Herpetological Conservation and Biology 10(3):801–810.
Submitted: 1 January 2015; Accepted: 2 August 2015; Published: 16 December 2015.

QUALITATIVE ANALYSIS OF FACTORS INFLUENCING THE DIVERSITY AND SPATIAL DISTRIBUTION OF HERPETOFAUNA IN CHAKWAL TEHSIL (CHAKWAL DISTRICT), PUNJAB, PAKISTAN

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***Abstract.*—Despite a global surge in research on amphibians and reptiles, insufficient work has been completed in Pakistan. We conducted the present study to examine factors influencing the diversity and spatial distribution of herpetofauna in the Chakwal District (Chakwal Tehsil), Punjab, Pakistan. We gathered data from March 2011 through July 2013 in selected sampling sites of the study area using standard methods. We used satellite images to identify and classify different landscape features. We found that the herpetofaunal diversity varied from 2.07 (unprotected tropical thorn forest) to 0.27 (mixed habitat in a wildlife sanctuary), while evenness oscillated between 1.76 (unprotected tropical thorn forest) and 0.21 (mixed habitat in a wildlife sanctuary). The two units with the highest similarity (0.82) were wetlands inside a protected area and wetlands outside of a protected area. Of the 12 variables tested, the factor analysis produced seven significant variables ($r > 0.80$) influencing the herpetofauna of the study area. These included hard substrate, water availability, agriculture activities, road network, traffic, road mortality, and habitat conversion. The processed image of the area shows that the area is still dominated by natural vegetation and forest. However, the natural areas are intersected by road networks that make them easily accessible. Changes in the land-use practices such as habitat conversion for residential development, housing schemes, and road development may cause reductions in the diversity of amphibians and reptiles. Data on current diversity and distribution is needed for planning and we have suggested options for herpetofauna conservation and management.**

Key Words.—GIS; protected areas; remote sensing; urbanization; species diversity

INTRODUCTION

Amphibians and reptiles have become the focus of many contemporary studies because these two vertebrate groups have a high percentage of threatened and data deficient species (Gardner et al. 2007a; IUCN. 2009. The IUCN Red List of Threatened Species. Update: Amphibian Facts. Available from http://cmsdata.iucn.org/downloads/more_facts_on_amphibians_1_.pdf [Accessed 28 December 2010]; IUCN. 2009. The IUCN Red List of Threatened Species. Update: Reptile Facts. Available from http://cmsdata.iucn.org/downloads/more_facts_on_reptiles_1.pdf [Accessed 28 December 2010]) and their populations are declining at a global scale (Wake 1991; Gibbons et al. 2000). It is believed that conversion of natural habitats for agriculture, human settlements, and other developments such as roads and highways are major contributors to land-use change resulting in the decline of diversity of amphibians and reptiles at some locations (Lajmanovich et al. 2003; Storfer 2003; Young et al. 2004; Gardner et al. 2007b). Further, the herpetofauna is also impacted by barriers to dispersal such as roads and highways (Cushman 2006; Parris 2006). Vehicular traffic results in herpetofaunal mortality, jeopardizing the survival of endemic, globally, and locally threatened species (Amarakoon et al. 2010; Baskaran and Boominathan 2010; Selvan 2011; Arijit et al. 2012; Karunarathna et al. 2013). Increased human settlements in protected areas (Katwate et al. 2013), followed by activities such as extensive grazing and deforestation for firewood (Wittemyer et al. 2008), have been reported to impact conservation measures in these areas.

Recent contributions on the herpetofauna of northern parts of Punjab Province, Pakistan include inventories and studies on abundance. Yousuf et al. (2010) recorded mean population densities of the Indian Bull Frog (*Hoplobatrachus tigerinus*) and Skittering Frog

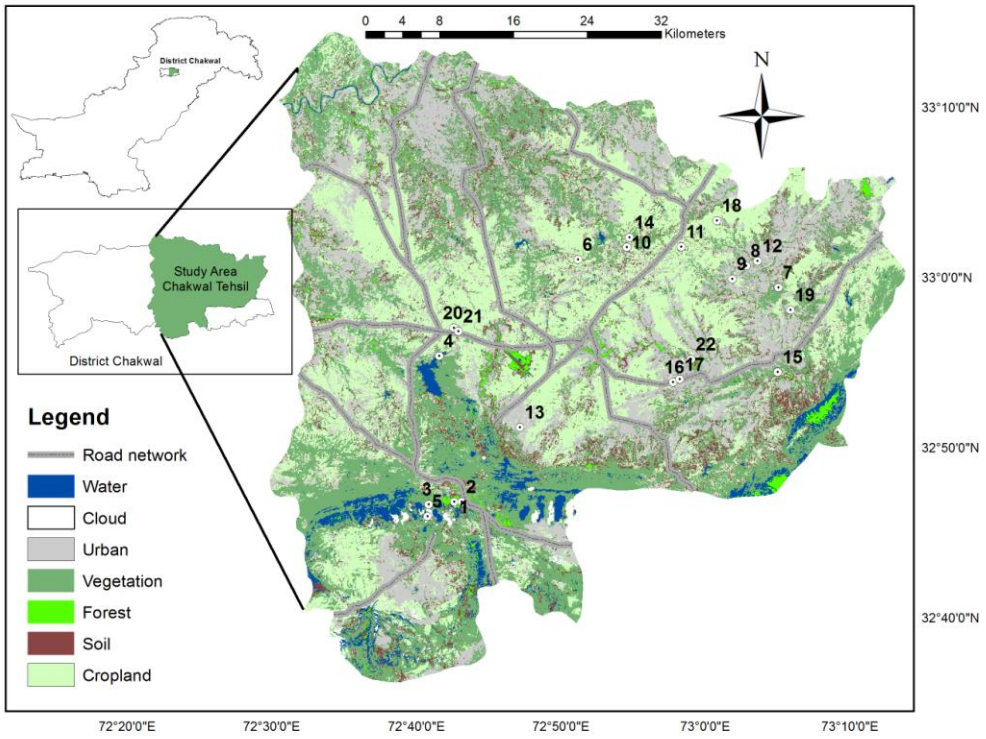

FIGURE 1. Image showing landscape features of Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan. The thick vegetation (shown as forest) dominates the area with some other vegetation type such as shrubs, urban and roadside vegetation. The areas along the roads have been converted into agriculture areas. The numbers 1–22 represent sampling sites. Sites 1, 2, 18 and 19: wetlands inside protected area; sites 4, 5, 20 and 21: wetlands outside protected area; sites 3 and 22: unprotected scrublands/ tropical thorn forest; sites 6, 7, 8, 9, and 10: mix habitat of the protected area (wildlife sanctuary) and sites 11, 12, 13, 14, and 16: village-cropland complex.

(*Euphlyctis cyanophlyctis*), respectively, as 25.07 frogs ha^{-1} from the paddy fields of Gujranwala, Punjab Province. Masroor (2011) presented an annotated checklist of nine amphibians and 32 reptiles of Margalla Hills National Park, Islamabad. Tabassum et al. (2011) reported the mean population density of *Euphlyctis cyanophlyctis* and *Hoplobatrachus tigerinus* as 1.09 ± 0.33 frogs ha^{-1} and 0.46 ± 0.11 frogs ha^{-1}, respectively, from Rawal Lake, Islamabad Capital Territory. Rais et al. (2012) recorded 35 species of amphibians and reptiles (29 genera, 16 families, four orders) from the districts of Rawalpindi, Islamabad, and Chakwal, Pakistan. Data on factors that influence diversity and distribution of amphibians and reptiles at habitat and landscape level are scare in Pakistan. We, therefore, conducted the present study to see if certain variables influence diversity and spatial distribution of the herpetofauna in Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan.

MATERIALS AND METHODS

Study area.—We undertook the present study in Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan. The area is located at about 498 m elevation and features a semi-arid climate. The annual average temperature of the area is 29.6 °C and average annual rainfall is about 620 mm (Hanif, M. and Ali, J. 2014. Climate Scenarios 2011–2040: Districts Haripur, Swabi, Attock and Chakwal Pakistan. Available from http://intercooperation.org.pk/uploads/pmd-ccc-scenarios.pdf [Accessed 25 November 2014]). The main landscape features include cultivated lands, with a network of rainwater streams and small water storage reservoirs, scrub and tropical thorn forests, permanent wetlands, and urban areas. The common crops include wheat, peanut, maize, millet, and sorghum. We selected 22 sampling sites (Fig. 1) and grouped them into the following units: (1) Village-Cropland Complex: areas with human habitations and rural settings, dominated by croplands; (2) Unprotected Scrubland/Tropical Thorn Forest: Unprotected areas with open habitat dominated by *Acacia modesta*, *A. nilotica*, *Dodonaea viscosa*, *Maytenus royleanus*, *Lantana camara*, *Cynodon dactylon*, *Chrysopogon serrulatus*, *Dactyloctenium scindicum*, *Cymbopogon jwarancusa*, and *Digitaria sanguinalis*; (3) Mixed habitat protected as a wildlife sanctuary: area of open habitat featuring scrub

vegetation, ephemeral streams, cultivated lands, and human habitations; (4) Protected Wetlands; and (5) Unprotected Wetlands (Fig. 1).

Methodology.—We surveyed each sampling site once during spring (March-April), summer (May-June), monsoon (July-August), fall (September-October), and winter (November-February) from March 2011 through July 2013. Although the duration of field visits varied from a minimum of one day to a maximum of three days, we recorded six field hours (morning: 0800–1000, after noon: 1400–1600, and evening: 2000–2200) of data on herpetofauna abundance site/visit/season. We collected qualitative data (presence-absence) on the basis of 12 variables including hard substrate, water availability, grazing activity, protection status of the site, agriculture, presence of road network, vehicular traffic, residential development, tourism, incidences of herpetofauna mortality along the roads, trapping of species, and habitat conversion into croplands, roads or human habitations based on field observations and satellite imagery. We used standard Visual Encounter Survey (Crump and Scott 1994) to record presence-absence and abundance of herpetofauna. All the potential habitats in the sampling sites were searched by similar random walks at a steady pace for a pre-defined amount of time (2 h/session) excluding the time invested in collecting information on the habitat or taking photographs or measurements (Crump and Scott 1994; Sutherland 1996). The freshwater turtles were observed using 8 × 38 binoculars. We followed Khan (2006) for species identification; Pyron and Wiens (2011), Pyron et al. (2013), and Praschag et al. (2007a, b) for the taxonomy of anurans, squamates, and freshwater turtles, respectively.

Data analysis.—We calculated species richness estimators such as abundance-based coverage estimator (ACE) and Chao 1 using program EstimateS 9.1.0 (Colwell, R.K. 2013. EstimateS: Statistical estimation of species richness and shared species from samples). These estimators have been widely used to estimate the true species diversity (see Chao 1984; Chao and Lee 1992; Colwell and Coddington 1994; Chazdon et al. 1998; Hortal et al. 2006 for details). We calculated the herpetofauna diversity, evenness, uniqueness, and similarity across the studied units using the following indices: Shannon-Weiner Diversity Index (H') = - Σ (pi ln pi) where pi = proportional frequency of the ith species; Evenness Index (E) = H'/ ln (S) where H' is the Shannon-Weiner Diversity Index and S is the number of species; Uniqueness index (U) = Ur /Rtot, where Ur is the number of species that are unique to the unit and R tot the total number of species recorded from all unit; Sorensen's Index of Community Similarity (Sorensen 1948) CC=2s / (a + b), where s is the number of species that are shared by the two units, a is the number of species in unit a, and b the number of species in unit b. We performed factor analysis in SPSS 22.0, using varimax rotation, to reduce 12 variables into fewer variables to determine which variables contributed most.

We downloaded the latest LANDSAT TM 30m imagery (path: 150; row: 37; date: 18–06–2010; Available from http://www.glovis.usgs.gov [Accessed 30 November 2013]) for Chakwal Tehsil (Chakwal District, Punjab Province, Pakistan). We stacked and extracted the areas of interest from the image. We adopted the method of supervised classification using LANDSAT TM 30 m imagery in 4, 5 and 7 band combination to identify different habitats. The signature reflectance response of urban areas, water bodies, soil and various forms of vegetation were very prominent in 4, 5 and 7 band combination. We performed aforementioned analysis in programs ERDAS Imagine ver. 11 and ArcMap ver.10.1.

RESULTS

We recorded 33 species of amphibians and reptiles belonging to 15 families from six different units of Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan (Appendix 1). The species richness estimators revealed that the observed number of species was slightly lower than the estimated number of species viz. 35 and 36 predicted by Abundance-based Coverage Estimator (ACE) and Chao 1, respectively. The highest number of individuals (6,586; accounting for 50 % of the total individuals) were recorded from the protected mixed habitat (wildlife sanctuary) followed by 2,486 (18%) from wetlands inside protected area while the lowest number (154) was recorded from unprotected scrublands and tropical thorn forests (Table 1). We recorded wetlands outside a protected area as the most species rich land unit with 27 (accounting 82 % of the total species recorded) species followed by village-cropland complex with 21 (63 %) species while unprotected scrublands and tropical thorn forests with 15 (45%) species was recorded as least diverse (Table 1). The medians of the number of individuals recorded across the selected units differed significantly (x = 7.08; df = 4; P = 0.006). Species diversity among the selected units varied from 2.07 (unprotected tropical thorn forest) to 0.27 (mixed habitat within protected area), evenness oscillated between 1.76 (unprotected tropical thorn forest) to 0.21 (mixed habitat within protected area; Table 1). The two units with the highest similarity (0.82) were wetlands inside a protected area and wetlands outside a protected area while wetlands inside a protected area and tropical thorn forest had the lowest similarity (0.52). We concluded that none of the units had high species uniqueness (Table 1).

TABLE 1. Herpetofauna diversity, evenness, uniqueness and similarity recorded from Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan. Abbreviations are WIPA = Wetland Inside Protected Area, TTF = Unprotected Scrubland/Tropical Thorn Forest, WOPA = Wetland outside Protected Area, WLS = Mix habitat of the protected area (Wildlife Sanctuary), and VCC = Village-Cropland Complex. Similar superscript in the columns shows significant difference ($P = 0.006$).

Sites	Number of species	Number of Individuals	Diversity index	Evenness index	Uniqueness index	Similarity Index			
						TTF	WOPA	WLS	VCC
WIPA	19 (57 %)	2486 (18%)	0.67	0.52	--	0.52	0.82	0.68	0.80
TTF	15 (45 %)	154[a] (1 %)	2.07	1.76	0.06		0.61	0.58	0.61
WOPA	27 (82 %)	1766[a] (13 %)	1.18	0.82	0.06			0.72	0.79
WLS	19 (57 %)	6586 (50 %)	0.27	0.21	0.06				0.70
VCC	21 (63 %)	2092 (16 %)	0.57	0.43	--				
Total	33	13084							

Of the 12 variables tested, the factor analysis produced seven significant variables ($r > 0.80$). The first two axes accounted for 64.53% of the variance in the raw data (Fig. 2). The first axis (D1) accounted for 33.06% and was strongly correlated ($r > 0.80$) with the presence of road network, vehicular traffic, herpetofauna mortality incidences along the roads, and habitat conversion (Fig. 2). The second axis (D2), accounted for 31.49% of the variability, showed strong positive correlation with hard substrate and water availability, and a strong negative correlation with agriculture (Fig. 2). The processed image of the district (Fig. 1) shows that the area is still dominated by natural vegetation and forest. However, these natural areas are intersected by roads facilitating access to wild areas. This has resulted in habitat fragmentation and its subsequent conversion into human settlements. The water bodies in the study area are mainly confined to the southeast and southwest.

DISCUSSION

Extensive surveys during this study enabled us to document more species than recorded previously from the Chakwal District by Rais et al. (2012). We recorded the Dicroglossidae and Agamidae as the most dominant families of anurans and squamates, respectively. Studies by Bobrov (1993), Zaini et al. (2012), and Katwate et al. (2013) on the herpetofauna from different parts of the world also identified the Dicroglossidae and Agamidae as the most abundant families. Species accumulation models (ACE and Chao 1 estimators) suggested that we would have recorded three more species from the studied district. Soberón and Llorente (1993) suggested that species accumulation models allowed to measure species inventory efficacy and completeness within a given study, and valid comparisons between land management units based upon a standardized measure of sampling effort. Although the number of species we recorded did not deviate much from the number of species predicted by the models, we still feel that our species list may represent an underestimate of the herpetofaunal diversity, particularly geckos, lacertids, and skinks. We did not aim to report any of the studied unit as the most or least significant, rather we wanted to gather baseline data on the herpetofauna. We recorded a high number of amphibians and reptiles from the protected mixed habitat (wildlife sanctuary) because the area had many seasonal and permanent ponds that were occupied by a high number of individuals of anuran species while we may had failed to detect few individuals in unprotected tropical thorn forest.

We found that the seasonal ponds formed during the rainy season in forest area and low-lying areas of the wildlife sanctuary and permanent wetlands, whether with or without protection, were important for aquatic and semi-aquatic species of anurans, freshwater turtles, and water snakes. We recorded *Euphlyctis cyanophlyctis* in abundance from village-cultivated complexes particularly when the croplands were inundated with rainwater. Our results are in agreement with Vasudevan et al. (2008) and Botejue and Wattavidanage (2012), who reported high anuran density (300 individuals ha^{-1}) along the streams and in cultivated habitats. Studies suggest that the sites with diverse wet microhabitats, such as sites in agricultural zones and mosaic sites are important for semi-aquatic herpetofauna conservation (Kati et al., 2007). The perennial streams and wetlands are vital for the conservation of semi-aquatic herpetofauna in an arid climate (Ficetola et al. 2004; Welsh et al. 2005) while ephemeral flooded lands are important for the successful breeding of amphibians (Bousbouras and Ioannidis 1997; Brodman et al. 2003).

We did not find a significant impact of grazing on the herpetofauna while Fabricius et al. (2003) reported that snakes and lizards are more abundant in communal grazing area. We recorded that agriculture activities, road network, traffic, herpetofauna mortality due to collision with vehicles, habitat conversion into agriculture and urban areas are affecting herpetofauna of Chakwal District. Studies have shown that the conversion of natural habitats for agriculture and human settlements affects amphibians and reptiles

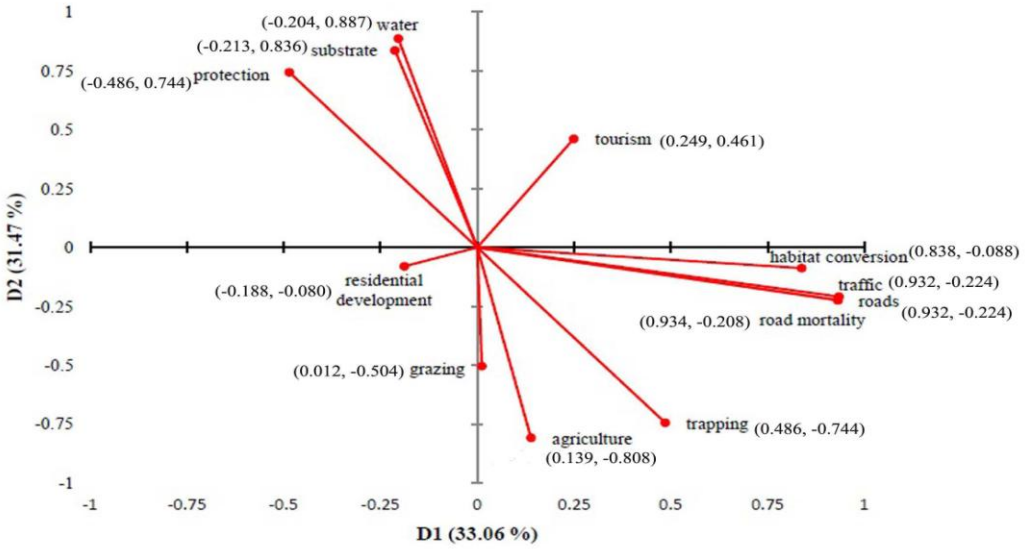

FIGURE 2. Plot of factor analysis for habitat variables and anthropogenic activities. The factors with absolute correlation values greater than 0.80 were considered significant. The values in parenthesis on the main plot show factor loading on axis 1 and axis 2 while along the axis show percentage of the variance in the raw data.

(Lajmanovich et al. 2003; Gardner et al. 2007b). Roads and highways serve as barriers to dispersal (Cushman 2006; Parris 2006) while vehicular traffic results in the increased mortality of many herpetofauna species (Selvan 2011; Arijit et al. 2012; Karunarathna et al. 2013). We found no impact based on the protection status of the site as we recorded a low diversity index value (0.27) from mixed habitat of the wildlife sanctuary. Katwate et al. (2013) and Wittemyer et al. (2008) suggested that conservation measures in protected areas such as wildlife sanctuaries seem to be ineffective at some locations due to increased human settlements followed by activities such as extensive grazing and deforestation for firewood. The protected areas are intended to provide safe refuge for wildlife species, but rapid human population growth rate in and around protected areas and weak implementation of laws have made the protection of the herpetofauna in these areas insignificant. Studies by Zaini et al. (2012), Barrett and Guyer (2008), and Fabricius et al. (2003) documented that degraded sites, secondary forest, and urban areas harbor high reptilian diversity. We believed that habitat conversion and urbanization may modify the herpetofauna species richness and diversity patterns by favoring species, such as *Duttaphrynus melanostictus*, *Duttaphrynus stomaticus*, *Lissemys punctata*, *Calotes versicolor*, *Varanus bengalensis* and *Hemidactylus* species and while eradicating others, such as *Nilssonia gangetica* and *Microhyla ornata.*

Changes in the land-use practices such as habitat conversion for residential development, housing schemes, and development of road networks may cause reductions in the herpetofaunal diversity in the Chakwal District. The perennial wetlands, with or without protection status, and ephemeral, flooded croplands are vital for the conservation of aquatic and semi-aquatic species while semi-open and open habitats with high vegetation density are significant for the conservation of the terrestrial herpetofauna in study area. There is great need to incorporate habitat requirements for amphibians and reptiles, particularly breeding anurans, freshwater turtles, and snakes, in any proposed human development projects in the district. Protection may be increased by the construction of wildlife passages under the roads and highways to reduce the herpetofaunal road mortality. As the area does not have many large permanent wetlands, construction of rainwater harvesting ponds would provide habitat to breeding anurans and fresh-water turtles, which, in turn, will provide prey for carnivorous species. Management of boundary vegetation along croplands would benefit skink and lacertid species while planting native tree species would provide habitat to agamids and some gekkonids. There should be a strict ban on the capture and trade of various species, such as Indian Soft-shell Turtle (*Nilssonia gangetica*)., Indus Valley Spiny-tail Lizard (*Saara hardwickii*), Fat-tail Gecko (*Eublepharis macularius*), Black Cobra (*Naja naja*) and Rat Snake (*Ptyas mucosus*). We suggest that detailed quantitative studies should be designed to assess the impact of factors such grazing, vehicular traffic and habitat conversion on the herpetofauna of the district.

Acknowledgments.—The authors are indebted with thanks to PMAS Arid Agriculture University, Rawalpindi for funding this study. The department had signed a Memorandum of Understanding with the provincial wildlife department and no special permit was required to conduct surveys in the study area.

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MUHAMMAD RAIS, Assistant Professor, Wildlife Management, PMAS-AAUR, has been working on various aspects of herpetology in the Potohar Area, Punjab, Pakistan. He has completed three foreign trainings (USA, Australia, and India) in herpetology. He is a member of IUCN amphibian specialist group. He has initiated research to document genetic diversity and radio-telemetric studies on endemic and threatened amphibians and reptiles of the area. He is currently executing two research projects (local and foreign funded) on genetic diversity, space use, habitat association, and monitoring of anuran populations. (Photographed by Syeda Maria Ali).

AYESHA AKRAM, holds an M. Phil. degree in Wildlife Management. She is currently doing her Ph.D. studies in Wildlife Management, PMAS AAUR. She is interested in documenting genetic diversity in *Fejervarya* species complex, understanding space by endemic anuran species, and designing protocols to monitor anuran populations in natural, semi-developed, and urbanized areas of Rawalpindi-Islamabad. (Photographed by Jawad Jilani).

SYEDA MARIA ALI, Assistant Professor, Department of Environmental Sciences, International Islamic University, Islamabad (IIUI), received her M. Phil. and Ph.D. from Quaid-i-Azam University, Islamabad. Dr. Ali is engaged in research contribution towards climate change, GIS/SRS, water quality and reuse, vegetation and soil science, and urban ecology. Dr. Ali has completed her post doctoral research activities related to drinking water quality from Indiana Purdue University, USA, and Species Distribution Modeling techniques from University of Canberra, Australia. She has demonstrated her commitment for quality education and progress of research initiatives in ecology, GIS, and remote sensing. (Photographed by Muhammad Rais).

MUHAMMAD ARSLAN ASADI soon after completing his M. Phil. in Wildlife Management from PMAS-Arid Agriculture University, Rawalpindi (PMAS-AAUR), joined the department as a Ph.D. scholar and Research Associate in the project titled "Base line studies on wildlife diversity in selected Protected Areas of Pakistan." He is interested to study effectiveness of the protected areas systems in conserving biodiversity, particularly herpetofauna, of Punjab, Khyber PakhtunKhwa Provinces and Azad Jammu and Kashmir. (Photographed by Muhammad Rais).

MISBAH JAHANGIR completed M.S. in Environmental Science from International Islamic University, Islamabad. Her keen areas of interest are climate change scenarios, remote sensing, and GIS. She has presented her work at several national and international conferences and volunteers for projects related to environmental management and community development. (Photographed by Syeda Maria Alir).

MUHAMMAD JAWAD JILANI completed M.Sc. and M.Phil. in Wildlife Management, PMAS-AAUR. He has volunteered in different research projects of the department. Muhammad is currently working as a Wildlife Biologist in Barari Forest Management, United Arab Emirates. Although he is involved in managing one of the largest collection of ungulates and carnivore species on Sir Bani Yas Island, he is more inclined towards herpetology and wishes to pursue doctoral studies in this field. (Photographed by Muhammad Arslan Asadi).

MAQSOOD ANWAR is the acting Dean of the Faculty of Forestry, Range and Wildlife and is the Chairman of Wildlife Management, PMAS-AAUR. He earned his Ph.D. in Wildlife Science from Utah State University, Utah, USA, in 1989. His doctoral research was on ecology of Grey Goral (*Naemorhedus goral*) in the Margalla Hills National Park (Islamabad Capital Territory) and developed a management plan for the park. He has generally focused on ecological studies of mammals and birds, in addition to data collection on threatened wildlife species. Maqsood also conducted studies on wildlife diversity and its management in protected areas of Pakistan, especially considering the social aspects of wildlife conservation. (Photographed by Muhammad Arslan Asadi).

APPENDIX 1. Checklist of species of amphibians and reptiles recorded from Chakwal Tehsil, Chakwal District, Punjab Province, Pakistan.

Class Reptilia	
Order Testudines	
Family Geoemydidae	
Pangshura smithii	Brown River Turtle
Pangshura tecta	Saw-back Turtle
Family Trionychidae	
Nilssonia gangetica	Indian Soft-shell Turtle
Lissemys punctata	Indian Flapshell Turtle
Order Squamata	
Sub-order Sauria	
Family Agamidae	
Calotes versicolor	Common Tree Lizard
Laudakia melanura	Black Rock Agama
Family Eublepharidae	
Eublepharis macularius	Fat- tail Gecko
Family Gekkonidae	
Cyrtopodion scabrum	Common Tuberculate Ground Gecko
Hemidactylus brookii	Spotted Barn Gecko
Hemidactylus flaviviridis	House Lizard
Family Lacertidae	
Acanthodactylus cantoris	Blue-tail Sand Lizard
Ophisops jerdonii	Rugose Spectacled Lacerta
Family Scincidae	
Eutropis dissimilis	Striped Grass Skink
Family Varanidae	
Varanus bengalensis	Bengal Monitor Lizard
Family Uromastycidae	
Saara hardwickii	Indus Valley Spiny-tail Lizard
Order Squamata	
Sub-order Serpentes	
Family Typhlopidae	
Ramphotyphlops braminus	Brahminy Blind Snake
Typhlops species	Blind Snake
Family Colubridae	
Amphiesma platyceps	Spotted Keel Back
Oligodon arnensis arnensis	Banded Kukri Snake
Oligodon taeniolatus	Streaked Kukri Snake
Platyceps ventromaculatus	Plains Racer
Ptyas mucosus mucosus	Dhaman
Spalerosophis diadema	Blotched Diadem Snake
Xenochrophis piscator	Checkered Keel Back
Family Viperidae	
Bungarus caerulus caerulus	Common Krait
Echis carinatus	Saw-scaled Viper
Class Amphibia	
Order Anura	
Family Bufonidae	
Duttaphrynus melanostictus	South-east Asian Toad
Duttaphrynus stomaticus	Indus Valley Toad

Family Microhylidae	
Microhyla ornata	Ant Frog
Family Dicroglossiade	
Euphlyctis cyanophlyctis	Skittering Frog
Hoplobatrachus tigerinus	Bull Frog
Fejervarya limnocharis	Cricket Frog
Sphaerotheca breviceps	Burrowing Frog