are generally diverse in herb species while shrub and trees are minor associates. *Plectranthus rugosus* is a moisture loving species and mostly grows on north and north east aspect. Difference in IVI, density/ha, cover/ha of *Plectranthus rugosus* in different sampling stand is due to the overgrazing of animals and unsustainable use for fuels, fodders and medicinal purposes by the peoples of the area. This unsustainable use will lead to the rapid decrease of *Plectranthus rugosus* in the area. Further study is needed to explore the effect of edaphic variables on the distribution of this important species.

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