Impact of soil carbon on flora and fauna of Cholistan Wildlife Sanctuary and Lal Suhanra National Park from Cholistan desert Pakistan

Muneeb Khalid[1], Sangam Khalil[1], Muhammad Abid[1], Tanveer Hussain[1], Muhammad Rafay[1], Muhammad Madnee[1], Muhammad Azeem Sabir[1], Huassain Ahmad Makki[1], Hamza Basit[1], Sana Ghafar[1]

1. *Institute of Forest Sciences, The Islamia University of Bahawalpur, 63100, Pakistan.*

Abstract

Amount of soil carbon has great impact on diversity of flora and fauna in desert type ecosystem. The study was conducted in Cholistan Wildlife Sanctuary (CWLS) and Lal Suhanra National Park (LSNP) to evaluate flora and fauna in contradiction of soil carbon stock. On the basis of stratification, vegetation structure and animal diversity; direct and indirect observations were made for biological diversity. Permanent 80 by 80m (0.64 ha) study sites was selected for sampling diversity of flora and fauna, while permanent transects of 805 by 62m (4.9 ha) was established for birds' inventory. During the floral study LSNP include 40 families including 103 Genus and 143 species while CWLS have 31 families including 85 genus and 123 species. found move diversity of birds including 28 species, mammals including 24 species and reptiles have 12 species in LSNP while birds include19 species, mammals 15 species and reptiles have 08 species in CWLS. Conclusively we can say soil carbon has positive impact on floral diversity which ultimately influence the fauna of the region. Higher will be the soil carbon greater will be the flora and fauna. In future limited soil C will also lower the biological diversity.

Keyword: Carbon**,** Cholistan, Fauna, Flora, LSNP, Sanctuary, Soil

I. Introduction

Today we are facing serious issues regarding the reduction in biological diversity. Decline in plants and animal diversity is one of which is the potential harm to terrestrial ecosystems and their functions (Naeem et al. 1994; Chapin et al. 2000; Sala et al. 2000; Loreau et al. 2001; Hooper et al. 2005; Balvanera et al. 2006). Reduced plant diversity may make it more difficult for terrestrial ecosystems to store long-lived carbon (C) pools as C sinks for atmospheric CO_2 (Fan et al. 1998; Pacala et al. 2001) that ultimately reduce the soil functioning. According to Lal (2004), the magnitude of the soil C pool is 3.3 times larger than the atmospheric pool and 4.5 times larger than the terrestrial biotic pool. Therefore, from the of greenhouse gases viewpoint, it's critical to comprehend whether and how variations in the number of plant species and fauna influence the rate of carbon sink in the soil.

Many studies (Tilman et al. 1996, 2001, 2006b; Hector et al. 1999; Hooper et al. 2000, 2005; Levine 2000; Naeem et al. 2000; Wolters et al. 2000; Spehn et al. 2005; van Ruijven & Berendse 2005) have suggested that the floral diversity/or composition of plant species affects ecosystem productivity, stability, nutrient dynamics, and invasibility. However, attribution of causation in such experiments has been open to alternative explanations (e.g. Huston 1997; Wardle 1999). Many of these studies have been understood and suggesting that experimentally imposed differences in plant species number mattered because greater species number gave greater differences in functional traits, thus allowing species to exploit resources in different ways (e.g. Hector et al. 1999; Tilman et al. 2001, 2006b; Spehn et al. 2005).

According to a few manipulative experimental studies conducted at small spatial scales (i.e., biodiversity–ecosystem functioning experiments), high floral diversity (both as species and functional group richness) increases SOC stocks by elevating carbon inputs (particularly below-ground carbon inputs) and by increasing microbial activity (Fornara & Tilman, 2008; Lange et al., 2015). For instance, high-diversity combinations of perennial grassland plant species retained 500% more soil carbon on average than monoculture plots of the same species during a 12-year study on grassland biodiversity (Fornara & Tilman, 2008). Across China, natural forest, shrubland, and grassland sites have likewise shown this favorable correlation (Chen et al., 2018).

Measures of multifunctionality have grown in popularity in ecosystem research in recent years. Multifunctionality is the capacity of an ecosystem to deliver many functions and services at the same time (Manning et al., 2018). Numerous relationships have been examined using these metrics, including those in which habitat diversity influences the multifunctionality of biogeochemical processes (Alsterberg et al., 2017), the alteration of ecosystem services' multifunctionality by land-use intensification (Allan et al., 2015), and the impact of drought and microplastics on soil multifunctionality (Lozano et al., 2021).

Experiments based on biological diversity include both flora & fauna and functional composition of the ecosystem, that's why these have potential ability for the provision of exceptional insights into the factors that control the C deposition in the soil. But the C sequestration in soil horizon is a slow progression while the experiments based on biological diversity are now getting sufficient duration for the investigation of its dynamics and fundamental grounds. Here we measured impact of soil C accumulation for flora and fauna from LSNP and CWLS. (Tilman et al. 2006a; Fornara, and Tilman 2008) have shown the positive correlation between species composition and soil organic carbon and resulted greater number of plants will result higher accumulated of C in soil in grassland communities. However, the extent to which C accumulation is dependent on the existence of in the plant community remains unclear. Here we report results based on additional sampling of soil C levels that we use to determine the potential role of functional composition on soil C accumulation through time (Schittko 2022). In order to ascertain the possible influence of functional composition on soil C accumulation over time, we present here results from additional soil C level measurements (Schittko 2022).

Our main hypothesis is that the higher soil organic carbon result greater number of flora that ultimately sustain the fauna. Positive effects of diversity on soil C accrual is totally dependent on greater C inputs returns to the soil from floral diversity (i.e. increased plant productivity). However, the existence of essential carbon has a large positive impact on plant productivity, (Brooker *et al.* 2008).

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Methodology:

Study Area: This research was carried out in the Protected Areas (Lal Suhanra National park and Cholistan Wildlife Sanctuary) of Bahawalpur District.

Lal Suhanra National Park: Lal Suhanra National Park (LSNP) having an area of 162567 acres (Survey Punjab Wildlife and Parks Department 2022) is located between 29° 12' and 29° 28′ northern latitude and 71° 48′ and 72° 08′ eastern longitudes, with an altitude from 125 to 140m, in south east Punjab, Pakistan. The area is highly diversified by flora and fauna, to conserve these resources the area was notified as national park in 1972. LSNP is of monstrous worth because of irrigated plantation, enclosures of wildlife, recreation facilities as well as fishing in the lake (Wariss et al., 2014).

Cholistan Wildlife Sanctuary: The Cholistan desert is a section of the world's seventh biggest desert, the Great Desert, which is extended along the south line of Punjab, Pakistan. The area of the Cholistan desert is 660,921 ha; it is situated 29º 59' North as well as 73º 16' East at an altitude of 112m.

Soil and Climate: Due to insignificant amount of organic matter, the soil of Cholistan desert is considered as poor. The Lesser Cholistan is described by huge saline compacted with alluvial soil (inter-dunal flats), which are generally stabilized to semi-stabilized. Soil of interdunal sites differs in surface, structure, and the degree of salinity and sodicity with pH ranges from 8.2 to 9.6. Sand dunes are much lower (under 100 meters) than those found in Greater part. Cholistan desert is, severe dry and long summer droughts which may extend for 4-6 years consistently. Mean summer temperature varies from 35 to 50º C during May to June. Annual precipitation is low ranging from 100 to 250 mm with its maximum during July to September during monsoons High temperatures, low humidity, and high rate of evapotranspiration change the desert into a demise valley with incredibly cruel conditions during summers (Hameed et al., 2011).

Impact of Carbon stock on wild flora and fauna

On the basis of stratification, vegetation structure and animal diversity by direct and indirect observations was determined.

Method of Direct observation

This study was conducted in two sections: field study and library method during whole research time period throughout the study area. During field study, all present vegetation structure including trees, shrubs, herbs and grasses and animal diversity including reptiles, birds and mammals within the area was identified by visual or vocalization (direct observation) and applying a 10×50mm binocular. Library resources was referred for complementary studies.

For direct observation of wild flora and fauna Line transect method was used. Vegetation and animal diversity including mammals, reptiles and birds was sampled along striped transect. Permanent 80 by 80m (0.64 ha) study sites was selected for sampling diversity of animals and vegetation characteristics throughout the study area. For birds' inventory, permanent transects of 805 by 62m (4.9 ha) was established. Samples was collected by moving along transects on consecutive days every week, starting at sunrise and continuing for 4-5 hours. Average walking time was 25 to 40 minutes per transect. All vegetation (Trees, Shrubs, Herbs and grasses) and Animal Diversity (Reptiles, Mammals and Birds which flew over transect) was identified by visual or vocalization (Agnew et al., 1986) (Ahmadpour et al., 2012).

Method of Indirect observation

The methodology that diminish every partiality as well as develop accuracy of large quantity estimations, was utilization of belt transect method used for the estimation of pellets. This strategy was utilized for current research along with minor adjustments in calculation of pellets that was alternatively call as "Transect Count Method". Such techniques included to follow a transect track of specific length (five to ten kilometers for every track), moreover width (one to five meters on every side, depends upon visuals) all through research area. Along track/transect every one of the pallets/droppings of various animals was recognized. This process was followed all over the transect length and was start moving back along the same path again, on reaching the end point of transect taking in count the droppings (new one) of various animals. As moving reverse by the side of similar trail, all the droppings which were noticed before was neglected and counted only those droppings which were not confirmed previously. This technique was followed until the initial position was reached. At every research area, various probable pairs of survey tracks were made through arbitrarily picked way to cover a distance of five to ten kilometers for each track with a sighting detection limit of one meter on every side. Track pathways was picked for the survey including all possible habitat types that incorporates field patches, woods edges, timberland regions with slim shelter cover and thick forest regions with close shade cover. These tracks were made between 10:30 a.m. to 5:30 p.m. In this way, all the possible vegetation and animal diversity were identified (Jain et al., 2011).

Results

Impact of carbon on Flora and Fauna:

The current study investigates the impact of carbon on flora and fauna. No such studies have been reported earlier in desert or in such any other ecosystem. Amount of carbon in soil substratum always play crucial role for the stability of desert ecosystem. Soil organic matter releases essential nutrients for plant growth after its decomposition. It is very helpful to increase the water holding capacity of the soil and microbial activities. The above said discussion is important for the floral diversity and its productivity. The more the soil organic carbon, the more the ecosystem stability which results in proper ecosystem functioning.

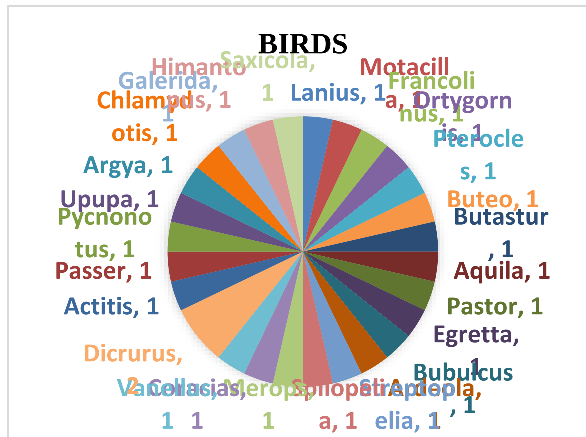
Flora of Lal Suhanra National Parks (LSNP):

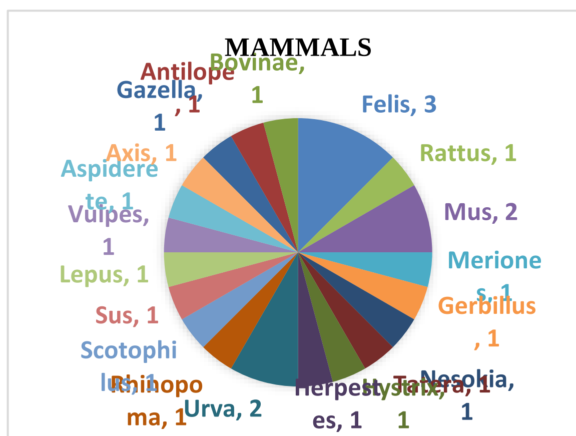
During the Flora study of Lal suhanra National park (LSNP), we identified 40 families including 103 Genus and 143 species (Table 1). Largest recorded family was Poaceae having 20 genus and 28 species. Family Fabaceae, Zygophyllaceae, Asteraceae, Papilionaceae have 5 while Cucurbitaceae, Aizoaceae, Typhaceae, Asclepiadaceae, Chenopodiaceae have 4 genera. Genus Aristida and Zizyphus have 4 species, while genus Cenchrus, Cleome, Convolvulus, Eragrostis, Haloxylon, Prosopis have 3 species from LSNP as shown in Figure 1. Number of species in each genus from CWLC are shown in figure 1. Table 2 describe the Pearson Correlation between CWLS and LSNP and showing the strong positive correlation.

Fauna of Lal Suhanra National Park and Cholistan Wildlife Sanctuary:

Amount of carbon has great impact of wild flora and fauna as the changing climate always shifting the vegetation from southern zones to northern polar region. During the study we have found 25 families of birds including 36 genera and 39 species. Largest families were Accipitridae, having 5 genera. Largest genera in birds were Pterocles, Dicrurus and Falco having two species. Rest of the genera has 1 species as shown in table 3. We have found 16 families of mammals including 25 genera and 31 species (Table 4). Largest family was Muridae having 6 genera. Reptiles contribute 9 families of reptiles including 14 genera and 15 species. Largest family was Colubridae, has 3 while Agamidae, Elapidae and Gekkonidae have 2 genera. All of the genera have 1 species in each except Eryx having 2 species as shown in table 5.

Total number of species in both habitats (CWLS and LSNP) are described in figure 4 which indicates that the number of species is higher in LSNP than the CWLS. Among these, birds are present in abundance in LSNP following the amounts of mammals and reptiles respectively. Number of species from each genus are shown in figure 2 and 3.





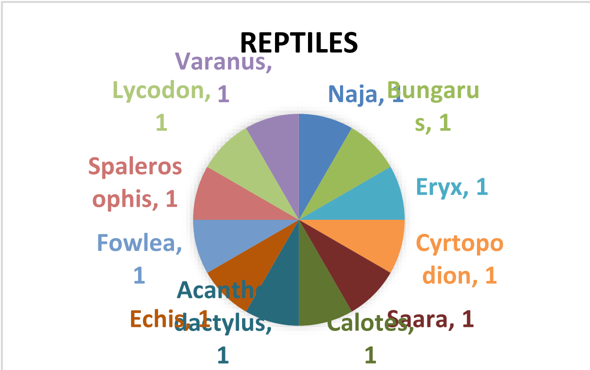
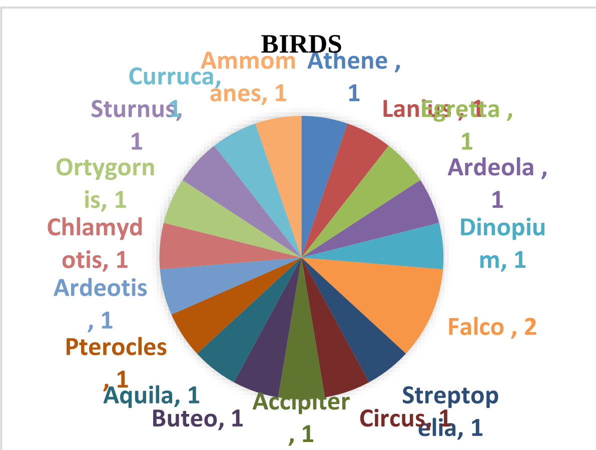
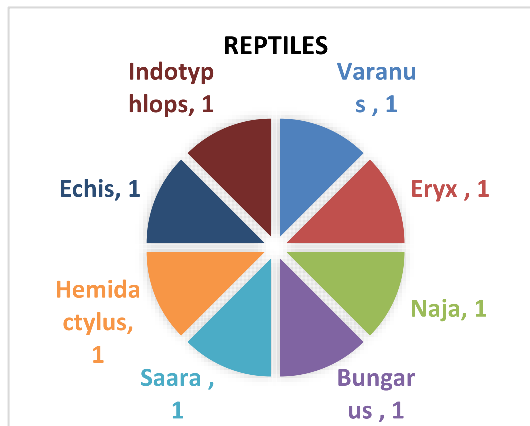


Figure 2: No. of species of birds, mammals and reptiles in each genus from LSNP





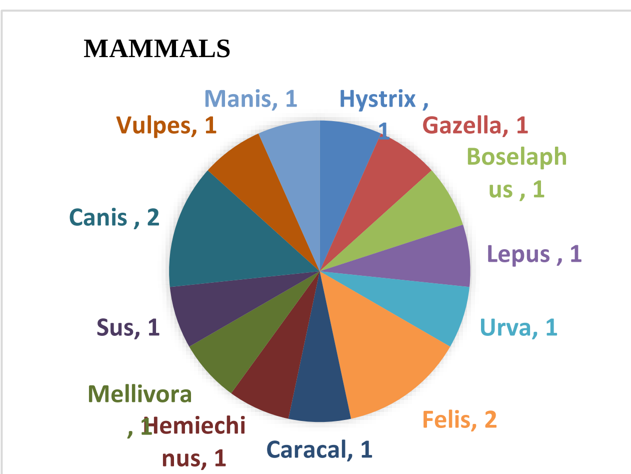


Fig 3. No. of species of birds, mammals and reptiles in each genus from CWLS

Table 1. Flora of Lal Suhanra National Parks (LSNP) and Cholistan Wildlife Sanctuary

Sr. no.	Family	Genus	Species	Local name	Habit
1	**Malvaceae**	*Abutilon*	*Abutilon indicum*	Gidawar	Herb
			Abutilon muticum	Gidawar	Herb
		Bombax	*Bombax ceiba*	Simal	Tree
2	**Convolvulaceae**	*Convolvulus*	*Convolvulus prostrartus*	Hiran Booti	Herb
			C. scindicus	Hiran Booti	Herb
			C. stocksii	Hiran Booti	Herb
		Cressa	*Cressa cretica*	Oine	Herb
3	**Ephedraceae**	*Ephedra*	*Ephedra ciliata*	Phoge	Shrub
4	**Polygonaceae**	*Calligonum*	*Calligonum polygonoides*	Phog	Shrub
5	**Zygophyllaceae**	*Fagonia*	*Fagonia bruguieri*	Dhman	Herb
			F. indica	Dhman	Herb
		Peganum	*Peganum harmala*	Harmal	Herb
		Seetzenia	*Seetzenia lanata*	Bhakra	Herb
		Tribulus	*T. longipetalus*	Bhakra	Herb
			Tribulus ochroleucus	Bhakra	Herb
		Zygophyllum	*Zygophyllum simplex*	Alethi, Lonak	Herb
6	**Orobanchaceae**	*Cistanche*	*Cistanche tubulosa*	Phaphorr/ Desert Hyacinth	Herb
7	**Capparidaceae**	*Capparis*	*Capparis decidua*	Kareer	Shrub
			C. spinose	Kubbar	Shrub
		Cleome	*Cleome brachycarpa*	Noli, Kasturi	Herb
			C. scaposa	Noli, Kasturi	Herb
			C. viscosa	Noli, Kasturi	Herb
		Dipterygium	*Dipterygium glaucum*	Fehl.	Shrub
8	**Neuradaceae**	*Neurada*	*Neurada procumbens*	Chappari	Herb
9	**Salvadoraceae**	*Salvadora*	*Salvadora oleoides*	Jal, Pilu	Tree
			Salvadora persica	Wan	Tree
10	**Tamaricaceae**	*Tamarix*	*Tamarix aphylla*	Ukhan, Farash	Tree
			Tamarix dioica	Lai	Shrub
11	**Oxalidaceae**	*Oxalis*	*Oxalis corniculata*	Khatti buti	Herb
12	**Cucurbitaceae**	*Citrullus*	*Citrullus colocynthis*	Kore Tomma	Herb

		Cucumis	*Cucumis melo*	Chibberh, Gwalaa	Herb
		Mukia	*Mukia maderaspatana*	Kakkri	Herb
		Praecitrullus	*Praecitrullus fistulosus*	Jangli Tindey	Herb
13	**Molluginaceae**	*Glinus*	*Glinus lotoides*	Phatokad	Herb
		Mollugo	*Mollugo cerviana*	Paddi	Herb
14	**Nyctaginaceae**	*Boerhavia*	*Boerhavia procumbens*	Bishkhira	Herb
15	**Tiliaceae**	*Corchorus*	*Corchorus depressus*	Bao Phali	Herb
16	**Cyperaceae**	*Cyperus*	*Cyperus conglomeratus*	Monghan	Sedge
			Cyperus rotundus	Deela	Sedge
17	**Asphodelaceae**	*Asphodelus*	*Asphodelus tenuifolius*	Piazii	Herb
18	**Amaranthaceae**	*Aerva*	*Aerva javanica*	Buie	Shrub
			Aerva pseudotomentosa	Buie	Shrub
		Amaranthus	*Amaranthus graecizans*	Tandlaa	Herb
			Amaranthus viridis	Tandulaa	Herb
19	**Aizoaceae**	*Gisekia*	*Gisekia pharnaceoides*	Balooka Saag	Herb
		Limeum	*Limeum indicum*	Barri Ulwaity	Herb
		Sesuvium	*Sesuvium sesuvioides*	Wisaah	Herb
		Trianthema	*Trianthema portulacastrum* Linn.	Choti Ulwaity	Herb
			Trianthema triquetra	Itsit, Wisaah	Herb
20	**Caesalpiniaceae**	*Cassia*	*Cassia italica*	Desi Sanas	Shrub
21	**Rhamnaceae**	*Zizyphus*	*Ziziphus mauritiana*	Beri	Tree
			Ziziphus nummularia	Beri, Ber	Tree
			Ziziphus spina-christi	Beri	Tree
			Ziziphus jujuba	Beri	Tree
22	**Asteraceae**	*Echinops*	*Echinops echinatus*	Ont kataara	Herb
		Eclipta	*Eclipta alba*	Bhangda	Herb
		Launaea	*Launaea nudicaulis*	Bhattale	Herb
			L. resedifolia.	Dudhkale	Herb
		Pulicaria	*Pulicaria crispa*	Bareem Dandi	Sub-Shrub

		Xanthium	*Xanthium strumarium.*	Buie	Shrub
23	**Fabaceae**	*Prosopis*	*Prosopis glandulosa*	Maskit	Shrub
			Prosopis juliflora	Maskit	Tree
			Prosopis cineraria	Jandi	Tree
		Vachellia	*Vachellia nilotica*	Kikar	Tree
			Vachellia jacquemontii	Kikri	Shrub
		Pongomia	*Pongomia pinnata*	Sukh chain	Tree
		Dalbergia	*Dalbergia sissoo*	Shisham	Tree
		Albezzia	*Albezzia procera*	White siris	Tree
			Albezzia lebbeck	Black siris	Tree
24	**Typhaceae**	*Typha*	*Typha domingensis*	Kundeer	Herb
			T. angustifolia	Narrow leaf cattail	Herb
		Physalis	*Physalis divaricate*	Mamooly	Herb
		Solanum	*Solanum surattense*	Kandiari	Herb
		Withania	*Withania coagulens*	Paneer	Shrub
			Withania somnifera	Aksen	Shrub
25	**Portulacaceae**	*Portulaca*	*Portulaca oleracea*	Lonak	Herb
			Portulaca quadrifida	Lonak	Herb
26	**Asclepiadaceae**	*Calotropis*	*Calotropis procera*	Aak	Shrub
		Caralluma	*Caralluma edulis*	Seetu, Pippun	Herb
		Leptadenia	*Leptadenia pyrotechnica*	Khip	Shrub
		Oxystelma	*Oxystelma esculentum*	Dudhani	Herb
			Oxystelma spiralis	Dudhani	Herb
27	**Chenopodiaceae**	*Chenopodium*	*Chenopodium album*	Bathuoo	Herb
		Haloxylon	*Haloxylon salicornicum*	Laana	Shrub
			Haloxylon stocksii	Khaar,	Shrub
			Haloxylon recurvum	Khaar	Shrub
		Salsola	*Salsola imbricata*	Laani	Shrub
		Suaeda	*Suaeda fruticosa*	Kali Laani	Shrub
28	**Euphorbiaceae**	*Chrozophora*	*Chrozophora sabulosa*	Nilkari	Herb
		Euphorbia	*Euphorbia granulata*	Hazaar Daani	Herb
			E. indica	Hazaar Daani	Herb
		Heliotropium	*Heliotropium crispum*	Kali Buie	Sub-Shrub
			Heliotropium strigosum	Gorakh Pen	Herb

29	**Brassicaceae**	*Farsetia*	*Farsetia hamiltonii*	Farid Boti	Shrub
			F. jacquemontii	Farid Boti	Shrub
30	**Papilionaceae**	*Alhagi*	*Alhagi maurorum*	Jawahan	Shrub
		Crotalaria	*Crotalaria burhia*	Chag	Shrub
		Melilotus	*Melilotus officinalis*	Sinji	Herb
		Sesbania	*Sesbania bispinosa*	Jintar	Shrub
		Tephrosia	*Tephrosia purpurea*	Jhill	Shrub
31	**Poaceae**	*Aeluropus*	*Aeluropus lagopoides*	Kalar ghaa	Grass
		Aristida	*Aristida adscensionis*	Laumb	Grass
			A. funiculate	Laumb	Grass
			A. hystricula	Laumb	Grass
			A. mutabilis	Laumb	Grass
		Brachiaria	*Brachiaria ramosa*	Bhorrat	Grass
		Cenchrus	*Cenchrus biflorus*	Dhamaan	Grass
			C. ciliaris	Dhamaan	Grass
			C. prieurii	Dhamaan	Grass
		Chloris	*Chloris gayana*	Chloris	Grass
		Cymbopogon	*Cymbopogon jwarancusa*	Khawi, Kettran	Grass
		Cynodon	*Cynodon dactylon*	Tallah	Grass
		Dactyloctenium	*Dactyloctenium aegyptium*	Dabb	Grass
		Desmostachya	*Desmostachya bipinnata*	Dib	Grass
		Digitaria	*Digitaria sanguinalis*	Ghaah	Grass
		Echinochloa	*Echinochloa colona*	Dhui	Grass
		Enneapogon	*Enneapogon desvauxii*	Sanawakri	Grass
		Eragrostis	*E. ciliaris*	Makni	Grass
			E. japonica	Makni	Grass
			E. minor	Makni	Grass
		Leptothrium	*Leptothrium senegalense*	Sevan, Ghorka	Grass
		Panicum	*Panicum antidotale*	Gandeel	Grass
			P. turgidum	Morrot, Bansi ghaa	Grass
		Pennisetum	*Pennisetum divisum*	Bansi ghaa	Grass
		Phalaris	*Phalaris minor*	Dumbi citi	Grass
		Polypogon	*Polypogon monspeliensis*	Sarkanda, Kanyy	Grass
		Saccharum	*Saccharum bengalense*	Sachii Sar	Grass
		Sporobolus	*Sporobolus ioclados*	Swag	Grass
32	**Moraceae**	*Ficus*	*Ficus virens*	Pilkan	Tree

		Morus	*Morus Alba*	Toot	Tree
33	**Combretaceae**	Conocarpus	Conocarpus erectus	Conocarpus	Tree
		Terminalia	*Terminalia arjuna*	Arjun	Tree
34	**Boraginaceae**	*Cordia*	*Cordia myxa*	Lasura	Tree
35	**Meliaceae**	*Melia*	*Melia azedarach*	Bakain	Tree
		Azadirachta	*Azadirachta indica*	Neem	Tree
36	**Myrtaceae**	*Eucalyptus*	*Eucalyptus cameldulensis*	Sufaida	Tree
			Eucalyptus citrodora	Sufaida	Tree
		Syzygium	*Syzygium cumini*	Jaman	Tree
		Melaleuca	*Melaleuca viminalis (Redirected from Callistemon viminalis)*	Bottle brush	Tree
37	**Bignoniaceae**	*Tecomella*	*Tecomella undulata*	Tecoma/Lahura	Tree
38	**Anacardiaceae**	*Mangifera*	*Mangifera indica*	Mango	Tree
39	**Moringaceae**	*Moringa*	*Moringa oleifera*	Sohanjna	Tree
40	**Arecaceae**	*Pheonix*	*Pheonix dactylifera*	Khajor/Date palm	Tree

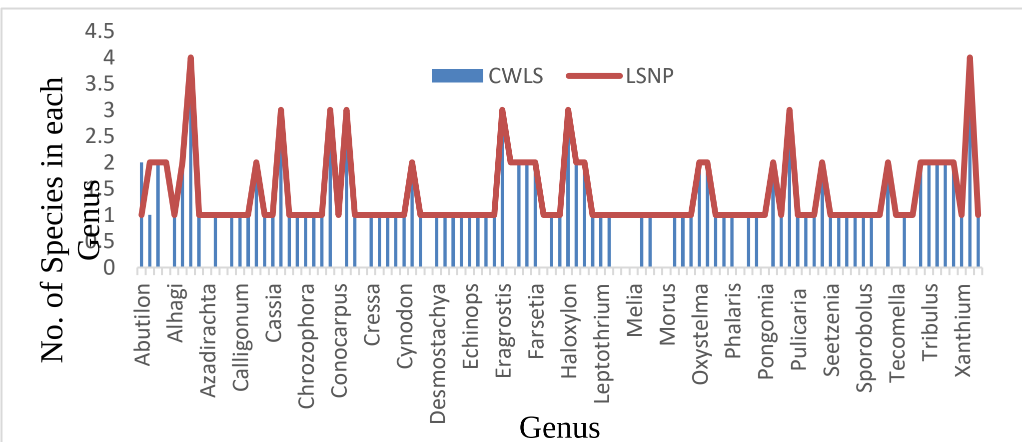


Fig 1. No. of species in each genus from Lal Sohanra National Parks (LSNP) and Cholistan Wildlife Sanctuary (CWLS)

Table 2: Pearson Correlation between CWLS and LSNP

	CWLS	LSNP
Pearson Correlation	1	.999**
Sig. (1-tailed)		.000
Sum of Squares and Cross-products	14770.115	17134.500
Covariance	143.399	166.354
N	104	104
Pearson Correlation	.999**	1
Sig. (1-tailed)	.000	
Sum of Squares and Cross-products	17134.500	19909.500
Covariance	166.354	193.296
N	104	104

**. Correlation is significant at the 0.01 level (1-tailed)

Table 3: List of No. of birds from LSNP and CWLS

Sr. no.	Family	Genus	Species	Local name	Status
1.	Laniidae	Lanius	*Lanius excubitor*	Greater grey shrike	LC
2.	Motacillidae	Motacilla	*Motacilla alba*	Pied wagtail	LC
3.	Phasianidae	Francolinus	*Francolinus francolinus*	Black partridge	LC
		Ortygornis	*Ortygornis pondicerianus (Redirected from Francolinus pondicerianus)*	Grey francoline	LC
4.	Pteroclidae	Pterocles	*Pterocles indicus*	Painted Sandgrouse	LC
			Pterocles orientalis	Black-bellied sandgrouse	LC
5.	Accipitridae	Buteo	*Buteo buteo*	Common buzzard	LC
		Butastur	*Butastur teesa*	White Eyed Buzzard	LC
		Aquila	*Aquila rapax*	Tawny eagle	VU

		Circus	*Circus macrourus*	Harrier	NT
		Accipiter	*Accipiter nisus*	Indian sparrow hawk	LC
6.	Sturnidae	Pastor	*Pastor roseus*	Rosy Starling	LC
		Sturnus	*Sturnus vulgaris*	Common starling	LC
7.	Ardeidae	Egretta	*Egretta garzetta*	Little egret	LC
		Bubulcus	*Bubulcus ibis*	Cattle egret	LC
		Ardeola	*Ardeola grayii*	Pond heron	LC
8.	Columbidae	Streptopelia	*Streptopelia decaocto*	Indian collard dove	LC
		Spilopelia	*Spilopelia senegalensis (Redirected from streptopelia senegalensis)*	Little brown dove	LC
9.	Meropidae	Merops	*Merops orientalis*	Small greenbee eater	LC
10.	Coraciidae	Coracias	*Coracias bengalensis*	Indian roller	LC
11.	Charadriidae	Vanellus	*Vanellus indicus*	Red Wattled Lapwing	LC
12.	Dicruridae	Dicrurus	*Dicrurus adsimilis*	Fork-tailed drongo	LC
			Dicrurus macrocercus	Black Drongo	LC
13.	Scolopacidae	Actitis	*Actitis hypoleucos*	Common sand piper	LC
14.	Passeridae	Passer	*Passer montanus*	Tree sparrow	LC
15.	Pycnonotidae	Pycnonotus	*Pycnonotus leucotis*	White-eared bulbul	LC
16.	Upupidae	Upupa	*Upupa epops*	Hoopoe	LC
17.	Leiothrichidae	Argya	*Argya caudata (Redirected from Turdiodes caudatus)*	Common Babbler	LC

18.	Otididae	Chlamydotis	*Chlamydotis undulate*	Houbara bustard	VU
		Ardeotis	*Ardeotis nigriceps*	Great Indian bustar	CR
19.	Alaudidae	Galerida	*Galerida cristata*	Crested Lark	LC
		Ammomanes	*Ammomanes deserti*	Desert lark	LC
20.	Recurvirostridae	Himantopus	*Himantopus himantopus*	Black winged stilt	LC
21.	Muscicapidae	Saxicola	*Saxicola caprata*	Pied bush chat	LC
22.	Sylviidae	Curruca	*Curruca nana*	Asian desert warbler	LC
23.	Strigidae	Athene	*Athene brama*	Spotted owl	LC
24.	Picidae	Dinopium	*Dinopium benghalense*	Golden-backed woodpecker	LC
25.	Falconidae	Falco	*Falco biarmicus jugger*	Lagar falcon	NT
			Falco cherrug	Saker falcon	EN

Table 4: List of mammals from LSNP and CWLS

Sr. no.	**Family**	**Genus**	**Species**	**Local name**	**Status**
1.	Felidae	**Caracal**	*Caracal caracal*	Indian caracal	LC
		Felis	*Felis lybica*	Desert cat	LC
			Felis chaus	Jungle cat	LC
			Felis sylvestris ornate	Indian desert cat	EN
			Felis margarita	Desert cat	LC
2.	Muridae	Rattus	*Rattus rattus*	House rat	LC

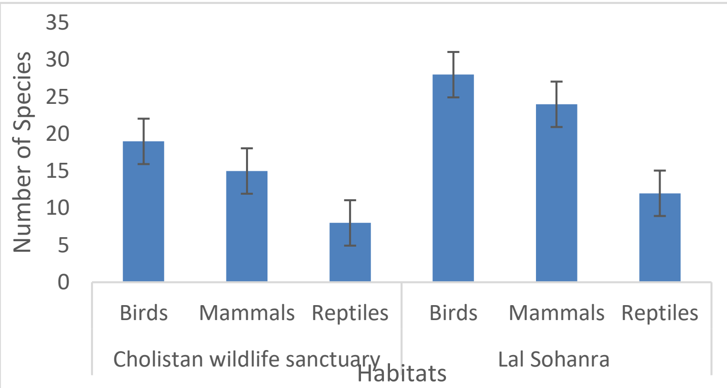
		Mus	*Mus musculus*	House mouse	LC
			Mus booduga	Little Indian field mouse	LC
		Meriones	*Meriones hurrianae*	Indian desert jird	LC
		Gerbillus	*Gerbillus gleadowi*	Indian hairy-footed gerbil	LC
		Nesokia	*Nesokia indica*	Short-tailed mouse rat	LC
		Tatera	*Tatera indica*	Indian Gerbil	LC
3.	Hystricidae	Hystrix	*Hystrix indica*	Indian Porcupine	LC
4.	Herpestidae	Herpestes	*Herpestes Mungo*	Indian Mongoose	LC
		Urva	*Urva auropunctata*	Small Indian mongoose	LC
			U. edwardsii	Grey mongoose	LC

5.	Rhinopomatidae	Rhinopoma	*Rhinopoma microphyllum*	Large-tailed mouse bat	LC
6.	Vespertilionidae	Scotophilus	*Scotophilus heathii*	Greater yellow house bat	LC
7.	Suidae	Sus	*Sus scrofa cristatus*	Indian Wild boar	LC
8.	Leporidae	Lepus	*Lepus nigricollis*	Desert hare	LC
		Vulpes	*Vulpes Vulpes*	Desert fox	LC
9.	Canidae	Canis	*Canis lupus*	Wolf	LC
			Canis aureus	Jakal	LC
10.	Trionychidae	Aspiderete	*Aspiderete gangeticus*	Indian soft-shell turtle	EN
11.	Trionychidae	Axis	*Axis axis*	Spotted deer	LC
12.	Cervidae	Gazella	*Gazella bennettii*	Chinkara	LC
13.	Bovidae	Antilope	*Antilope cervicapra*	Black buck	NT
		Bovinae	*Boselaphus tragocamelus*	Nilgai	LC
14.	Erinaceidae	Hemiechinus	Hemiechinus auratus	Hedgehog	LC
15.	Manidae	Manis	Manis crassicaudata	scaly anteater	EN
16.	Mustelidae	Mellivora	*Mellivora capensis*	Honey badger	LC

Table 5: List of reptiles from CWLS and LSNP

Sr. no.	Family	Genus	Species	Local name	Status
1.	Elapidae	Naja	*Naja naja*	Black Cobra	LC
		Bungarus	*Bungarus caeruleus*	Common krait	LC
2.	Boidae	Eryx	*Eryxx johnii*	Common sand boa	NT
			Eryx conicus	Sand boa	NT
3.	Gekkonidae	Cyrtopodion	*Cyrtopodion scabrum*	Common tuberculate ground gecko	LC
		Hemidactylus	*Hemidactylus brookii*	Spotted house gecko	LC
4.	Typhlopidae	Indotyphlops	*Indotyphlops braminus*	Brahminy blind snake	LC
5.	Agamidae	Saara	Saara hardwickii (Redirected from *Uromastyx hardwickii*)	Spiny Tailed Lizard	C
		Calotes	*Calotes versicolor*	Common tree lizard	LC
6.	Lacertidae	Acanthodactylus	*Acanthodactylus cantoris gunther*	Blue-tailed sand lizard	EN
7.	Viperidae	Echis	*Echis carinatus*	Saw-scaled viper	LC
8.	Colubridae	Fowlea	*Xenochrophis piscator*	Checkered Keelback	LC
		Spalerosophis	*Spalerosophis arenarius*	Red spotted diadem snake	LC
		Lycodon	*Lycodon aulicus*	Wolf snake	LC
9.	Varanidae	Varanus	*Varanus bengalensis*	common Indian monitor	LC

Fig 4. No. of species in CWLS and LSNP



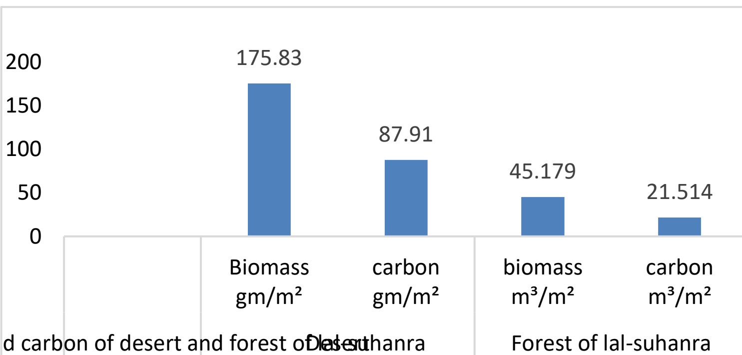


Fig 5. Biomass and carbon stock of desert and Lal-suhanra

Discussions:

Flora

Tree diversity near water bodies in Cholistan was $0.0116/m^2$. Overall floral diversity in Cholistan wildlife sanctuary was 0.015 plant per meter square. These results are correlated with Jhariya and Singh, (2021). Plant diversity vary under various climatic regimes. Jhariya and Singh, (2021) described the various herb related diversity against numerous fire regimes. They found maximum biological diversity under medium fire zones in dry terrestrial ecosystem. Furthermore, over story and understory vegetation species composition and carbon pool vary against multiple factors (Jhariya, 2017), vegetation management regimes (Ares et al., 2009), Soil moisture, nutrient status (Newbery et al., 1996), anthropogenic disturbance regimes (Oraon et al. 2014, 2015; Jhariya et al., 2014, 2014; Kittur et al., 2014; Jhariya 2017).

During the Flora study of Lal suhanra National park, we identified 40 families including 103 Genus and 143 species while in Cholistan wildlife sanctuary these results concluded 31 families including 85 genus and 123 species. These results are correlated with Kaushal and Baishya (2021), they examined 1280.9Mg/ha biomass production, 577.77Mg/ha carbon pool and species richness were 21.

Different forest ecosystems (Mixed and pure forest) have different biomass productivity, carbon pool and species richness (Kaushal and Baishya, 2021). Similar kind of results was collected during current study as we have studied two ecosystems (Lal Suhanra National park and Cholistan wildlife sanctuary) and found different species difference, and species richness.

Singh and Singh 1986; Singh and Singh 1987; Rai et al. 2012 found regeneration loss in different ecosystem (pure and mixed) that ultimately reduced the diversity and carbon pool of the regions while Cholistan wildlife sanctuary and Lal suhanra national park have severe drought conditions that receive less than 200mm annual rainfall. These severe environmental factors are directly proportional to the biomass productivity, species richness and carbon stock. The total carbon stock of Cholistan wildlife sanctuary was 87.91 gm/m² and total biomass calculated was 175.83 gm/m² while total carbon stock in Lal suhanra National park 21.51404883 m³/m² and total biomass was 45.179 m³/m² as shown in figure 5. Natural ecosystems are the key source of above and below ground carbon and food source in the world (Vicharnakorn et al., 2014). Reduction in biological diversity always leads to the diminution of stored carbon stock that run the natural ecosystems.

Fauna

The ecosystem stability fundamentally depends upon the amount of carbon present in the soil. The soil carbon is essential for soil physiochemical and microbial activity that ultimately leads to stability and enhance productivity. The more the plant production higher will be herbivores (secondary producers). The more the stable ecosystem greater will be the biological diversity.

Cholistan wildlife sanctuary and Lal-Suhanra National park have great potential regarding wildlife species. There is no such evidence of enlisting wildlife species from Cholistan as well as Lal Suhanra National Park. Khan et al., (2004), the only researcher who worked about nature resourse diversity in Cholistan in which he enlisted a few of wildlife species present there. We witnessed all of the enlisted species provided by Khan et al., (2004) and also encountered some of other species in Cholistan Wildlife sanctuary as shown in table 3, 4 & 5.

Animal diversity always leads to continuity of life, economic interest and ecosystem functioning (Singh, 2002). Genetic and species diversity are the most common types of biological diversity (Ardakani, 2004). Usually the animal diversity varies with the changing environmental factors, topographic factors and altitude (Maranon et al., 1999; Ahmadpour et al., 2012). Our findings about 42 families, 59 genus and 64 species in Lal suhanra National Park and 30 families, 39 genus and 42 species in Cholistan Wildlife sanctuary are correlated with Maranon et al., (1999) who described various species, genus and families under different ecosystems based on their topography, altitude and environmental factors.

Schmitz et al., 2018 studied the effect of zoo-geochemicals on diversity of animals in nature. They reviewed a large range of animal's diversity in different taxas which may increase or decrease with the changing zoo-geochemistry of earth surface. Our results as shown in figure 4 are very similar to Schmitz et al., 2018, during our research period we have found move diversity of of birds including 28 species, mammals including 24 species and reptiles have 12 species in LSNP while birds include19 species, mammals 15 species and reptiles have 08 species in CWLS.

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