

Aquatic Plants of Sialkot District, Pakistan

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Abstract: In this taxonomic account 20 aquatic plants, which are reported for the first time from Sialkot District are presented. These species were *Pistia stratiotes* L., *Eichhornia crassipes* (Mart.) Solms, *Mentha spicata* L., *Nasturtium officinale* R. Br., *Phyla nodiflora* (L.) Greene, *Persicaria glabra* (Wild.) M. Gomes, *Cyperus alopecuroides* Rottb., *Cyperus nutans* Vahl, Enum., *Cyperus glomeratus* L., *Cyperus digitatus* Roxb., *Saccharum spontaneum* L., *Polypogon fugax* Nees ex Steud., *Arundo donax* L., *Typha latifolia* L., *Juncus articulatus* L., *Nymphaea nouchali* Burm.f., *Veronica-anagallis-aquatica* L., *Ranunculus scleratus* L., *Lemna minor* L. Regular field tours were conducted to collect aquatic flora of Sialkot district, Pakistan. In total of 20 species belonging to 15 families were collected from different sites and habitats. Plants were dried and preserved by using standard herbarium techniques and deposited in the Herbarium of Pakistan Islamabad. Inclusive morphological work was carried out under dissecting binocular. Diverse morphological, vegetative and floral characters were observed. Morphological features play a most important role in identification of flora and their classification at the species and generic level. This will give a path for future researchers to identify and recognize culinary wetland vegetables in order to prevail over the food crises.

Key words: Aquatic Plants • Morphological • Vegetative • Reproductive characters

INTRODUCTION

Sialkot district is situated at the lower range of ice-covered mountain tops of Kashmir nearby the Chenab river, in the north-east of the Punjab Province. Sialkot city is the capital of Sialkot district. At an altitude of 256 m above sea level, lying between 33° North latitude and 74.7° in East longitude. There are four Tehsils in district Sialkot namely Daska, Pasrur, Sambrial and Tehsil Sialkot. There are three seasonal small streams in Sialkot, district namely they are aik, bher and palkhu. The land of Sialkot district is usually plain and fertile. During monsoon season in summer, maximum rain fall is being recorded that must be consequences of the flooding which are frequent in irrigated areas. One of the advanced and best equipped weather forecasting and warning center is available in Sialkot. Sialkot is basically an agricultural District. Mostly it is full of greenery. The most important crops and fruit of district Sialkot are wheat, rice, citrus and guava. As far as the production rate is concerned, their

average annual production over the period 1998-2001 was 453, 242, 6 and 11 thousand Metric Tons, respectively. A diversity of vegetables are also cultivated in the district. In this district there are 14 flour mills, 57 rice husking units, one sugar mill, one vegetable ghee unit and one fruit juice unit already working. Wetland flora are photosynthetic organisms, sufficient to observe with the naked eye, that vigorously develop everlastingly or occasionally submerged underneath, suspended on, or growing up throughout the wet plane. Wetland flora are characterized in seven plant divisions: Cyanobacteria, Chlorophyta, Rhodophyta, Xanthophyta, Bryophyta, Pteridophyta and Spermatophyta which are represented by 33 orders and 88 families with concerning 2,614 species in Ca. 412 genera [1]. There are several types of wetland species up to thousands belonging to unlike genera colonized in fresh water environment along the margins at the bottom in the surface of ponds and lakes, at ditches or muddy places, or in the natural drainage systems. Wetland flora is very grave habitat and basic center for fishes. It is

an absolute oxygen source for aquatic life, a very safe place for both the prey and predator [2, 3]. Basic component of the healthy environment is aquatic flora. All vegetations whatever on soil or in or in the region of aquatic life exhibit the process, photosynthesis and by doing this these plants contributed to accumulation of oxygen in the environment [4]. Wetland flora has displayed variety. Special forms of wetland are there; these may be emergent plants, submerged plants, free moving, rooting and floating plants [5]. Many soft plants water may give a prospective atmosphere for the appropriate enlargement and expansion. Hydrophytic vegetation are surrounded in profound water and the somatic parts primarily upper surface of water plane restrain monocotyledonous plants belong to the family Poaceae and plants that have wider foliages. Plants perform a considerable part to secure the water significance which avoids seashore surface against devastation. Almost all wetland plants due to their roots in deposits underneath water and its somatic parts in the atmosphere [6]. *Polygonum spp.*, *Cyperus spp.* and *Typha latifolia* are well-known examples of emergent forms of wetland flora.

Surface of water is completely enveloped with the wetland flora. Occasionally wetland flora exhibit no connection with dirt or underneath in water though others deep-rooted plants in water with asymmetrical foliages that may enhance and fall with water level. This specific flora adapted special structures to move smoothly above the water obviously similar to air spaces in roots, hairs on foliage which capture air and produced little sound in stem for specific purposes. Truly floating wetland flora are duckweed and water meal. *Nymphaea spp.* and *Nelumbo spp.* are entrenched lucid plants, very significant hydrophytic flora. These exhibit marked role to provide for other hydrophytic flora. These plants darken out below water plant and instigate drop of oxygen for the bottomless plant [4, 7]. In this category wetland vegetation exhibit distinctive parts of including twigs, roots and foliage. Plant rooted below, this hydrophytic vegetation develop below the outer surface but some foliage, flowers and seeds on the upper surface of it. The surroundings of the majority submerged vegetation is confined in aquatic habitat ranges in depth of 10-12 feet [8]. Pondweeds are the vital submerged plants (*Potamogeton sp.*, *Utricularia sp.* and *Elodea sp.*)

MATERIALS AND METHODS

Materials: The equipments used for the during research work, were previous literature, maps, pencil, rubber, field note book, scale, polythene bags, old newspapers, blotting papers, camera, color films etc.

Collection of Plant Material: Regular field tours were conducted to collect aquatic flora of Sialkot district, Pakistan. In total of 20 species belonging to 15 families were collected from different sites and habitats. All plant specimens were collected in triplicate and voucher number was elected to plants. Date of collection, locality, habitat and color of inflorescence and leaves were recorded during collection trips.

Drying and Preservation: Plants were dried and preserved by using standard herbarium techniques and deposited in the Herbarium of Pakistan Islamabad.

Morphological Studies: Inclusive morphological work was carried out under dissecting binocular. Diverse morphological (vegetative and floral) characters were observed and confirmed by Flora of Pakistan [9]. The following morphological characters of each species were studied and 5-7 specimen of each species were observed for morphological studies.

Vegetative Characters:

Habit: Annual or perennial, erect, prostrate or decumbent.

Root: Type, length, width texture of root, hairs present or absent.

Stem: Type, thickness, Shape, length and width, texture of stem, color and texture

Leaf: Type, Shape, length and width, texture and color of leaf, form of leaf sheath (glabrous, scabrid, open or folded). Length and shape of ligule (membranous, lacerate membranous, with ciliated fringe or white hairs).

Reproductive Characters

Inflorescence: Raceme or spike (open, contracted, cylindrical or ovate). Length and shape of Panicle

Spikelet: Shape, length and width, sessile and single or in group or pedicellate.

Glumes: Shape, length and width, texture, number of nerves of flower and upper glume. keeled or not keeled.

Lemmas: Shape, length, width, texture, keeled or not keeled, number of nerves on lower lemmas.

Paleas: Shape, width and length, texture of palea, prominent or not prominent.

Stamens: Number, size and colour.

Carpel: Number of style and stigma, size and colour of ovary, unilocular or multilocular.

Caryopsis: Length, width, pubescence and shape.

RESULTS

Pistia stratiotes L.

Family: Araceae

Synonym: *Pistia spathulata* Michaux

Morphological Description: *Pistia stratiotes* L. possesses floating roots with feathery, flaccid appearance pendulous in water. Roots are 45-50 cm in length and 1.5-2 cm in width. These exhibit whitish to yellowish color. Root hairs are present plumosely. These are submersed underneath the freely moving leaves comprise of small branches appears as displaying a spongy network of thick bunches under water surface. The stem of *Pistia stratiotes* is very much reduced and condensed, which may be of offset type. An offset, thick and short thick runner like branch which generates at the tip a new plant. It can develop in every side from the chief stem of the parent plant. On If any unplanned damage consequences in the splitting up of these units, each is competent of foremost an autonomous existence. Leaves of *Pistia stratiotes* are non-sheathing, texture velvety and shape is obovate, obcordate to obcordate. Leaves are apparently basal, usually petiolate with sheathing bases, most of the time subtended by cataphylls, blades various e.g. linear, simple (base often cordate to sagittate), sometimes peltate or variously compound (e.g. pinnate, radiate, pedate). Leaves are condensed spineless, giving an appearance of rosette like, these are 6-8 with no leaf stalks; leaves are 8-12cm in length and 8-10cm in width; light greenish in color; with parallel venation, lamina is broad 10-15 major veins were observed. On the Leaves, in some cases small hairs are present that enhances the softening of the leaves therefore these are minutely - pubescent so they

are Puberlulent. The margins of leaves of *Pistia stratiotes* are not acute it may be truncate or somewhat weavy. A small and glandular bract is present in which flowers are closed which is known as spathe. Spathe is of white color bract and at the margins of spathe small hairs are present, called pilose. Spathe is present inside the folded leaves up to 4-6mm in length and 2-3mm in width. Flower complete, bracteolate, both male and female flowers are actinomorphic, pedicillate, monoecious. There is no distinction between calyx and corolla, no perianth. There are two types of flowers, male flower and female flower which are present nearly hidden in center, spathe is a special bract covering both the male and female flowers. On surface of the spathe very small hairs were present. By viewing the flower with keen observation it may look like a heart or boat shaped. Male flower arranged around a central stalk on upper portion of boat like structure, stamens are 2-10. The female flower is solitary and is present in lower small portion of the boat like structure. O vary is unilocular and many ovules present in the ovary. The texture of flower is glandular. Inflorescence in case of *Pistia stratiotes* is spadix, branched or unbranched thick, fleshy spike enclose in one or more bracts, called Spathe. *Pistia stratiotes* is very significant due to vegetative reproductive strength. New plants grown at the end of the stolons and then they get separated from their parent plant by means of fragmentation. This species have very great potential of reproduction which is usually occur with the help of seeds. Fruit is a green berry like baccate. Fruit arising from female flower as a many-seeded, green rupturing irregularly. Numerous seeds are produced in this species and these are oblong.

Flowering Period: June-July (in warmer season)

Distinguishing Characters: Rosette and velvety leaves, galabrous, white flowers, presence of spathe, flowers are enclosed in the leaves.

Common Name: Water lettuce, Water cabbage

Vernacular Name: Sabs booti

Distribution in Pakistan: Sialkot, Multan, Chaarsada, Hazara, Gujranwala, Gujrat, Sargodha, Mansehra, Abbotabad, Balakot, Baluchistan, Sindh.

Distribution in World: America, Bangladesh, Brazilia, Philipines, China, Colambia, Cambodia, Hong Kong, Africa, North America, Indonesia, Japan and Malaysia.

Economic Importance: It is used as an precious ornamental plants, sometime to give an improved aquatic habitat look it is used as an decorative intention in the aquariums.

Note: It appears in wetland flora as an competitive, aggressive weed which let not grow any vegetation in its native habitat. It is a threat for aquatic life including aquatic vegetation as well as aquatic fauna. Because *Eichhornia crassipes* cause eutrophication which ultimately cause death of the aquatic life. It is a perfect source of habitat for the mosquitoes and other insects and microbes to colonize well that ultimately originate problems to human race. While on the other hand it has quite unique and special capacity to absorb the heavy metals. It proves as a pollutant absorbent

***Eichhornia crassipes* (Mart.) Solms**

Family: Pontederiaceae

Synonym: *Pontederia crassipes* Mart.

Morphological Description: Roots are fibrous and fleshy ranging in length from 40-55 cm and in width 8-15 cm. These are very thick roots like roots of *Pistia stratiotes*. Stem in this plant is offset type quite thick which may be of light green in color. It helps in the vegetative growth of this plant and reproduces new plants on detachment from the parent plant body. Leaves glabrous, up to 12-15cm in length and 7-10 cm in width. Leaves shape is broadly ovrbicular or broadly ovate, margins entire, obtuse, base is cuneate, sometime rounded. Petiolate, Petiole is prominent, glabrous and spongy, 5-28 cm long, with a fusiform bulbous portion about the middle. Peduncle spongy. Veins are parallel in arrangement. Peduncle measures from 28-35 cm. Sepals and petals are not distinguish from each other so term perianth is used to describe floral characters. Perianth consists of 4-7 parts, from light white-purplish to dark purplish in color. While observing with care it is found that on perianth upper portion rounded, darker in purplish color a visible area is present In the mid of this area yellow spot of small size is present, which is unique. Filaments are curved but free, Stamens 6 or 3 long and 3 short; glandular texture. Carpel is heterostylic, stigma glandular hairy. Flower exhibit violet to purplish colour and are spirally arranged on the top of the branches. Capsule ovoid.

Flowering Period: August-November

Distinguishing Characters: Foliage in a rosette pattern, dark green very bulbous stalks just bladder. Flowers in elongated heads of 5 or more. Corolla blue, purple or white. It is used as a beautiful ornamental plant. It is vigorously energetic and hazardous wetland herb.

Common name: Water hyacinth

Vernacular Name: Jal-khmbi

Distribution in Pakistan: It is present in majority cities of Pakistan including Sialkot, Gujranwala, Sargodha, Multan, khuzro, Hazara, Chakawal, Islamabad, Rawalpindi, Charsada, Abottabad, Mansehra.

Distribution in World: Brazilia, Philipines, India, China, Indonesia, Bangladesh, Tropics and Sub Tropical area.

Economic Importance: It is used as precious ornamental plants. Sometime, to give a better aquatic habitat look it is used as a decorative purpose in the aquariums.

Note: It emerges in wetland flora as an competitive, aggressive weed which let not grow any vegetation in its native habitat. It is a threat for aquatic life including aquatic vegetation as well as aquatic fauna. Because *E. crassipes* cause eutrophication which ultimately cause death of the aquatic life. It provides habitat to the mosquitos and other insects and microbes to colonize well that ultimately cause problems to human race. while on the other hand it has quite unique and special capacity to absorb the heavy metals. It proves as a pollutant absorbent. So it is suggested that it should be grown in control environment so that aquatic vegetation will flourish and humans get benefited by appreciate able role to maintain purity of environment.

***Mentha spicata* L.**

Family: Lamiaceae

Synonyms: *Mentha viridis*(L.) L.

Morpholgical Description: It is a Perennial, herbs, no hairs are present, fragrant. Stems erect, ascending, 32-60 cm, it is branched. Stems is quadrangular, surface is slightly glabrous Leaves are green in color, opposite, oblong to lanceolate simple, 2.5-7 x 1-2.5 cm borders are dentate, apex is acute type, base rounded base is

present. Small flowers, shaped in groups, spikes are terminal, 3-6 cm, light purple or whitish corolla is present. Calyx is of gland dotted texture. Sometimes ciliate hairs are visible. Fruit is nut which is dark greenish to brown.

Flowering Period: June-October

Distinguishing Characters: Quadrangular stem is most important distinctive feature which is glabrous. Gland dotted calyx is present. Ciliated hairs are present. Plants have very pleasant fragrance. Flower is creamy white in color.

Common Name: Spearmint

Vernacular Name: Jungli Podina

Distribution in Pakistan: Silakot, Mansehra, Abbottabad, Rawalpindi, Islamabad, Faislabad, Multan, Balakot.

Distribution in World: Africa, Europe, Asia, India, North, America, Indonesia.

Economic Importance: It is best resource of spearmint oil which is extensively used worldwide. There are various mouth freshners, toothpaste, chewing gum which are prepared with this plant. It is used for enhancing the fragrance of different cooking dishes.

Note: It is found everywhere within Pakistan. Its aroma is tension reliever. Recent research has shown that spearmint tea may be used as a treatment for hirsutism in females.

***Nasturtium officinale* R.Br.**

Family: Brassicaceae

Synonym: *Sisymbrium nasturtium-aquaticum* L.

Morphological Description: It is Perennial herb, emergent, glabrous. Lower at the nodes fins roots are present. Greenish-yellow stems. It is branched, creeping and luscious. Leaves exhibit shiny surface, compound pinnate type of venation, borders are wavy, apex is obtuse, cuneate type base is present. Leaflets 2-6, ovate-oblong lamina of leaf is present, small flowers, racemes almost 30-40 flowers, flowers are tetramerous, petals are 4 white, obovate, apex round, longer, corolla is cruciform. Fruit is siliqua or silicula.

Flowering Periods: April-July.

Distinguishing Characters: The most distinctive feature is that the corolla is cruciform, raceme of 30-40 flowers. Flowers are tetramerous.

Common Name: Water-cress

Vernacular Name: Brahmi saag / Talmira

Distribution in Pakistan: Sialkot, Hazara, Rawalpindi, Abbottabad, Sargodha, Islamabad, Mansehra, Multan, Sindh and also in Baluchistan.

Distribution in World: U.S, Europe, North America and in temperate Asia.

Economic Importance: It is mostly used as a source of vegetables. In many places it is used as an ornamental plant. This plant is getting attention for the process of purification of its habitat and its assimilation in plant biomass. Results Chapter no. 3 Taxonomic studies of Aquatic plants in district.

***Phyla nodiflora* (L.) Greene**

Family: Verbenaceae

Synonym: *Verbena nodiflora* Linn.

Morphological Description: It is herbaceous and perennial plant. Dicot, it is branched, creeping. At the nodes roots are emerges. Foliage are opposite, 4-38 mm long, 4-19 mm broad, dentate, decussate, spatulate, sessile, margins of leaves is serrate to entire, apex abrupt, round, pubescent to glabrous, bracteates. Short Inflorescence oblong to cylindrical, axillary, Flowers small, white in color, congested flowers. Ovate shaped fruit is present.

Flowering Period: Woody rootstock, leaves are serrate on one side and entire on the other side. Flowers with very unique symmetry with light pinkish color.

Common Name: Frog-fruit

Vernacular Name: Mada

Distribution in Pakistan: Sialkot, Sargdha, Abbottabad, Mansehra, Rawalpindi, Islamabad, Baluchistan, Sind.

Distribution in World: Native to California, America, North, America, Indonesia.

Economic Significance: Frog fruit normally is a high-quality nectar plant for butterflies. It is a striking plant incoherent over boulders or the boundaries of lynching baskets. It also can withstand drought and flooding.

Note: Must be cultivated because it is a source of nectar, good habitat for butterflies.

***Persicaria barbata* (L.) Hara.**

Family: Polygonaceae

Synonym: *Polygonum barbatum* L.

Morphological Description: Herb, Perennial, erect, 32-64cm in length. It is rounded and branched, Stem is glabrous, at nodes it is somewhat thick, hairs are present, stipulate. Foliage are upto 5.5-12.5 × 2-4 cm Leaves are simple and sessile having entire margin, 1.2-13.5 x 0.45-3.4cm base is acute type, lanceolate leaf lamina acuminate apex, hairs are present on both surfaces, ciliate margins are present, pinnately veined. Ocrea tubular type is present. Flowers are small, whitish in colour, inflorescence is terminal, erect 3-8 cm, numerous spikes are present and they are similar to panicle. Greenish colored perianth is present. 3-8cm long, trigonous nut measured.

Flowering Period: April-August

Diagnostic Characters: White flowers, terminal inflorescence, green perianth, ocrea tubular, funnel shaped bract.

Common Name: Knotweed

Vernacular Name: Biskatali

Distribution in Pakistan: Sialkot, Hazara, Sargodha, Islamabad, Rawalpindi.

Distribution in World: India, Taiwan, china, Indonesia, Bangladesh, Thailand.

Economic Importance: It exhibit anti-tumor activity. It has activity having anti-oxidant.

Note: It has many uses of *Polygonum barbatum* which make it precious. These uses include antitumor activity, anti-oxidant.

***Persicaria glabra* (Willdenow) M. Gomez**

Family: Polygonaceae

Synonym: *Polygonum glabrum* Willd.

Morphological Description: It is herbs, annual, completely and glabrous. Erect stem is present, branched and dilated at nodes. Leaves, 5-10 × 1.6-3 cm. leaves are simple and petiolate. Leaves are completely glabrous, acuminate and margins are entire, acute base, apex is acute type, pinnately veined and lanceolate type leaf lamina is present. Terminal Inflorescence is present, erect 5-7 cm, spikes are dense and similar to panicle. Bracts are present which are funnel shaped non ciliate. Large pedicel is present which is larger than bracts. Pinkish colored Perianth is present. Achenes incorporated in perianth.

Flowering Period: June-August

Diagnostic Characters: Simple petiolate leaves are present. Pinkish flowers are present, 5-parted, leaves glabrous achene fruit, black-brown in color.

Common Name: Dense knotweed

Vernacular Name: Purera

Distribution in Pakistan: Sialkot, Hazara, Rawalpindi, Mansehra, Abbottabad, Sindh,

Distribution in World: India, Nepal, Sri Lanka, Indonesia, China.

Economic Importance: It is economically very important. It possesses phenolic components. Anti-inflammatory activity was exhibited by *Polygonum glabrum*.

***Cyperus alopecuroides* Rottb.**

Family: Cyperaceae

Synonym: *Juncellus alopecuroides* (Rottb.)

Morphological Description: Perennials, tufted, small rhizomes are absent, stem is smooth upto 4-8mm in diameter, smooth and trigonous green in color.

Leaves are small, sheathing type of leaves, light green in color, delicate, spike is present. Apex is scabrous, inflorescence is a compound anthodium.

Flowering Period: April-September

Diagnostic Characters: Inversely arranged leaves, spikelets are quadrangular, dark green achenes are present. Mucronulate type apex is present.

Common Name: Foxtail Flatsedge

Vernacular Name: Motha ptera

Distribution in Pakistan: Abbottabad, Siran Valley, Sialkot, Rawalpindi, Punjab, Sindh, Balochistan.

***Cyperus nutans* Vahl, Enum.**

Family: Cyperaceae

Morphological Description: Perennial, small rhizomes are short, tillers are present, stem is culm, is smooth up to 2-8 cm in diameter, smooth and trigonous. Leaves are small, sheathing type of leaves, light green in color, delicate, ligulate, bracts are present. Leaf blades are sharp and up to 5-10 mm wide. Inflorescence is anthodia, clusters of spike is present, glumes are also found, glumes are like bracts, fruit is nut which is ovoid.

Flowering Period: May-October

Distinguishing Characters: Brownish to light yellow colored flowers. It is an attractive sedge. It is different from the Poaceae members in many ways. Its stem is triangular type and bract is present in *Cyperus nutans*.

Vernacular Name: Kaah

Distribution in Pakistan: Sialkot, Hazara, Rawalpindi, Abbottabad, Sargodha, Hari pur, Islamabad, Gujrat, Mansehra, Multan, Sindh, Baluchistan.

Distribution in World: East Himalaya, Nepal, Sri Lanka, India, West Himalaya, Cambodia.

Economic Importance: It is used widely as ornamental, decorative purposes. Source of fodder for animals. It acts as a natural source of soil binding and helps to avoid soil erosion.

Note: It is important sedge.

***Cyperus glomeratus* L.**

Family: Cyperaceae

Synonym: *Chlorocyperus glomeratus* (L.)Palla

Morphological Description: Annual, rhizome absent, stem, trigonous, smooth, leaves are short, sheaths up to 22 cm, delicate, greenish in color, often brown-dotted, straight; blades are present, green or greyish green, flat, margins narrowly curved lamina above scabrous, scabrous apex. Inflorescence an anthodium, glumes, are present leaves are also present that are like glumes, rachis flat, brown, internodes nut mm, elongate, with almost linear sides, trigonous, brown finely reticulate and dark nutlets.

Flowering Period: September-October

Distinguishing Characters: Brown colored flowers are present. Long dark green colored leaves and Inflorescence a compound anthela, dark nutlet is present.

Vernacular Name: Bnati

Distribution in Pakistan: Sialkot, Sahiwal, Islamabad, Karachi, Lahore, Multan, Hazara, Kashmir, Sindh and Gilgit.

Distribution in world: Africa, Japan, America, Australia, Malaysia, Newzeland, Philipine.

Economic Importance: It is a good source source of fodder for livestock.

***Cyperus digitatus* Roxb.**

Family: Cyperaceae

Synonym: *Cyperus digitatus* f. *contractior* Kük.

Morphological Description: Perennial, Rhizome are present, short, horizontal, covered by brown or dark-brown scales. Stem, trigonous, edges obtuse, smooth, basal Leaves, sheathing, yellowish or brown, soft, scarious sometimes, blades 50 cm or longer, wider, flat or folded, margins narrowly, smooth, scabrous, apex long, trigonous, scabrous. Inflorescence a compound anthodium, glumes are present, acute, midnerve area green, sides with 2-3 conspicuous veins and often with reddish. Fruit is a nut up to green-brown in color.

Distinguishing Characters: Trigonous culm, leaves are inversely mostly shaped, dark green stem, rachilla persistent, simple leaves, fruits are nuts.

Flowering Period: July-August

Common Name: Finger flatsedge

Vernacular Name: kati

Distribution in Pakistan: Abbottabad, Siran Valley, Sialkot, Rawalpindi, Punjab, Sindh, Balochistan

Distribution in World: India, Indonesia, Nepal, Sri Lanka, Africa, Malaysia, Australia.

Economic Importance: It is a useful weed. It is also a source of fodder for livestock.

Note: It is poisonous weed to against pest. Also it is used to treat different disease.

***Saccharum spontaneum* L.**

Family: Poaceae

Synonym: *Saccharum canaliculatum* Roxb.

Morphological Description: Perennial, tall erect, culms 2-5 m high. Leaf-blades are long and up to 8.5 mm wide, petiole is present, glaucous. Panicle 23-40 cm in length. Hairy peduncle is present, racemes, usually long, the internodes and pedicels hirsute. Spikelet's are similar and whitish in color, glumes are present, equal, sub-coriaceous, somewhat glabrous, ciliate margins; upper lemma narrow, very shortly awned.

Flowering Period: July-September

Diagnostic Characters: It is an invasive species. White colored flowers with soft and delicate texture.

Common Name: Kans grass.

Vernacular Name: Kana

Distribution in Pakistan: Abbottabad, Gujrat, Sialkot, Rawalpindi, Sindh, Balochistan, Kashmir and Gilgit.

Distribution in World: India, Indonesia, Nepal, Sri Lanka, Africa, Malaysia, Australia.

Economic Importance: Efficient soil binder, as well as roofing material. Sometimes used to make mats and chicks.

***Polypogon fugax* Nees ex Steud.,**

Family: Poaceae

Synonym: *Polypogon interruptus* Auct.

Morphological Description: Annual, decumbent at the base and roots arise from the lower nodes. Leaf-blades are 3-16.5 cm long, 2.5-13.5 mm wide, rough, ligulate, narrowly ovate panicle, oblong or, usually lobed, 06-8 cm wide, dense sometimes bristles are present. Pale green or dark green color. Inflorescence is panicle of spikelets, spikelets 1.5-2.4 mm in length. Slightly notched glumes at the apex, sometimes rough, minutely hairy on the boundaries with a fine straight awn 0.6-3 mm long; lemma about half the glumes, smooth, awnless.

Flowering Period: May-August

Distinguishing Features: Herbaceous, leaves are sheathing type leaf, fine and distinctive glumes. Shiny green color is present.

Common Name: Blue-grass

Vernacular Name: Bani kaah Results Chapter no. 3 Taxonomic studies of Aquatic plants in district Sialkot, Pakistan

Distribution in Pakistan: Abbottabad, Gujrat, Sialkot, Rawalpindi, Sindh, Balochistan, Kashmir, Gilgit, Baltistaan.

Distribution in World: India, Indonesia, Nepal, Sri Lanka, Africa, Malaysia, Australia.

Economic Importance: It is an important part of fodder for animals. It is an important soil binder

***Arundo donax* L.**

Family: Poaceae

Synonym: *Arundo bifaria* Retz.

Morphological Description: Perennial, rhizomes, erect culm, up to 6.5m high. Leaf-blades are somewhat sharp, linear-lanceolate, round base wide, glabrous, smooth, long-attenuate at the tip. Panicle 35.65 cm in length and

5-8 cm wide. Spikelet 15-20mm in length, glumes are present, lanceolate to narrowly lanceolate, hairy all over the back below the middle with hairs.

Flowering Period: June-December

It is used as roofing material. *Arundo donax* can present a better-quality renewable energy biomass resource. Its leaf are broadest. It is use to make the qalams. It is also used to make mats, trays.

Common Name: Giant reed

Vernacular Name: Naari

Distribution in Pakistan: Sialkot, Hazara, Gujranwala, Gujrat, Multan, Charsada, Bahawal Nagar, Baluchistan, N.W.F.P. and Kashmir.

Distribution in World: Asia, Africa, Saudi Arabia, California, India, China.

Economic Importance: It is used as an energy crop. it is used to increase the fertility of soil. It is widely used as a source of biofuel. it is best source of woodwind reed.

Note: Because of the high nutrient level and productive role in production of biomass, it should be cultivated on large scale to get benefitted.

***Typha latifolia* L.**

Family: Typhaceae

Morphological Description: Tall plant up to 120-220 cm high, thick stem terete. Linear leaves, broadly linear, 8-22 mm broad. inflorescence stem equal at some extent shorter than the leaves. Inflorescence parts of male and female are adjacent. At maturity female parts slightly longer than the male parts. Cylindric, delicate dark brown or blackish brown. Male flowers hanging simple hairs and in tetrad form pollen. Female flower bracteates, stigma lanceolate, fleshy, dark brown in color.

Flowering Period: June-August

Distinguish Characters: Dark brown large flowers which is the most important distinguishing character. Leaves are broad and fleshy, margins of leaves are very shape, hands can be injured easily, long and dark green leaves.

Common Name: Cooper's reed

Vernacular Name: Arra

Distribution in Pakistan: Abbottabad, Siran Valley, Sialkot, Rawalpindi, Punjab, Sindh, Balochistan.

Distribution in world: Native in North and South America, Europe, it is native to all states except hawaii, Africa, Malaysia and Australia.

Economic Importance: It is widely used by villagers to make baskets. It is very useful fodder for livestock.

Note: On road sides it is very common, it is important in horticulture. It should cultivated on large scale.

***Juncus articulatus* L.**

Family: Juncaceae

Morphological Description: Perennial, small rhizomes are present, up to 2-4 mm in diameter, green to dark green in color, medium stem, erect culm, erect to almost prostrate, non-stoloniferous, terete stem is present. Leaves are cauline type. Leaves shorter than stem linear transversely, apex obtuse, subterete, green, basal sheaths usually brown in color. inflorescence terminal, panicle, little dichotomous, branched, flowers are small, ovate to ovoid in shape, brown and maroonish in color sessile, perianth lanceolate, fruit is a capsule.

Flowering Period: July-October Results Chapter no. 3 Taxonomic studies of Aquatic plants in district Sialkot, Pakistan

Distinguishing Characters: Its flowers are very unique in color which is reddish maroon. Inflorescence is terminal panicle, hollow stems are present. Rarely is it found creeping near the aquatic habitats.

Common Name: Jointed-rush

Vernacular Name: Janoor

Distribution in Pakistan: Sialkot, Sahiwal, Islamabad, Karachi, Lahore, Shakargarh, Multan, Hazara, Kashmir, Sindh and Gilgit.

Distribution in World: Japan, America, Australia, Malaysia, Newzeland, Philipine.

Economic Importance: Used as a fodder for animals, decorative plants and used to make local baskets, carpets. Help to avoid erosion of soil and helps in keep binding the soil surface.

***Nymphaea nouchali* Burm.f**

Family: Nympheaceae

Synonym: *Nymphaea stellata*

Morphological Description: It is a perennial herb, submerged, foliage are 15-25 cm in diameter, gleaming having waxy layer shell as far as abaxial side is concerned; orbicular type foliage lamina, entire type margins are present, petiole is present, stipules are present which are of sheathing type. As far as diameter of flowers is concerned 12-15 cm in diameter, yellowish in color or sometimes light whitish. Petiole and peduncle both are similar to each other. Peduncle almost equal to petiole. Marginal petals (perianth 5-6lobes), which is persistent having entire margins, ovate and acute type of apex is found. Petals that are present inside (12-15 lobes), Long Stamens and anthers are present. They also exhibit large attachment.

Flowering Period: April-August

Distinguishing Characters: Yellowish to white flowers are present, abundant on the surface on the water giving it to a very present view.

Common Name: Lotus

Vernacular Name: Kamiyan

Distribution in Pakistan: Kashmir, Punjab, Baluchistan, Sindh, Gilgit, Baltistan.

Distribution in World: China, India, Africa, Australia.

Economic Importance: In the United States, a number of American Indian ethnic group use lotus in their diets. All parts of the plant are edible, but it is primarily grown for its thick roots, or rhizomes.

Note: The lotus has been cultivated for culinary and religious purposes in China, Japan, India, Egypt and other parts of Asia and the Middle East for thousands of years.

***Veronica-anagallis-aquatica* L.**

Family: Scrophulariaceae

Synonym: *Veronica catenata* Pennell

Morphological Description: It is a herbaceous and perennial. It may exhibit hairs on the surface also on their axes of inflorescence. Straight type of stems is present. It is also succulent and branched ranges 12-42 cm high. Foliage are sessile. They exhibit opposite arrangement, grasp the opposite portion where the foliage bases come close. Elliptical leaf blade is present 3-6×2-3.5, apex is acute type. Slightly serrate margins are present. Axillary type racemes, found present which measured up to 5-12 cm, comprise of various flowers 15-26.

Distinguishing Characters: Leaves are arranged oppositely, inflorescence is simple raceme, blue colored petals are present.

Flowering Period: March-May

Common Name: water speedwell

Vernacular Name: Neelam

Distribution in Pakistan: Sialkot, Hazara, Rawalpindi, Islamabad, Abbottabad, Swat, Baluchistan.

Distribution in World: America, France, Asia Europe, North Africa.

Economic Importance: Leaves of this plant are edible.

Note: Blue water speedwell (*Veronica-anagallis-aquatica*) is considered as an environmental weed in Victoria and is considered to be a powerful hazard to one or more plant life formations in this state.

***Ranunculus scleratus* L.**

Family: Ranunculaceae

Morphological Description: Annual herb, thick roots are present, fibrous. Erect stems, without hairs, hollow, basal and somewhat cauline foliage are present, petiole is present in basal leaves, 3 lobed blade, somewhat ovate or reniform, 2-5.5 × 1.8-5 cm, cordate type base is present, apex is rounded in shape, reticulate venation, crenate margins are present. Foliages of lower side appear similar to basal leaves. Leaves of upper portion of the stem is mostly found 3 lobed, base cuneate and petiolate, In diameter flowers are measured upto 1.4-2 cm, flowers

are of yellow color. Pedicel 0.4-1.4 cm, glabrous. Sepals are Ovate and reflexed. Obovate type petals are present. Apex is rounded in shape, flowers are numerous, solitary, yellow petals are present. Fruit is achene.

Flowering Period: March-June

Distinguishing Characters: Presence of achene and soft hairs are the distinguishing character of *R. scleratus*. Leaves are trilobed.

Common Name: Celery leaf buttercup.

Vernacular Name: Zeharili pati

Distribution in Pakistan: Sialkot, Hazara, Rawalpindi, Islamabad, Abbottabad, Swat, Baluchistan.

Distribution in World: Asia Europe, North Africa, America, France.

Economic Importance: It is used as an ornamental purpose. It has poisonous constituents in it that's why used as a poison source.

Note: It has high nutrient level. It is proved toxic used as poisoning agent.

***Lemna minor* L.**

Family: Lemnaceae

Morphological Description: Free floating fronds on water exterior, 1-5 coherent in one minute group, without green stalk at base with a slightly white stipe connecting fronds shiny green, sometimes reddish surface, scarcely reddish, deeper red on upper surface than on lower), obovate to elliptic, ovoid, long and wide flat, near apex with mostly distinct papillae on surface, margin entire, base rounded, reaching apex, greatest distance between lateral veins. Root 0.5-1.5 sheath not winged, apex mostly curved.

Distinguishing Characters: Green and very minute in size found as a thin green mat on water surface. Their flowers are very conspicuous and rarely visible.

Common name: Duckweed

Vernacular Name: Cheetri

Distribution in Pakistan: Kashmir, Punjab, Baluchistan, Sindh, Gilgit Baltistan.

Distribution in World: China, Australia, Africa, Asia, Europe and North America,

Economic Importance: It may be a very excellent source of food for aquatic fauna. It is an important because it exhibits high amount of starch and other nutrients.

Note: It flourishes in water with high nutrient levels. It can grow well at pH 7 and temperatures between 6 and 33 °C. Quick growth of *Lemna minor* was observed in the form of colonies. Develops small, thick, starch-packed organs called 'turions' which grow to be inactive and sink to the water bottom for winter, the following spring, these recommence growth and float back to the surface.

DISCUSSION

Taxonomic research work of wetland flora of Sialkot district was conducted to examine the morphological, palynological and anatomical features during the year 2012-2013. The hydrophytes were collected from Sialkot district with complete external morphological characteristics. The 20 reference specimens of different genera of the following respective families including, Araceae, Pontederiaceae, Polygonaceae, Ranunculaceae, Lamiaceae, Verbenaceae, Cyperaceae, Poaceae, Typhaceae, Lemnaceae, Juncaceae, Cruciferae and Nymphaeaceae were subjected to extensive taxonomic investigation. Worldwide, wetland flora shows an intensive multiformity in morphological aspects. These comprise habit of plant as far as water depth is concerned, arrangements of foliage, size and shape of foliage, rooting pattern, stem type, presence or absence of hairs and rest of the naked and microscopic vegetative as well as characteristics of flowers.

Pistia stratiotes was very unique in its morphology. The plant exhibited leaf limb which was ob-cuneate or fan shaped with parallel veins, swollen basal region and sheathing ligule which was also reported by [10]. However, a very short description about it in flora of Pakistan is mentioned. Hence the present research on morphological aspects of this plant is contribution to Flora of Pakistan. Morphological studies on *Eichhornia crassipes* showed similar features with the work of [10]. The presence of rhizomes, fibrous roots, offshoots and swollen petiole are diagnostic features for the specific determination. *Mentha* is one of the difficult genera of the family Lamiaceae. The morphological characterization of *Mentha spicata* with leaf Ovate, decumbent base, acute apex, entire margins, basal part is curved and lamina is vascularized are useful character to characterized

the species. *Nasturtium officinale* can be identified due to, stem hollow, branched, creeping, leaves pinnate, leaflets were mostly separated with very conspicuous hydathodes. These all characteristics corroborate with the study of [11]. The length and width of *Phyla nodiflora* leaves was calculated 4-38 mm, 4-18.5 mm respectively and slightly differs from the Flora of Pakistan, which was 5-40 mm, 4-20 mm. *Persicaria barbata* was also studied extensively which include plant length observed 32-64 cm, presence of ocrea, leaves upto 5.5-12.5 × 2-4 cm, Inflorescence is terminal, 3-8cm long, trigonous nut measured upto 1.5x 1-2 mm, While in Flora of Pakistan length of plant 30-60cm, Inflorescence 5-10 cm and trigonous nut 1.8-2 x 1.2-1.5 mm were recorded.

Observed characters of *Persicaria glabra* that include simple leaves and petiolate, glabrous margins entire and acuminate, acute base, apex is acute type, terminal inflorescence, erect 5-7 cm, spikes, funnel shaped bracts, Achenes incorporated in perianth were similar to the description of Flora of Pakistan also reported by [12]. Morphology of *Polygonum aviculare* reflected certain features which include prostrate herb, delicate stem, branched, small leaves, elliptical, upto 1-3cm in size, ocrea 1-veined, petiole absent, acute apex is acute, very small type of flowers, perianth and achene fruit which showed similarity with the description in the Flora of China. The morphological characterization on *Cyperus alopecteroides* Rottb include Perennial, furnished with small rhizome. Aerial stem, trigonous, leaves long; broad, keeled, apex trigonous, scabrous. Inflorescence a compound umbel, side yellowish or grey, with reddish brown linings or bands, margins narrowly scarious and elliptical nut closely resembled with the study of [13]. *Typha latifolia* can be identified due to the diagnostic features height of plant 100-200 cm, terete stem, leaves linear-broadly linear. The morphological characterization of *Cyperus nutans* can be identified rhizomes, with tillers. Stem 2-6 cm diam, trigonous, smooth. Leaves shorter than stem green, soft, margin straight or slightly ligulate, grey-green, scabrous. anthelodium Inflorescence. Morphological description of *Cyperus nutans* revealed Rhizome, short, covered with brown scales. Stem, obtuse, trigonous, smooth and trigonous, basal leaves, sheathing which were similar with the description of Flora of Pakistan. *Ranunculus scleratus* revealed height 35-55 and 12-15 stamens, whereas description from Flora of Pakistan i.e plant height 10-75cm and stamen variation observed. *veronica-anagallis-aquatica* exhibited herbaceous pattern, hairs on the surface also on their axes of

inflorescence [14]. Straight stem, foliage are sessile. They exhibit opposite arrangement, grasp the opposite portion where the foliage bases come close, elliptical leaf. *Lemna minor* showed Fronds free floating, oblong, spherical apices. These were corroborated with the description in Flora of Pakistan [15].

Utilization of plants for the treatment of diseases in human being is as old a put into practice as the human race itself. However information of plants use co-evolved with human society throughout the experiential use of plants, generation after generation. In this study, I documented on the local uses of ethnobotanically important plants. Most of the recorded species in my work have also been reported as fodder species by other workers [16]. The present findings regarding the similarity in the use of plants as fodder are in agreement with previous studies. In present work aquatic plants i.e. *Ranunculus scleratus*, *Phyla nodiflora* and used as fodder. Some of the plant has medicinal uses in my project. Medicinal plants are invariably used in local health system in traditional societies. Medicinal plants are, *Mentha spicata*, *Ranunculus muricatus*, *Nasturtium officinale* and *caltha alba* etc in my work. [17-23], reported these plants to be medicinal. There are species used as edible fruits and vegetables. the leaves of, *Nasturtium officinale*, *commeliana*, *Mentha spicata*, *Eclipta alba* and *Conyza bonariensis*, these plants are used to heal wound, burns and injury as reported in my work are in accordance with the work of [16, 24, 25], they reported these plants to heal wounds.

CONCLUSION

It is concluded that Morphological features play a most important role in identification of flora and their classification at the species and generic level. This will give a path for future researchers to identify and recognize culinary wetland vegetables in order to prevail over the food crises. Native people of the region must be endowing with awareness concerning floral biodiversity and conservation. Procedures should be taken to preserve rare species which are near to extinction. Elemental studies of wetland flora to evaluate their nutritional value.

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