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Plant diversity of vegetation mosaics in a fresh water swamp of doon valley

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Abstract
Swamps are wetlands where water oozes out from surface also known as 'Oogals'. In past time, low lying area of Doon Valley were having an interconnected chain of swamps. But excessive human interference resulted in destruction of majority of Doon Valley swamps. Swamps are ecotones exhibiting high biodiversity of palatable species making them susceptible to overexploitation. The present study is conducted in Mothronwala fresh water swamp of Doon Valley which is under anthropogenic threat. A total of 62 species are recorded from vegetation mosaics. The diversity in vegetation mosaics of Mothronwala swamp is represented by 26 families, 51 genera and 62 species. Poaceae is the most dominant family of vegetation mosaics. The most dominant life form of vegetation mosaic are herbs followed by shrubs and grasses. The nearby population is dependent on swamp forest for fodder, food, fuel wood and medicinal plants leading to loss in floristic diversity. A proper conservation strategy is needed for maintaining biodiversity of freshwater swamp.

Keywords: plant diversity, fresh water swamps, mothronwala, vegetation mosaic

Introduction
Wetlands are defined as land transitional between terrestrial and aquatic ecosystem,where water table is usually at or near the surface or the land is covered by shallow water (Mitsch and Gooselink, 1986) [11]. Swamps are marshy wetlands where water oozes out from the surface locally also known as 'Oogals'. In past time low lying areas of Doon valley were having a chain of swamps but excessive anthropogenic interference resulted in destruction of majority of swamps. Fresh water swamps help in absorbing toxic chemicals, cleaning polluted water and in maintaining water quality Swamps are ecotones exhibiting high biodiversity of economically important plants due to which they are susceptible to overexploitation. Wet lands are repositories of fresh water. The rain water infiltrates and then percolates down and this makes water clean and suitable for drinking. Doon valley fresh water swamps in southern fringe of the valley seems to play an important role in the evolution of human settlements and industrial growth. Vegetation of freshwater swamps in DOON VALLEY are extensively studied by Kanjilal (1901) [8], Dakshini (1960 a, b, 1965, 1970, 1974) [1, 2, 3, 4, 5], Somdeva and Aswal (1974) [14], Somdeva and Srivastava (1978) [15], Ghildiyal and Srivastava (1989) [7], Joshi and Dhyani (2007) [6] and Sharma and Joshi (2008) [12]. Present paper focuses on plant diversity in five important vegetation mosaics of Mothronwala swamp forest.

Materials and Methods
Study site
The present study is carried out in Mothronwala swamp forest of Dehradun valley which lies between latitudes 29°58' Nand 31°02' N and longitudes 77°34' E and 78°18' E in state of Uttarakhand. Mothronwala swamp forest is spread over an area of 22 acres, on the north of the confluence of rivers Rispana, Bindal and Suswa. It is located 5 km away on the southern part just atfoothills of Shivaliks. The area is sunny and dominated by several herbaceous community mosaics. The vegetation is several layered with a distinct floristic composition at each stratum. in aquatic running part *Rorripa nasturtium aquaticum, Bacopa monnieri* dominate.The moist to very moist zone is dominated by *Coix lachryma jobi, Pozolzia pentendra and Polygonum barbatum. Lantana camara,Chromolaena odorata, Ipomoea carnea* are dominant shrubs. The climate of the area is hot but humid. However the variation of micro-climate seems to play a major role in the formation of a unique community mosaic

Methodology
The study area was frequently surveyed for understanding of community mosaics.Once identi Standard methods of collection, preservation and maintenance of specimen in herbarium were followed in accordance with Jain and Rao (1977) [9]. Collections of plant species were done in summer, rainy and winter seasons. After collection, processing, preservation and mounting of specimen were done on herbarium sheets. The herbarium sheets were identified from BSI (NC) Dehradun. Flora by Gaur (1999) [13] were used for description and nomenclature of plants. The plant species were then classified on the basis of habit and life forms.

Results and Discussion
The floristic diversity of vegetation mosaics is represented by 62 species (Table 1). Poaceae was the most dominating family followed by Asteraceae and Cyperaceae. Vegetation mosaics are represented by 26 families angiosperms and 50 genera. One species of pteridophyte *Diplazium esculentum* is also recorded from vegetation mosaic. Classification on the basis of habit reveals that herbs are main life form followed by shrubs and grasses.
The maximum species diversity (31 species) occurred in community 5 whereas lowest species diversity (13 species) occurred in community 2. In all the species number is relatively low when compared with adjoining land

communities probably due to perennial water or high moisture presence throughout the year. The low diversity can also be attributed to high human interference. The nearby population is dependent on swamp forest for fodder, food, fuel wood and medicinal plants leading to loss in diversity. Overexploitation of medicinal plant *Acorus calamus* is evident. Herbs are the most dominant followed by shrubs which is an indicator of high disturbance. Excessive grazing is one important biotic factor which plays an important role in reducing vegetation.

The contribution of growth forms in various community mosaics (Table 2) indicates dominance of herbs followed by sedges. Moist areas are particular habitats of sedges. Herbs ranged from 8 species to 16 species and sedges in between 2 species to 5 species. A comparative contribution of individual growth form (Figure2) indicates absence of under shrub in community 1, 2 and 4 Organ of perennation is in the form of rhizome. Rootstock and tuber in characteristic swampy plants (Table 3). Annual plant species in general have seeds as perennating organ. Freshwater swamps of Doon valley are unique ecosystem but due to land use change and overexploitation, they are under great threat. A proper conservation strategy is needed for maintaining biodiversity of swamp.

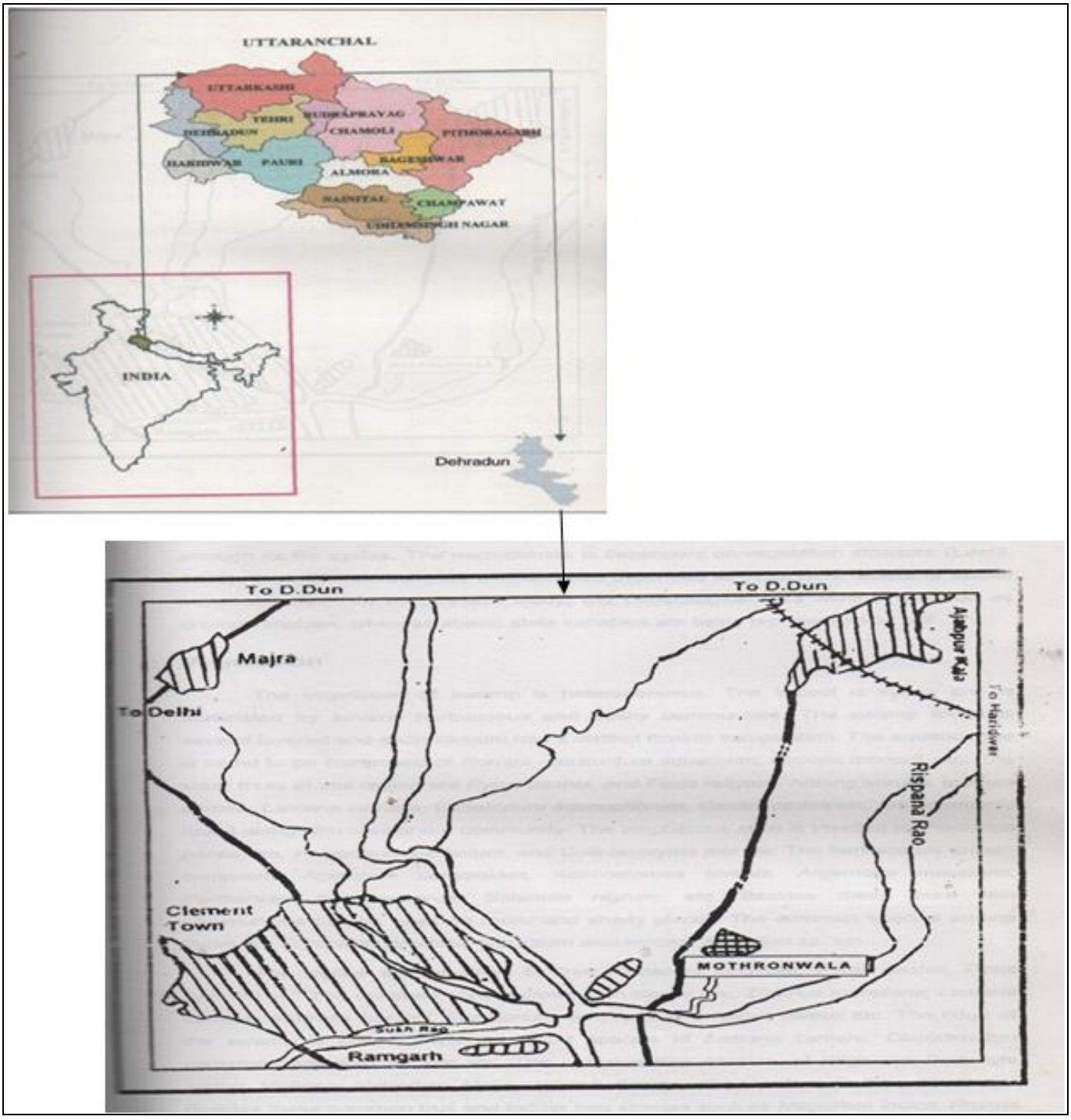

Fig 1: Location of the study area

Table 1: Growth habit of various community mosaics in the study area

Community	Grasses	Sedges	Shrubs	Undershrubs	Herbs	Total
C_1	04	05	01	00	11	21
C_2	00	04	01	00	08	13
C_3	01	03	03	01	14	22
C_4	03	05	00	00	09	17
C_5	05	02	02	06	16	31

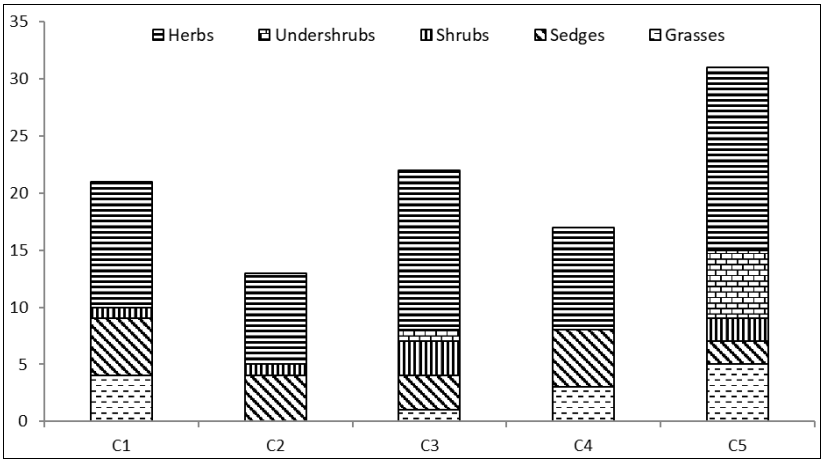

Fig 2: Relative composition of growth forms in community mosaics

Table 2: Floristic Diversity of Vegetation with presence of species in various community mosaics

Plant species	C_1	C_2	C_3	C_4	C_5
Enydra fluctuans	+	+	+	+	–
Cyperus nutans	+	+	+	+	–
Bacopa monnieri	+	+	+	+	–
Ipomoea carnea	+	+	–	–	–
Fimbristylis bisumbellata	+	+	–	+	–
Fimbristylis dichotoma	+	+	+	+	–
Ageratum conyzoides	+	+	+	+	–
Eclipta alba	+	+	–	–	–
Cyperus globosus	+	–	–	+	–
Pouzolzia pentandra	+	+	+	+	–
Polygonum barbatum	+	–	+	+	–
Commelina benghalensis	–	+	+	+	–
Eupatorium adenophorum	+	+	+	–	–
Justicia quinqueangularis	–	+	–	+	–
Acorus calamus	–	–	+	+	–
Calamus tenius	–	–	+	–	–
Coix lacryma–jobi	–	–	+	–	–
Allmania nodiflora	+	–	+	–	–
Cyperus brevifolius	–	–	+	+	–
Mentha piperita	–	–	–	+	–
Imperata cylindrica	–	–	–	+	+
Paspalum scrobiculatum	–	–	–	+	+
Desmodium trifolium	–	–	–	–	+
Eleusine indica	+	–	–	–	+
Cyperus rotundus	+	+	–	–	+
Cassia tora	–	–	–	–	+
Parthenium hysterophorus	+	–	+	–	+
Clerodendrum viscosum	–	–	–	–	+
Cyperus cyperoides	–	–	–	–	+
Justicia procumbens	–	–	–	–	+
Sigesbeckia orientalis	–	–	–	–	+
Urena lobata	–	–	–	–	+
Oxalis corniculata	–	–	–	–	+
Apluda mutica	–	–	–	–	+
Sorghum nitidum	–	–	–	–	+
Sida cordata	–	–	–	–	+
Artemesia vulgaris	–	–	–	–	+
Artemisia roxburghiana	–	–	–	–	+

Desmodium laxiflorum	–	–	–	–	+
Ziziphus nummularia	–	–	–	–	+
Evolvulus nummularius	–	–	–	–	+
Bidens biternata	–	–	–	–	+
Lantana camara	–	–	+	–	–
Barleria cristata	–	–	–	–	+
Euphorbia hirta	–	–	–	–	+
Cynodon dactylon	+	–	–	–	–
Echinochloa colona	+	–	–	–	–
Xanthium strumarium	+	–	–	–	–
Setaria glauca	+	–	–	–	–
Solanum nigrum	+	–	+	–	–
Phyllanthus urinaria	–	–	+	–	–
Cartissa opaca	–	–	+	–	–
Callicarpa macrophylla	–	–	+	–	–
Solanum torvum	–	–	+	–	–
Diplazium esculentum	–	–	+	–	–
Phragmites karka	–	–	–	+	–
Saccharum spontaneum	–	–	–	–	+
Centella asiatica	–	–	–	–	+
Rubus niveus	–	–	–	–	+
Triumfetta rhomboidea	–	–	–	–	+
Polygonum hydropiper	–	–	–	–	+
Vernonia cinerea	–	–	–	–	+

Table 3: Organ of perennation and Uses of individual species

Plant Species	Family	Growth Form	Organ of perennation	Use	Flowering time
Enydra fluctuans Lour.	Asteraceae	Herb	Seed	Leaves are eaten as salad and used as vegetable. Decoction of plant used in urinal trouble, diarrhea and dysentery	Nov. to April
Cyperus nutans Vahl.	Cyperaceae	Sedge	Rhizome		Aug. to Nov.
Bacopa monnieri (L.) Penell	Scrophulariaceae	Herb	Seed	Plant paste applied externally for rheumatic pains; also used in epilepsy, improves intellect	Throughout the year
Ipomoea carnea Jaquin Enum.	Convolvulaceae	Shrub	Seed	-	Throughout year
Fimbristylis bisumbellata (Forsk.) Bubani	Cyperaceae	Sedge	Seed	-	Aug.-Nov.
Fimbristylis dichotoma (L.) Vahl	Cyperaceae	Sedge	Seed	-	Aug.-Nov.
Ageratum conyzoides L.	Asteraceae	Herb	Seed	Roots are made into paste and applied on sores & cuts and other skin ailments	Jan.-Dec.
Eclipta alba (L.) Hassk.	Asteraceae	Herb	Seed	Decoction of plant used in catarrh & throat pain, plant juice in asthma, fever and constipation	Jan.-Dec.
Cyperus globosus Allioni	Cyperaceae	Sedge	Seed	-	Aug.-Dec.
Pouzolzia pentandra (Roxb.) Bennett & Brown	Urticaceae	Herb	Seed	-	Oct.-April
Polygonum barbatum L.	Polygonaceae	Herb	Seed	-	Jan.-Dec.
Commelina benghalensis L.	Commelinaceae	Herb	Seed	Plant juice given in dysentery and paste applied on body swelling and ache.	July-Nov.
Eupatorium adenophorum Sprengel	Asteraceae	Herb	Seed	Crushed leaves applied on wound	Feb.-Aug.
Justicia quinqueangularis Koenig ex Roxb.	Acanthaceae	Herb	Root stock seed	-	Mar.-Sep.
Acorus calamus L.	Araceae	Herb	Tubers and rhizomes	Soft drinks made from rhizome, extract of rhizome used in gastrointestinal trouble and bronchitis	June-Sep.
Calamus tenius Roxb.	Arecaceae	Herb (Palm)	Seed	Stems of leaves often used for mats & fan, flowers used in amenorrhea, stem used to make containers, basket, fruits are edible.	July-Nov.
Coix lacryma–jobi L.	Poaceae	Grass	Seed	Leaves used as fodder, grains for beads and rosaries, rarely as substitute for rice	Sep.-Nov.
Allmania nodiflora (L.) R. Br.	Amaranthaceae	Herb (annual)	Seed	Used as vegetable, antimicrobial and anti-inflammatory	May-June
Cyperus brevifolius (Rottb.) Hask.	Cyperaceae	Sedge	Rhizome	Decoction of whole plant used in malaria, colds, cough; leaves and tubers used in diarrhea.	Aug.-Nov.
Mentha piperita L.	Lamiaceae	Herb	Seed	Plant is source of peppermint used in medicines and flowering; source of menthol used in indigestion and malarial fever.	Aug.-Sep.
Imperata cylindrica (L.) P. Beauv.	Poaceae	Grass	Seed	Wooly hairs of inflorescence used for staunching wound and stuffing. Roots used as tonic.	Jan.-Dec.
Paspalum scrobiculatum L.	Poaceae	Grass	Seed	Root paste applied to belly in painful urination; medicinal extract used as eye drops	July-Dec.

Desmodium trifolium (L.) DC.	Fabaceae	Herb	Seed	Palatable	July-Sep.
Eleusine indica (L.) Gaertn.	Poaceae	Grass	Seed	Palatable	July-Nov.
Cyperus rotundus L.	Cyperaceae	Sedge	Rhizome	Essential oil	July-Dec.
Cassia tora L.	Caesalpiniaceae	unsershrub	Seed	Plant extract seeds and leaves used in skin diseases, cuts and wounds. Leaves and roots used as vermicide and vermifuge	Apr.-Sep.
Parthenium hysterophorus L.	Asteraceae	Herb	Seed	-	Throughout year
Clerodendrum viscosum Ventenat	Verbenaceae	Herb	Seed	Leaves used as vermifuge and in skin diseases; stem used as fuel.	Feb.-May
Cyperus cyperoides (L.) Kuntze	Cyperaceae	Sedge	Rhizome	-	July-Nov.
Justicia procumbens L.	Acanthaceae	Herb	Seed	-	Feb. - Apr.
Sigesbeckia orientalis L.	Asteraceae	Herb (annual)	Seed	Juice of fresh herb used as dressing for wounds, decoction of leaves and young shoots used as lotion for ulcers and parasitic skin disease.	Oct.-Nov.
Urena lobata L.	Malvaceae	undershrub	Seed	Stem yields a coarse fibre, decoction of roots given in gonorrhea	Aug.-Nov.
Oxalis corniculata L.	Oxalidaceae	Herb	Seed	Leaves taken as salad or cooked as vegetable	Throughout year
Apluda mutica L.	Poaceae	Herb	Seed	As fodder and for thatching the huts and as brooms	Sep.-Oct.
Sorghum nitidum (Vahl) Persoon	Poaceae	Grass	Seed	As fodder, also made into brooms.	Aug.-Oct.
Sida cordata (Burm.f.) Borss. Waalk	Malvaceae	Herb	Seed	Stem yields a coarse fibre; leaves, roots and bark medicinal used in gonorrhea	Throughout year mainly in rainy season
Artemesia vulgaris AUCT.NON L.	Asteraceae	Herb	Seed	Leaf juice used against intestinal worms, young leaves made into brooms	July-Dec.
Artemisia roxburghiana Wallich ex Besser	Asteraceae	undershrub	Seed	Plant extract antipyretic, used as tonic and also in skin allergy	Sep.-Nov.
Desmodium laxiflorum DC.	Papilionaceae	undershrub	Seed	As fodder	Aug.-Dec.
Ziziphus nummularia (Burm.f.) Wight & Arn.	Rhamnaceae	Shrub	Seed	Fruits edible, leaves used as fodder	Sep.-Feb.
Evolvulus nummularius (L.) L.	Convolvulaceae	Herb	Seed	-	Aug.-Oct.
Bidens biternata (Lour.) Merrill & Sheriff	Asteraceae	Herb	Seed	Leaves used in leprosy, leaf juice used in cuts	Throughout the year
Lantana camara L.	Verbenaceae	Shrub	Seed	Fuel, furniture; leaves insecticidal	Throughout the year
Barleria cristata L.	Acanthaceae	undershrub	Seed	Medicinal	Sep.-Nov.
Euphorbia hirta L.	Euphorbiaceae	Herb	Seed	Medicinal	Jan.-Dec.
Cynodon dactylon (L.) Persoon	Poaceae	Grass	-	Medicinal	Jan.-Dec.
Echinochloa colona (L.) Hort. Bot. Berol.	Poaceae	Grass	Seed	Palatable, grains prepared as rice	July-Oct.
Xanthium strumarium L.	Asteraceae	Herb	Seed	–	July-Dec.
Setaria glauca (L.) P. Beauc.	Poaceae	Grass	Seed	Palatable grains occasionally eaten	Aug.-Nov.
Solanum nigrum L.	Solanaceae	Herb	Seed	Medicinal	Throughout the year
Phyllanthus urinaria L.	Euphorbiaceae	Herb	Seed	Leaves intoxicant to fishes	Almost throughout the year
Cartissa opaca Stapf. ex Haines	Apocynaceae	Shrub	Seed	Palatable, fruits edible	Apr.-June
Callicarpa macrophylla Vahl.	Verbenaceae	undershrub	Seed	Fruits edible; medicinal	July-Sep.
Solanum torvum Swartz	Solanaceae	Shrub	Seed	–	Nov.-July
Diplazium esculentum (Retz.) Sw.	Pteridophyte	Herb	-	Palatable	July-Aug.
Phragmites karka (Retz.) Trinius ex Steudel	Poaceae	Grass	Rootstock	-	July-Nov.
Saccharum spontaneum L.	Poaceae	Grass	Rootstock	Medicinal (leaves)	Sep.-Nov.
Centella asiatica (L.) Urban	Apiaceae	Herb	Seed	Medicinal	Apr.-May
Rubus niveus Thunb.	Rosaceae	Shrub	Seed	Fruits edible; medicinal	-
Triumfetta rhomboidea Jacquin	Tiliaceae	undershtub	Seed	Medicinal	Aug.-Nov.
Polygonum hydropiper L. Spach	Polygonaceae	Herb	Seed	Medicinal	Jan.-Dec.
Vernonia cinerea L. Lessing	Asteraceae	Herb	Seed	Medicinal	Jan.-Dec.

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