

Status of Smooth Coated Otter (*Lutrogale perspicillata sindica*) in Pakistan

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Abstract.- A review of the available literature on Smooth coated otter (*Lutrogale perspicillata sindica*) has been made covering its nomenclature, status, distribution, biology, habitat, behavior, ecology, ecological role, food and feeding habits, breeding, territory size and various threats. Out of 13 species of otters Pakistan hosts only two; smooth coated otter (*Lutrogale perspicillata sindica*) and Eurasian or common otter (*Lutra lutra*). Smooth coated otter is called “Oodh Balao” in Urdu language and the sub-species found in Pakistan is known as Sindh otter. The status of the species has recently been declared as vulnerable in Pakistan by IUCN. It prefers plain areas and is widely distributed in Sindh, some parts of the Punjab and a few places in Khyber-Pakhtunkhwa along Indus River. The nocturnal mammal is adapted to a semi aquatic mode of life. Average body weight is seven kg, head and body length 61 cm and tail length around 40 cm. Smooth coated otter is a top carnivore of wetlands and feeds mainly (up to 96%) upon fish. It is considered to be a suitable indicator of pollution level in a wetland. The animals form strong monogamous pairs; males are larger but still females dominate the pair. Breeding may occur throughout the year, gestation period varies from 61-63 days and young ones at their birth are covered with fur and their eyes do not open until up to 10 days. The weaning takes almost 130 days and the young ones start taking fish at the age of three months. Litter size of 2-4 cubs is normal and rarely five but recently six cubs have been observed in Sindh. The home range varies from 7-12 km² depending upon the availability of food and other basic attributes of the habitat. Habitat fragmentation, otter-human conflicts, hunting for skins and lack of awareness among general public are main threats to the species.

Key words: Sindh otter, Mustelidae, Lutrinae, WWF Pakistan, Sindh Wildlife Department.

INTRODUCTION

Otters belonging to the order Carnivora of class Mammalia, are semi-aquatic members of the

family Mustelidae which also includes weasels, martens, polecats, badgers, skunks, grisons and minks. Otters are placed in the sub-family Lutrinae. There are 13 species of otters distributed all over the world except for Australia, Antarctica and some oceanic islands (Mason and Macdonald, 1986). Pakistan hosts only two species of otters *i.e.* smooth coated otter (*Lutrogale perspicillata*) and common or Eurasian otter (*Lutra lutra*) (Roberts, 1997).

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Harris (1968) has described three sub-species of smooth coated otter; *Lutrogale perspicillata perspicillata*, *L. p. maxwelli*, and *L. p. sindica*. The species found in Pakistan has been referred to as sub-species *L. p. sindica* (Pocock, 1939) with the common name Sindh otter.

NOMENCLATURE

Smooth coated otter is known as Ludhar, Ludhro, Da Khuwarr Spay and Oodh Balao in Punjabi, Sindhi, Pashto and Urdu languages of Pakistan, respectively (Khan *et al.*, 2009). The species was initially illustrated and named as *Lutra perspicillata* by Geoffroy (1826). It was referred to as *Lutra tarayensis* by Hodgson (1839), *Lutra macrodus* by Gray (1865) and *Lutra ellioti* by Anderson (1878). The genus *Lutrogale* has also been considered as synonymous with *Lutra* by some of the authors (Chasen, 1940; Harris, 1968). It has also been used as a subgenus of *Lutra* by Payne *et al.* (1985) and Ellerman and Morrison-Scott (1966). Different studies have suggested evolution of *Lutrogale* from *Lutra*-like ancestors (Pohle, 1919; Willemsen, 1992). Pocock (1949) was the first to name the species as *Lutrogale perspicillata*. Pocock (1941), Corbet and Hill (1992), Willemsen (1980) and Wozencraft (2005) also distinguished *Lutrogale* as a monotypic genus. For highlighting the distinctiveness in morphology and behavior from genus *Lutra*, the smooth coated otter was placed in separate genus *Lutrogale* (Duplaix, 1975; Corbet and Hill, 1991; Hwang and Lariviere, 2005). Davis (1979) has shown close affinities of smooth coated otter to genus *Aonyx* through his studies of different chromosome numbers possessed by the species. Koepfli *et al.* (2008) have also suggested that *Lutrogale* should be transferred to the sub-family Aonyxinae from the Lutrinae, which would then comprise of *Aonyx capensis*, *Aonyx cinerea*, and *Lutrogale perspicillata*.

STATUS

Smooth coated otter is known to be one of the least studied species (Hussain and Chaudhry, 1997). It has been assessed as 'Vulnerable' by IUCN Red List of Threatened Species (IUCN, 2008) and listed

in Appendix II of CITES (Shenoy, 2005). According to Status and IUCN Red List of Pakistan Mammals, it has been assessed as 'Near Threatened' (Sheikh and Molur, 2005). In Pakistan, the species is protected under the Sindh Wildlife Protection Act 1972, Punjab Wildlife Protection, Preservation, Conservation and Management Act 1974 and NWFP Wildlife Protection, Preservation, Conservation and Management Act 1974 and is placed in Third and Second Schedule, respectively (Shafiq, 2005).

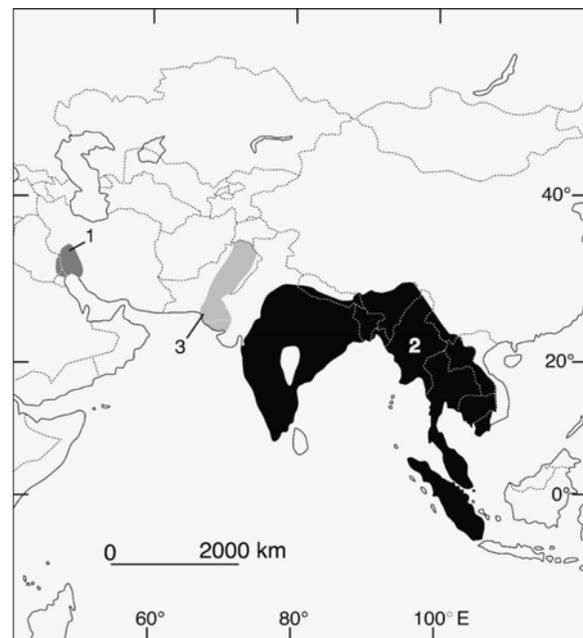


Fig. 1. Worldwide distribution of *Lutrogale perspicillata*; 1, *Lutrogale perspicillata maxwelli*; 2, *Lutrogale perspicillata perspicillata*; 3, *Lutrogale perspicillata sindica* (Source: Hwang and Lariviere, 2005)

DISTRIBUTION

Global distribution

Smooth coated otter is found in South and South East Asia including Pakistan, India, Nepal, Bhutan, Bangladesh, South West China, Myanmar, Thailand, Vietnam, Malaysia, Indonesia, Kampuchea, Laos, Malay Peninsula, Sumatra, Java and Borneo (Mason and Macdonald, 1986; Corbet and Hill, 1992). Although it's current distribution in

Middle East is not known however, isolated population of the species exists in Iraq as well (Pocock, 1941). Hooshang and Bernhard (1997) have reported the smooth coated otter to be extant in Iran being present in the Hur-al-Azim wetland, Khuzestan, located near the borders with Iraq.

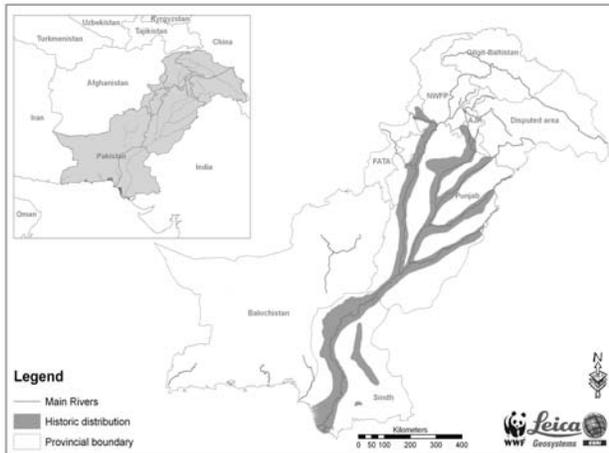


Fig. 2. Historical distribution of *Lutrogale perspicillata sindica* in Pakistan. (Source: Corbet and Hill, 1992; De Silva, 2006; Roberts, 1997) © WWF Pakistan.

Regional distribution

Only five otter species occur in Asia, three species of which occur in the Indian sub-continent including *Lutra lutra*, *Lutrogale perspicillata* and *Aonyx cinerea* (Pocock, 1941; Prater, 1971; Hussain and Chaudhry, 1997; Conroy *et al.*, 1998) and these three species are heading towards decline (Hussain, 1998a). The smooth coated otter is distributed throughout South and South-east Asia (Pocock, 1941; Mason and Macdonald, 1986; Hussain, 1993). Prater (1948) has described the species as an otter of the plains. He has also indicated that the species in Indian subcontinent is present in the northwestern desert, the dry zone of central India and the Deccan plateau. The species is generally found in rivers, lakes, peat swamp forests, mangrove forests and even in rice fields in South-east Asia (Foster-Turley, 1992; Sivasothi and Burhanuddin, 1994; Melisch *et al.*, 1994). Pocock (1941) has described the historical distribution of smooth coated otter from the Himalayas southward to Karnataka and eastward to Burma. The smooth coated otter is found in India

from the Himalayas southward, and thought to be absent from central India (Pocock, 1949; Prater, 1971; Foster-Turly *et al.*, 1990; Hussain, 1993). Shenoy (2005) has indicated that smooth coated otter can be found throughout India from the Himalayas southward.

Local distribution

Blanford (1881) reported that the species is prominent in the Indus valley in Sindh. Murray (1884) has described the presence of smooth coated otter in Sindh, where he observed twenty to thirty tamed otters tethered by fishermen on River Indus, while some were basking and others were found to be playing on the sand. Pocock (1939) and Mason and Macdonald (1986) have described the species to be extant in Pakistan extending from Bahawalpur southwards to Sindh; in lower Indus valley and Eastern Nara and has been regarded as a distinct race being different from the Indian form, having smaller size. Gachal and Slater (2004) and Gachal *et al.* (2007) have reported the distribution of the species from Sukkur to Guddu Barrage area with being more frequent around Taunsa Barrage at River Indus. Roberts (1997) has reported this species in Sindh in the areas of Keti Bunder, Sindh coast, Sundari Lake and in the East Nara swamps, about 25 km upstream of Sukkur Barrage and in Punjab in the areas of Marala in River Chenab, Sidhnai in River Ravi and water storage reservoirs at Lal Suhanra near Bahawalpur. The range of the Smooth coated otter beyond lower Indus has been described as indefinite.

It has been conceived to extend into Balochistan being the same otter that was recorded as *Lutra vulgaris* by Pitman, who has seen the tracks of the otter on Euphrates and Tigris (Pocock, 1939). During last two to three years, the species was perceived as extinct by the local people in the areas of Chotiari Reservoir, Nara canal, Keenjhar Lake and Keti Shah riverine forest where once it was reported to be extant. But recently, Khan and Hasnain (2008) have confirmed the existence of smooth coated otter in Chotiari Wetlands Complex in Sanghar District, Nara canal in Khairpur, Nawabshah and Sanghar Districts, Keenjhar Lake in Thatta District and Keti Shah riverine forest in Sukkur District.

BIOLOGY

Smooth coated otter is adapted to a semi-aquatic mode of life with flattened head, thick muscular tail, smooth and dense pelage and comparatively large paws that are webbed between digits (Roberts, 1997). These are named on the basis of their shorter smooth coats (Gachal *et al.*, 2007). The fur is thick and water proof with two types of hair; a dense under fur which traps an insulating layer of air and remains dry while the otter is swimming and the longer, overlying guard hairs that are water proof (Foster-Turley *et al.*, 1990). Around 40 cm long powerful muscular tail is flattened ventrally with upper surface rounded which makes in its distal portion more or less triangular appearance in cross section. The upper border of rhinarium makes a convex outline. The body is thick and limbs are short with hind limb measuring up to 133 mm and ear 23 mm. The feet have short blunt claws. The fur color at belly is buffy-white to silvery buff which merges gradually into flanks of darker brown. The pelage is smooth with fur slightly shorter. Adult range in head and body length from 59-64 cm with the tail averaging 40 cm. A large male from Sindh weighed up to 10 kg. A glandular pouch can also be found which surrounds the anus (Roberts, 2005). Three pairs of mammae can be found in females (Houghton, 1987; Roberts, 1997). Tracks display distinct claw impressions with the webbing also being evident sometimes (Foster-Turley, 1992). The life span of the species in captivity is almost 20 years and in the wild ranges between 4 to 10 years (Hussain and Chaudhry, 1997).

HABITAT

Smooth coated otters are found in lowlands, mangroves, freshwater wetlands, forested rivers and lakes (Chanin, 1985). Rice fields in Malaysia have also been regarded as an important habitat for the species (Foster-Turley, 1992). In these rice fields and other adjoining rural areas, they are adaptable to live in close association with the people and have even been found more tolerant against the human activities than other otter species such as Eurasian otter (*Lutra lutra*) and hairy-nosed otter (*Lutra*

sumatrana) (Foster-Turley, 1992). In Pakistan, the species prefers plain areas in Punjab, NWFP and Sindh around rivers, canals, lakes and fish ponds surrounded by thick vegetation especially *Typha* sp., *Phragmites* sp. and *Sacchram* sp. (Khan *et al.*, 2009).

BEHAVIOR AND ECOLOGY

A little is known about the ecology of this species (Burton and Pearson, 1987). However, these are known to be sociable and gregarious animals, helping each other while fishing together in close cooperation (Dunbar, 1931; Eates, 1968; Hussain and Chaudhry, 1997; Roberts, 1997; Anoop and Hussain, 2005; Gachal *et al.*, 2007). They have a shy nature (Macdonald, 1983; Shenoy, 2005) and are generally secretive and nocturnal (Hussain, 1998a). They show seasonal migrations in accordance with the suitability of habitats (Houghton, 1987; Macdonald, 1983; Mason and Macdonald, 1986; Roberts, 1997; Hussain, 1998a). Although, they are diurnal in habits such as foraging, sprinting and grooming but continuous human disturbances in some of the areas in Sindh have made it to behave like a nocturnal animal (Khan and Hasnain, 2008). These have been found to use high dry lands of islands in marshes for grooming, sprints and constructing dens. A group of this species can be intimidating at times (Foster-Turley, 1992). They are very vocal especially in case of excitement where they emit repeatedly highly pitched screams (Roberts, 1997).

ECOLOGICAL ROLE

Smooth coated otter is considered a suitable indicator of wetlands' health, being sensitive to any deterioration that occurs along the food chain (Erlinge, 1972). Otters are known as top predators of aquatic ecosystems, shaping the aquatic species of the communities. They tend to be very sensitive to deteriorated water quality, toxicity and disturbances (Anoop and Hussain, 2004; Hussain, 1998b). Being at the top of the food chain, otters are among the first species to disappear when their environment is contaminated by pollutants such as heavy metals and organochlorines like

polychlorinated biphenyls (PCBs) (Foster-Turley *et al.*, 1990).

FOOD AND FEEDING HABITS

Smooth coated otter is a top carnivore species of wetlands (Shenoy, 2005). Being amphibious, it forages largely in aquatic habitats and also takes terrestrial prey (Foster-Turley *et al.*, 1990). The availability of fishes throughout the year is a major factor for smooth coated otters to remain in a place (Melquist and Hornocker, 1983). They are the most specialized fish eaters consuming large fishes (Kruuk *et al.*, 1994; Tiler *et al.*, 1989) and crustaceans primarily due to their robust teeth (Kingdon, 1991). Smooth coated otter has been found to hunt all fish species that are found in Indus River but particularly it is fond of murrel (*Ophiocephalus striatus*), cat fish (*Seluridae* sp.) and cray fish (*Machrobrachium malcolmsonia*) in the River Indus (Roberts, 1997). It also feeds on rodents, frogs, freshwater prawns, larger spiders and birds, if successful in capturing them (Walker *et al.*, 1964; Kruuk *et al.*, 1994). There have also been reports of feeding on chickens and ducks but no evidence to support these claims could be found (Foster-Turley, 1992). Anoop and Hussain (2005) has reported that 96.02 % of the smooth coated otter's diet consists of fish, 1.08 % of frogs, 1.07 % of crabs, 1.07 % of birds and 0.76 % of insects in Kerala, India.

BREEDING

The breeding may occur throughout the year (Roberts, 1997) and the young ones are also born throughout the year (Foster-Turley, 1992). They form strong monogamous pairs, with males being larger but still females dominate the pair (Chanin, 1985). Gestation period varies from 61 to 63 days. In captivity, the mating was found to be taking place in water. The young ones at their birth are covered with fur and their eyes do not open up to 10 days after the birth. The young ones are not allowed to leave dens up to six weeks. The weaning takes almost 130 days (White, 2004) and the young ones start taking fish at the age of three months (Roberts, 1997). The young ones start entering water after

about 46 days. Litter size of 2-4 cubs is normal (Roberts, 1997) however, Khan *et al.* (2009) have observed six cubs with a female in Chotiari Wetlands Complex in Sindh.

TERRITORY SIZE

The territory ranges from 7 to 12 km² (Mason and Macdonald, 1986; Kruuk, 1995). The home ranges of the male and female were recorded as 17 km² and 5.5 km², respectively in the National Chambal Sanctuary, India (Hussain, 1993). They mark their territory by spraints which can easily be located as the otters are very conspicuous about the selection of sites for this purpose (Foster-Turley, 1992). They use communal sites for defecation and spraints are loose mostly slimy (Anoop and Hussain, 2005; Hussain and Chaudhry, 1997). They deposit faeces on prominent areas of grass thickets near the embankment for delineating their boundaries (Roberts, 1997).

THREATS

The major damage caused to otter populations worldwide is from illegal international trade of their skins and body parts. The otter skins are mainly used to prepare traditional Tibetan dress called "Chupa" used usually by high-ups in the society as a symbol of wealth, prestige and social standing (IOSF, 2008). In Pakistan, smooth coated otters are hunted for their pelts by the fishermen in Sindh (Roberts, 1997) that fetch high prices, Pak Rs. 12,000/- to 15,000/- for a single otter skin (Khan *et al.*, 2009) and regarded as sign of wealth by the Russians and Chinese (Gachal and Slater, 2003). The otters are also hunted by fish farmers in Sindh who consider them a threat to the fish stocks (Roberts, 1997). Deterioration of otter habitats (Gachal *et al.*, 2007; Khan *et al.*, 2009) and construction of barrages and irrigation channels (Gachal *et al.*, 2007) has also resulted in the decline of otter population in Sindh. Otters are also hunted due to the misconception of their use in medicinal recipes such as a cushion made of otter skin cures the piles and a cap cures the migraine (Khan *et al.*, 2009). There are some reports that the powdered otter testicles are used for the treatment of sexual

weaknesses (IOSF, 2008). Habitat degradation through water pollution, clearing out of vegetation and burning of undergrowth by locals, human-otter conflicts, food competition, increased tourism and weak enforcement of wildlife laws are also the threats faced by otters in the country (Khan *et al.*, 2009).

CONCLUSIONS AND RECOMMENDATIONS

Smooth coated otter is an important ecological indicator of a healthy wetland and associated biodiversity especially the fish fauna (Erlinge, 1972; Shenoy, 2005). Once distributed widely throughout Sindh, it exists in fragmented habitats in isolated populations now (Khan *et al.*, 2009). If the threats and stresses it is facing persist, it will become endangered and its survival be questioned in the study area. Hence, it is mandatory to conserve this species through restoration of its habitats, minimizing the threats and its relocation from sensitive to protected habitats.

Smooth coated otter is among the least studied species (Hussain and Chaudhry, 1997). Lack of awareness about the species among the general public as well as the students and researchers of Biology, Zoology and Wildlife in Pakistan is among the major threats to the species (Khan *et al.*, 2009). Although some ecological studies (Khan and Hasnain, 2008; Khan *et al.*, 2009) have reported its distribution in Sindh but no studies on biology, hematology, blood biochemistry and genetics of Smooth coated otter have been carried out in the country so far. Therefore, there is a need to motivate researchers of the relevant fields to conduct thorough studies on the distribution and biology of the species in the country especially in the Punjab and NWFP Provinces.

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REFERENCES

- ANDERSON, J., 1878. *Anatomical and zoological researches comprising an account of the zoological results of the two expeditions to Western Yunnan in 1868 and 1875. Mammalia. 1.* Bernard Quaritch, London. 951 pp.
- ANOOP, K. R. AND HUSSAIN, S.A., 2005. Food and feeding habits of Smooth coated otter (*Lutra perspicillata*) and their significance to the fish population of Kerala, India. *J. Zool.*, **266**:15-23.
- ANOOP, K.R. AND HUSSAIN, S.A., 2004. Factors affecting habitat selection by Smooth coated otter (*Lutra perspicillata*) in Kerala, India. *J. Zool.*, **263**: 417-423.
- BLANFORD, W.T., 1881. *Fauna of British India. Mammalia.* Taylor & Francis, London.
- BURTON, J.A. AND PEARSON, B., 1987. *Guide to the rare mammals of the world.* Collins, London. pp. 240.
- CHANIN, P., 1985. *The natural history of Otters.* Christopher Helm, London. pp. 179.
- CHASEN, F.N., 1940. A handlist of Malaysian Mammals. *Bull. Raffles Mus.* **15**: 1-109.
- CONROY, J., MELISCH, R. AND CHANIN, P., 1998. The distribution and status of Eurasian otter (*Lutra lutra*) in Asia – A preliminary review. *IUCN OSG Bull.* **15**: 15-30.
- CORBET, G.B. AND HILL, J.E., 1992. *The mammals of the Indomalayan Region, A Systematic review.* Oxford University Press, pp. 488.
- CORBET, G.B. AND HILL, J.E., 1991. *A world list of mammalian species.* 3rd Edition, British Museum Nat. Hist., London. pp. 243.
- DAVIS, J.H., 1979. The chromosomes of the African Spot Necked Otter *Hydrictris maculicollis*. *Chromosome Inf. Serv.* **26**: 11-13.
- DeSILVA, P., 2006. Survey Techniques and Monitoring Otter Populations. *Proceedings of the IUCN/SSC Training Workshop Kathmandu, Nepal.*
- DUNBAR, B.A.A., 1931. *Wild animals in central India.* Edward Arnold, London. pp. 296.
- DUPLAIX, N., 1975. River otters in captivity. In: *Breeding endangered species in captivity* (ed. R.D. Martin). Academic Press, London, pp. 315-327.
- EATES, K.R., 1968. *An introduction to the vertebrate fauna of Sind and Khairpur State. Mammalia,* West Pakistan GAZETTER Sind Region, Government of West Pakistan. pp. 33-52.
- ELLERMAN, J.R. AND MORRISON-SCOTT, T.C.S., 1966. *Checklist of palaeartic and Indian mammals 1758 to 1946.* 2nd Edition, British Museum Natural History, London. pp. 810.

- ERLINGE, S., 1972. Interspecific relations between the otter *Lutra lutra* and mink *Mustela vison* in Sweden. *Oikos*, **23**: 327-335.
- FOSTER-TURLEY, P.A., 1992. Conservation aspects of the ecology of Asian small clawed and Smooth coated otters on the Malay Peninsulas. *IUCN OSG Bull.*, **7**: 26-29.
- FOSTER-TURLEY, P.A., MACDONALD, S. AND MASON, C., 1990. *Otters; An action plan for their conservation*. Kelvyn Press, Inc., Broadview, Illinois, USA. pp. 126.
- GACHAL, G.S. AND SLATER, F.M., 2004. Barrages, Biodiversity and the Indus River Dolphin. *Pakistan J. biol. Sci.* **7**: 797-801.
- GACHAL, G.S., MEMON, Z., QADIR, A.H., YUSUF, S.M. AND SIDDIQUI, M., 2007. Ecological Impact on the status of Otter (*Lutrogale perspicillata*). *Sindh Univ. Res. J.*, **39**: 19-26.
- GACHAL, G.S. AND SLATER, F.M., 2003. Historical and current status of the Indus River Dolphin (*Platanista minor*) Owen 1853: Its conservation and future. *Sindh Univ. Res. J.*, **35**: 51-62.
- GEOFFROY, S.H., 1826. *Loutre Dictionnaire Classique. Hist. Nat.*, **9**: 515-520.
- GRAY, J.E., 1865. Revision of the genera and species of Mustelidae in the British Museum. *Proc. Zool. Soc. London*, **1865**: 100-154.
- HARRIS, C.J., 1968. *Otters: A study of the recent Lutrinae*. Weinfield and Nicoloson, London, United Kingdom. pp. 397.
- HODGSON, B.H., 1839. Summary description of four new species of otter. *J. Asiatic Soc. Bengal*, **8**: 319-320.
- HOOSHANG, Z. AND BERNHARD, G., 1997. New comments on Otters in Iran. *IUCN OSG Bull.*, **14**: 1-2.
- HOUGHTON, S.J., 1987. The smooth coated otter in Nepal. *IUCN OSG Bull.*, **2**: 5-8.
- HUSSAIN, S.A., 1998a. *Conservation status of otters in the Tarai and Lower Himalayas of Uttar Pradesh, India*. Proceedings 7th International Otter Colloquium, Trebon, Czeck Republic. pp. 131-142.
- HUSSAIN, S.A., 1998b. *A note on the historical record of otter distribution in India with special reference to Lower Himalayas and Tarai*. Proceedings, 7th International Otter Colloquium, Trebon, Czeck Republic. pp. 143-147.
- HUSSAIN, S.A., 1993. *Aspects of the ecology of Smooth coated otter (Lutra perspicillata) in National Chambal Sanctuary*. Ph.D. thesis, Aligarh Muslim University.
- HUSSAIN, S.A. AND CHOUDHURY, B., 1997. Distribution and status of the Smooth coated otter (*Lutrogale perspicillata*) in National Chambal Sanctuary, India. *Biol. Conserv.*, **80**: 199-206.
- HWANG, Y.T. AND LARIVIE'RE, S., 2005. *Lutrogale perspicillata*. *Mammal. Sp.*, **786**: 1-4.
- IOSF, 2008. *Alarming trade in otter fur*. IOSF. 7 Black Park, Bradford, Isle of Skye, IV49 9DE, Scotland. 11 pp.
- IUCN, 2008. *IUCN red list of threatened species 2008*. <http://www.iucnredlist.org>
- KHAN, W.A. AND HASNAIN, S.A., 2008. *Large mammals at Indus for all programme sites* (Unpublished Report). WWF-P, Karachi, pp. 88.
- KHAN, W.A., QASIM, M., AHMAD, E., AKBAR, G., HABIB, A.H., ALI, H., QAMAR, F. M., CHAUDHRY, A.A., IQBAL, S., BHAAGAT, H. B., AKHTAR, M. AND AHMAD, M.S., 2009. A survey of smooth coated otter (*Lutrogale perspicillata sindica*) in Sindh Province of Pakistan. *IUCN OSG Bull.*, **26**: 15-31.
- KINGDON, J., 1991. *Arabian mammals: A natural history*. Academic Press, London, pp. 279.
- KOEPFLI, K., KANCHANASAKA, B., SASAKI, H., JACQUES, H., LOUIE, K.D.Y., HOAI, T., DANG, N.X., GEFFEN, E., GUTLEB, A., HAN, S., HEGGBERGET, T. M., LAFONTAINE, L., LEE, H., MELISCH, R., RUIZ-OLMO, J., SANTOS-REIS, M., SIDOROVICH, V. E., STUBBE, M. AND WAYNE, R. K., 2008. Establishing the foundation for an applied molecular taxonomy of otters in Southeast Asia. *Conserv. Genet.*, **9**: 1589-1604.
- KRUUK, H., 1995. *Wild otters: Predations and populations*. Oxford University Press, pp. 290.
- KRUUK, H., KANCHANASAKA, B., SULLIVAN, S. AND WANGHONGSA, S., 1994. Niche separation in three sympatric otters (*Lutra perspicillata*, *Lutra lutra* and *Aonyx cinerea*) in Huai Kha Khaeng, Thailand. *Biol. Conserv.*, **69**: 115-120.
- MACDONALD, D.W., 1983. The ecology of carnivore social behavior. *Nature*. **301**: 379-380.
- MASON, C. F. AND MACDONALD, S.M., 1986. *Otters: ecology and conservation*. Cambridge University Press, Cambridge, London. pp. 236.
- MELISCH, R., ASMORO, P.B. AND KUSUMAWARDHANI, L., 1994. Major steps taken towards otter conservation in Indonesia. *IUCN OSG Bull.*, **10**: 21-22.
- MELQUIST, W.E. AND HORNOCKER, M.G., 1983. Ecology of river otters in West Central Idaho. *Wildl. Monogr.* **83**: 1-60.
- MURRAY, J.A., 1884. *The vertebrate zoology of Sind*. Richardson, London.
- PAYNE, J., FRANCIS, C. M. AND PHILLIPS, K., 1985. *Field guide to the mammals of Borneo*. The Sabah Society with World Wildlife Fund, Malaysia, Kuala Lumpur. pp. 332.
- POCOCK, R.I., 1949. *The fauna of British India, including Ceylon and Burma*, Vol. 2, *Mammals*. Taylor and Francis, London. pp. 265-317.
- POCOCK, R.I., 1941. *The fauna of British India including Ceylon and Burma, Mammals*. Taylor and Francis, Volume 2, London. pp. 265-317.
- POCOCK, R.I., 1939. Notes on some British Indian Otters with

- descriptions of two new sub-species. *J. BNHS.*, **41**: 514-517.
- POHLE, H., 1919. Unterfamilie der Lutrinae. *Arch. Naturgesch.*, **85A**: 1-249.
- PRATER, S.H., 1971. *The book of Indian animals*. Bombay Natural History Society, 3rd Edition, pp. 324.
- PRATER, S.H., 1948. *The book of Indian animals*. 1st Edition, Bombay Natural History Society, pp. 324.
- ROBERTS, T.J., 2005. *Field guide to the large and medium sized mammals of Pakistan*. Oxford University Press, Karachi. pp. 259.
- ROBERTS, T.J., 1997. *The mammals of Pakistan*. Revised Edition, Oxford University Press, Karachi, pp. 525.
- SHAFIQ, M.M., 2005. *Wildlife acts and rules of Pakistan*. Pakistan Forest Institute, Peshawar, pp. 297.
- SHEIKH, K.M. AND MOLUR, S., 2005. *Status and red list of Pakistan's mammals*. IUCN Pakistan. pp. 344.
- SHENOY, K., 2005. *Against the current, Otters in the River Cauvery*, Karnataka. Wildlife Trust of India. pp. 31.
- SIVASOTHI, N. L. AND BURHANUDDIN, H. M. N., 1994. A review of otters (Carnivora: Lutrinae) in Malaysia and Singapore. *Hydrobiologia*, **285**: 151-170.
- TILER, C., EVANS, M., HEARDMAN, C. AND HOUGHTON, S., 1989. Diet of Smooth Indian otter (*Lutra perspicillata*) and fish eating birds: A field survey. *J. Bombay nat. Hist. Soc.*, **86**: 65-70.
- WALKER, E.P., WARRICK, F., UIBLE, H.E., HAMLET, S.E., DAVIS, M.A. AND WRIGHT, P.F., 1964. *Mammals of the World*. John Hopkins Press, Baltimore, 5th Edition. pp. 769.
- WHITE, T., 2004. *Lutrogale perspicillata*, <http://animaldiversity.ummz.umich.edu>
- WILLEMSEN, G.F., 1980. Comparative study of the functional morphology of some Lutrinae especially *Lutra lutra*, *Lutrogale perspicillata* and the Pleistocene *Isolalutra cretensis*. *Proc. Konink Ned Akad van Wetenschappen B.* **83**: 289-326
- WILLEMSEN, G.F., 1992. A revision of the Pliocene and Quaternary Lutrinae from Europe. *Script. Geol.*, **101**: 1-115.
- WOZENCRAFT, W.C., 2005. Order Carnivore. In: *Mammal species of the world: A taxonomic and geographic reference* (eds. D.E. Wilson and D.M. Reeder). Johns Hopkins University Press, Baltimore. pp. 279-348.

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