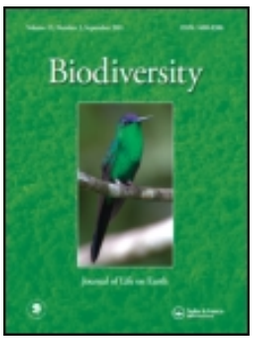

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Biogeographical distribution and natural groupings among five sympatric wild cats in tropical South Asia

Mohammed A. Ashraf

Abstract. Small to large carnivorous mammals in the tropical belt face extinction at an unprecedented rate. The vanishing of sympatric wild cats appears to be due to habitat fragmentation, human encroachment & poaching. The focus of this study is on ecological and distributional parameters that influence the wild cat communities in tropical South Asia. The distributional data for five sympatric cats is analyzed with the aim of understanding the species-habitat association under a conceptually unified binary-matrix framework. The use of cluster analysis techniques in this ecological study have helped to reveal the natural groupings among felid guilds and their ecological resource partitioning mechanism in shared habitats.

About the Author: *Mohammed Ashraf* is a wildlife biologist with an interest in the conservation of large carnivorous species threatened in tropical ecosystems. He is particularly focused on species that serve as 'flagship keystone' species for overall biodiversity conservation. He holds a Higher National Diploma in Ecology from Myerscough College and a BSc. Honours in Wildlife Biology from Anglia Ruskin University in Cambridge, UK.

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INTRODUCTION

South Asia is the home of many entrancing, charismatic, wild cats. Unfortunately many are either Critically Endangered or Threatened, according to the IUCN Red List classifications. When we speak about South Asia, we have a tendency to only talk about India or Pakistan whereas this region consists of eight nations (see below). Most of the countries in South Asia are recognized as mega-biodiverse nations with significant ecological, aesthetic, spiritual and socio-economical resource potential. The aim of this paper is two-fold; firstly, to introduce the diversity of 5 species of wild cats in South Asia and their conservation status; secondly, to attempt to provide quantitative & analytical treatment for these five tropical cats based on their spatial distributional data and their historical biogeography that broadly encompasses six South Asian nations.

ECOSYSTEM OF SOUTH ASIA

South Asia is commonly understood as the Indian subcontinent; however, it actually encompasses eight countries. From west to east the countries are Pakistan, India, Maldives, Sri Lanka, Nepal, Bangladesh, Bhutan and Myanmar (previously known as Burma). The focus of this study is on these eight countries and the collation of distributional data in the form of the presence and absence of five sympatric felids that share the resources of this large eco-region. The word sympatric is used to describe the fact that these felids have overlapping territorial boundaries.

The climate of South Asia is monsoonal with an average precipitation rate of 100-200 cms/year in most parts. The vegetation characteristics are tropical moist and tropical dry deciduous to semi evergreen, with tall grasslands to

Map 1.
South Asia and surrounding areas.

Table 1. Habitat Types of South Asia

Habitat Types	Country
Alluvial Grasslands and Sub Tropical	India and Bangladesh
Moist Deciduous Forest	
Mangrove Forest	India & Bangladesh
Subtropical & Temperate Upland Forest	Nepal, Bhutan, India
Tropical Moist Deciduous Forest	India & Myanmar
Tropical Dry Forest	India & Myanmar
Tropical Moist Ever Green Forest	India, Myanmar & Bhutan

Table 2. Species distribution in binary-matrix format across six nations

Species	India	Pakistan	Bangladesh	Nepal	Bhutan	Myanmar
Cloud Leopard	1	0	0	1	1	0
Fishing Cat	1	0	1	1	1	1
Leopard Cat	1	0	1	1	0	1
Leopard	1	1	1	1	1	1
Tiger	1	0	1	1	1	1

mangrove forest ecosystems. From a strictly ecological and zoo-biogeographical standpoint, the South Asian biomes are classified and tabulated (Table 1) in relation to climate, topography and altitude (Wikramanayake *et al*. 1998).

WILD FELID ECOLOGY IN SOUTH ASIA

This paper primarily attempts to explore the distributional associations among five sympatric wild cats. I treated the distributional (Present/Absent) data with cluster analysis techniques. Before proceeding to the quantitative part, it is imperative to provide brief ecological information about the species subject to my analysis.

1. Clouded Leopard *(Neofelis nebulosa)*

The Clouded leopard is a secretive cat like all other cats in South Asian forests. Its elusiveness, arboreality and forest habituation make it difficult to study in the wild, hence the absolute abundance of this charismatic species is largely unknown. It is a Vulnerable species according to the IUCN Red List categorization.

Distributional Countries: Bangladesh, Nepal, India, Bhutan, Myanmar, China, Tibet, Indonesia, Japan, Malaysia, Singapore, Taiwan and Thailand.

Population Status: Density or abundance of this cat is still largely unknown due to the logistical difficulties of studying this species. There have been no in-depth studies beyond interviews with local people.

2. Fishing Cat *(Prionailurus viverrinus)*

The Fishing Cat with its stocky powerful build and short legs was given its Latin name due to its rather viverrine or civet-like appearance. The common name however is appropriate as well since fish have been found to be its most frequent prey in Nepal's Royal Chitwan National Park.

Habitat & Distribution: Fishing Cats are strongly associated with wetlands. They are typically found in mangrove swamps and marshy areas, oxbow lakes, reed beds and tidal creeks in tropical Asia. The Fishing Cat has a discontinuous distribution. Although its distributional range covers South and Southeast Asia, the population abundance is relatively highest in the valley of the Ganges and Brahmaputra river basins in India and Bangladesh.

Population Status: Ecological studies of Fishing Cats have hardly been carried out. According to the IUCN its population status in South Asia is insufficiently known. Fishing Cats are locally common around wetlands. Major systems which potentially support large numbers of Fishing Cats include the Sundarban mangrove forests of Bangladesh and India, as well as the wet grassland region along the foot of the Himalayas in India and Nepal (Nowell *et al*. 1996).

3. Leopard Cat *(Prionailurus bengalensis)*

Leopard cats tend to be yellowish brown in the tropics and greyish brown in northern parts of its range. The taxonomic status of the Leopard Cat is controversial, and needs re-examination. (Nowell *et al* 1996).

Habitat & Distribution: The Leopard Cat has a wide distribution in Asia, ranging up to 3000 m in parts of its range, which extends into the Himalayas along river valleys. It occurs in a broad spectrum of habitats, from tropical rain forest to temperate broadleaf and marginally coniferous forest as well as shrub forest and successional grassland. Leopard Cats are excellent swimmers and have successfully colonized offshore islands throughout their ranges.

Population Status: The Leopard Cat is not on the IUCN Red List. It is neither a Threatened nor a Vulnerable species. It is common (relative to other sympatric felids) across much of its range.

4. Leopard *(Panthera pardus)*

The Leopard is one of the most clever and skilful species among felid guilds. Highly adaptable and resilient this species can chiefly co-exit with other large sympatric carnivores such as the Lion in the African savannah and the Tiger in tropical Asia.

Habitat & Distribution: Leopards are found throughout the Indian sub-continent with the exception of desert, the Sundarban mangroves and densely settled areas. In the Himalayas, Leopards are sympatric with snow leopards up to 5,200 m, although they are more commonly live below the tree line. Seidensticker (1986) speculates that Leopards and Tigers are probably absent from the island of Borneo due to the lack of a large ungulate prey base, and that Leopards were 'squeezed out' from the island of Bali by the presence of Tigers, and from Sumatra by an abundance of other felids.

Population Status: The Leopard is either Endangered or Vulnerable, depending on the large geographical habitat preferences and depending on it various sub-species, according to the IUCN Red List (Nowell *et al.* 1996). Although the Leopard can co-exist with tigers, it can compete with the prey base of tigers when there is an absence of a large ungulate population which typically Tigers prefer (Sunquist 1989). Leopards are better able to survive outside protected areas, but in most cases populations can be expected to show a decline trend due to habitat loss, depletion of prey, and direct mortality by humans.

5. Tiger *(Panthera tigris)*

Tigers are the largest terrestrial carnivorous mammals on earth. The Tiger sits on top of the food chain, regulatings the ecological pyramid and acts as a 'Flagship Keystone' species for overall biodiversity conservation in tropical Asia (Wikramanayake *et al.* 1998). The extant subspecies are currently 5 in number and they all share a distinct ecological and geo-political boundary. South Asia harbours the largest population of tigers in the wild with approximately 60% of the total wild population of tigers living in India, Bangladesh & Nepal.

Habitat & Distribution: The tiger is found in a variety of habitats, from the tropical evergreen and deciduous forests of southern Asia to the coniferous, scrub oak and birch woodlands of Siberia. It also thrives in the mangrove swamps of the Sundarbans in Bangladesh, the dry thorn forest of north-western India and the tall grasslands at the foot of Himalayas (Wikramanayake *et al*. 1998). The geographical distribution of the tiger once extended across Asia from eastern Turkey to the sea of Okhotsk, however, its range has been greatly reduced in recent times. Currently, tigers survive only in scattered populations from India to Vietnam and in Sumatra, China and in the Russian Far East.

The leopard (*Panthera pardus*) owes its success in part to its opportunistic hunting behaviour and its adaptability to a variety of habitats. The leopard consumes virtually any animal it can catch and ranges from rainforest to desert. Its ecological role resembles that of the similarly-sized cougar in the Americas. Physically, the spotted cat most closely resembles the jaguar, although it is of lighter build.

A, Tiger (*Panthera tigris*) is the most common subspecies of tiger, constituting approximately 80% of the entire tiger population, and is found in India, Bangladesh, Bhutan, Myanmar and Nepal. It has disappeared from much of its former distribution including the Caucasus, Java and Bali. Several subspecies are extinct and others critically endangered; B, The Leopard Cat (*Prionailurus bengalensis*) is a small wild cat of Southeast Asia. On average it is as large as a domestic cat, but there are considerable regional differences. The habitat of this cat is forest and rainforest both in low and mountainous areas, usually not arid areas. It lives close to watercourses and may be found in heights up to 3000 m. The Leopard Cat can climb trees skilfully. It is also able to swim, but will seldom do so.

Population Status: Tigers are the most Critically Endangered species among all the wild felids according to the IUCN Red Data Book. There were 100,000 tigers at the end of the 19th century. A recent survey and literature review of the status of tigers for CITES concluded that the maximum number now is no less than 7,700 (Nowell *et al.* 1996).

CLUSTER ANALYSIS OF FELIDS

Cluster analysis is used extensively in ecological and biogeographical studies (Krebs 1989). Faced with a series of sites (islands, fields or indeed any other habitats which contain a range of species), conservationists often wish to know which sites form natural groups based on shared species. Cluster analysis converts lists of shared data into an easy-to-interpret graphic. The graphic identifies groups of locations or 'clusters' where constituent members are more inherently similar to each other than they are to 'outliers' (Forey *et al.* 1992; Sokal *et al.* 1963). The technique extracts two types of information from a species distribution data set; (a) the distribution of the taxon and (b) the history of the study area. In this study I quantify the species & habitat associations (i.e. close or loose tie-in groupings) with five sympatric (overlapping habitats) felids that share a large ecological landscape in tropical Asia. In other words, I attempt to know which sites (geopolitical-boundary) form natural groups and tight-associations based on the distributional data. Table 2I shows the basic tabulated version of the cluster data in a binary matrix form i.e. the presence (1) or absences (0) of the felids in six geo-political boundaries (countries) in South Asia. However, the actual mathematical matrix formulation is tedious therefore a Multi Variance Statistical Package (MVSP, Version 3.1), a powerful computational digital tool, was used for providing the graphical clarity of the cluster diagram.

RESULTS

The Sorensen coefficient (S_s) with MVSP (Forey et al. 1992; Krebs 1989) was used to obtain clear results. S_s computes a decimal based on the number of species common to any two sites relative to the number at each individual site (Krebs 1989). The result attempts to explore the level of site-specific association among felids in terms of their natural groupings, habitat utilisation patterns and the biogeographical speciation (if these exist).

The cluster diagram (Diagram 1) reveals that group 1.1 (Myanmar & Bangladesh) and group 1.2 (Nepal & India) are tightly (S_s>0.88 but S_s<1 or S_s=1) associated in terms of ecological groupings of felid distributions. The country Bhutan (Bhut) is moderately associated (S_s >0.76 but S_s<1) with group 1 in terms of felid distribution but Pakistan is very loosely associated (S_s >0.28 but S_s<1) with the rest of the countries for its poor ecological or other geo-climatic characteristics to support felid guilds. Let's now explore the association and separation of our five felids in diagram 2.

Diagram 1. The habitat association among the five felids in South Asia

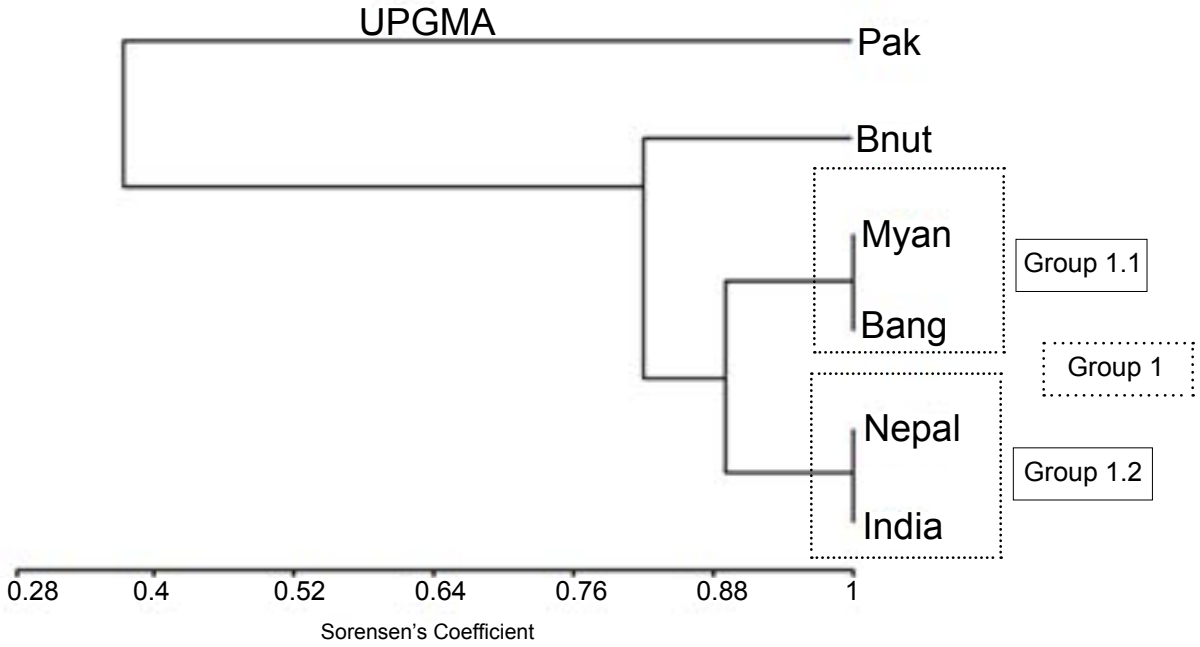
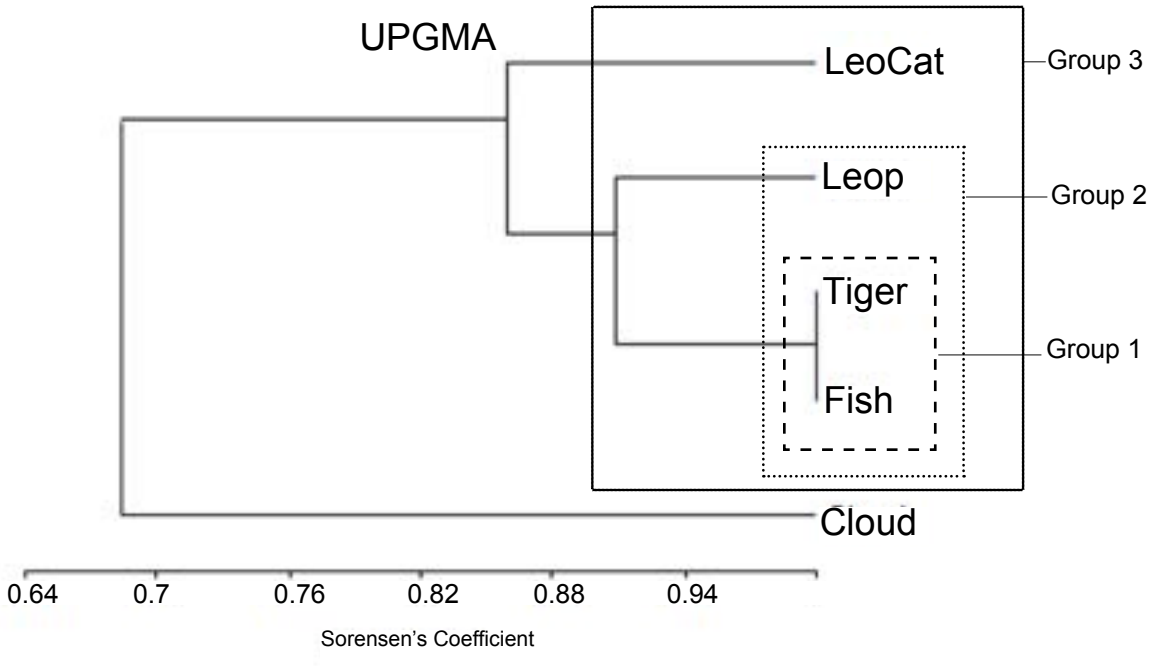


Diagram 2. The association of the sympatric felids in South Asia



The Fishing Cat lives along rivers, brooks and mangrove swamps. As the name implies, fish is the main prey of this cat, of which it hunts about 10 different species. It also hunts other aquatic animals such as frogs or crayfish, and terrestrial animals such as rodents and birds. The inter-digital on its paws help the cat gain better traction in muddy environments and water, like other mammals in semi-aquatic environments.

DISCUSSION

The underlying mechanisms from the cluster diagrams have significant ecological and conservational implications. In groups 1 & 2 in diagram 2, we can see that Tigers, Fishing Cats (Fish) and Leopards (Leop) are tightly associated with Sorensen coefficients falling in the range between 0.88-1 (S_s>0.88 but S_s<1 or S_s =1). All these three cats are highly resilient in terms of their predatory characteristics and are ecologically sympatric. My assumption is that Tigers and Fishing Cats can sympatrically co-exist without creating inter-specific competition over food resources or aggression, hence the tight association reflected in the cluster diagram. This is due to the fact that their habitat and resource utilisation patterns are partitioned naturally due to their predatory behaviour. Tigers prey on large cervids, bovids and suids (e.g. deer, buffalo and wild boar) in the tropical belt whereas fishing cats usually hunt small mammals and fish. My data, coupled with ecological and biogeographical parameters of these felids, indicate that resource partitioning probably is the major determining factor for the Tiger, Leopard and Fishing Cat to coexist with little inter-specific competition. In group 2, Leopards are tightly associated (S_s >0.88 but S_s<1) with Tigers and Fishing Cats but not as close as the group 1 itself (S_s>0.94 but S_s<1). My observation is Leopards are squeezed out from other felids (Tigers and Fishing Cats) due to the prey biomass competition with Tigers, hence ecological separation is more significant than anthropogenic or zoogeographical factors. In group 3, Leopard Cats (LeoCat) are also closely associated (S_s >0.82 but S_s<1) with group 1 & 2. That is probably due to the resource utilization patterns of Leopard Cat being compromised by that of Leopards, Tiger and Fishing Cats. On the other hand, Clouded Leopards are very loosely associated (S_s>0.64 but S_s<1) with the rest of the groups (group 1, 2 & 3) because of geographical and altitudinal niche partitioning as opposed to the ecological resource partition with Tigers or Leopards. This highly secretive cat lives in upper Himalayan habitats of Tibet, China and Japan where other sympatric felids are either less in number or not present in their biogeographic range.

CONCLUSION

This paper attempts to provide the ecological and distributional co-relationships among five sympatric felids in tropical Asia. It focuses the need for understanding the natural groupings of felids based on cluster analysis techniques. These techniques, with appropriate use, can provide us with the underlying biological basis of resource partitioning among sympatric carnivores thereby giving us a broader understanding of wild cat conservation science.

REFERENCES

Forey, P.L., J.C Humpfries, I.L. Kitching, R.W. Scotland, D.J. Siebert, & D.M. Williams. 1992. Cladistics: a practical course in systematics. Oxford Science Publications, Oxford, 191pp.

Krebs, J.R. 1989. Similarity coefficient and cluster analysis. pp. 293-327, in Ecological methodology, Harper Collins, New York, 654pp.

Nowell, K., P. Jackson. 1996. Wild cats: status survey and conservation action plan. Gland, IUCN

Sokal, R.R., & P.H. Sneath. 1963. Principles of numerical taxonomy. W.H. Freeman, San Fransisco, 320pp.

Seidensticker, J. 1986. Large carnivores and the consequence of habitat insularization: ecology and conservation of tigers in Indonesia and Bangladesh. Pages 1-41 in S. D. Miller and D.D. Everett, editors, Cats of the World: biology, conservation and management. National Wildlife Federation, Washington, D.C.

Sunquist, M.E. 1989. Ecological constraints on predation by large felids. In Carnivore, behaviour, ecology and evolution: 164-182. Gittleman, J.L. (Ed.). London, Chapman & Hall.

Wikramanayake, E. Dinerstein, J. G. Robinson, K.U. Karanth, D. Olson, D. Bolze. 1998. An ecology-based method for defining priorities for large mammal conservation: The Tiger as Case Study. *Conservation Biology* 12:865-878

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