

REVIEW

Historic distribution and recent loss of tigers in China

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Abstract

Historical records can provide important evidence of changes in distributions of wildlife species. Here we discuss the distribution of the tiger (*Panthera tigris* Linnaeus, 1758) over the past 2000 years in China based on 2635 historical records. We also compare tiger distributions outlined in these records with ecosystem type maps. Throughout this time period, tigers maintained a broad distribution across 7 biomes (from forests to deserts). However, in recent decades the range has been significantly condensed. Today, only 2 populations remain, neither of which is independently viable. Tigers have completely disappeared from the temperate broadleaf and mixed forests of central China, a region that was traditionally their most important biome in China. The continued presence of wild tigers in China is highly dependent on significant conservation measures.

Key words: China, conservation, historical distribution, *Panthera tigris*, tiger.

INTRODUCTION

Tigers (*Panthera tigris* Linnaeus, 1758), the largest felid (Kitchener & Yamaguchi 2010), are adaptive animals (Sunquist 2010) and important ecological actors in the ecosystems where they occur (Seidensticker 1996). Tigers once occupied a broad geographical distribution in Asia. They inhabited almost all habitat types in which there was cover and sufficient prey, from moist tropical forests to alluvial grasslands to temperate broadleaf and mixed forests (Kitchener 1999; Sanderson *et al.* 2006). Today, tiger range has collapsed to approximately 7% of the 19th century range (Dinerstein *et al.* 2007), resulting in worldwide concern about their conservation and recovery

(Sanderson *et al.* 2010).

Hemmer (1976) argues that the center of tiger evolution was in China, and recent genetic analyses appear to at least to partially confirm this hypothesis (Luo *et al.* 2004). The earliest fossil records of tigers in China are from Lantian, Shaanxi and date to 750 000–1 150 000 years ago (Zhou 1965). Archeologists have also found bone remains from Yuyao, Zhejiang Province (Wen & He 1981) and from Xichuan, Henan Province that date to 5000–4000 BCE and 2000 BCE, respectively (Jia 1977; Li 1998).

Across Asia, tigers are powerful cultural symbols and China is no exception. Human–tiger interactions abound in Chinese literature and date back to the Shang Dynasty (1600–1046 BCE). Oracle bones used for divination in ancient China bear inscriptions with tiger hunting records (Li 1998). *Shijing* (*The Book of Songs*) dates from 1046 to 500 BCE and is the oldest collection of Chinese poetry. The Chinese character for tiger appears in the volume titled *Minor Odes of the Kingdom*. White tigers are recorded in

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Shan Haijing (*A Chinese Bestiary*), book about geography, fauna and flora, compiled between the fourth and first centuries BCE. The most famous story of tiger–human conflict in China is “Wu Song killing the tiger” from *Shuihu Zhuan* (*Outlaws of the Marsh*), written between the 14th and 16th century.

Although the metaphorical significance of wild tigers in China remains strong, it now appears that wild tigers are almost extinct in China. The decline of tigers in China is a relatively recent phenomenon (Wang *et al.* 1999; Tilson *et al.* 2004; Zhang *et al.* 2005). In the present study, we map the historical distribution of Chinese tigers by geo-referencing historical records used in studies by He (1996), Ma (1999, unpublished data), Shi *et al.* (1998) and Liu (2001), as well as provincial records contained in provincial chorographies. These records demonstrate that tigers had an extensive ecological range in the past. In this paper we also provide an insight into the centuries-long stability in the spatial distribution of tigers, and the following dramatic and rapid collapse during the 20th century. It is our belief that the tiger’s historically recent collapse is, at least in part, reversible. Efforts should focus on the remaining wild tiger populations that persist along China’s southern and northern borders, where tiger populations are contiguous to populations in bordering countries.

MATERIALS AND METHODS

For historical records before 1990, we examined stud-

ies by He (1996: 1696 records up to 1949), Ma (1999, unpublished data: 53 records, 1781–1930), Shi *et al.* (1998: 63 records, 1870–1959), Liu (2001: 70 records, 1368–1912) and records contained in local chorographies. For hundreds of years, local chorographies were widely kept in China. They record natural, cultural and economic history of places. For modern records from 2000, we used studies by the Wildlife Conservation Society (2007, unpublished data), Feng *et al.* (2008) and Su *et al.* (2005).

The records we selected included at least 1 of 3 observation types: (i) attacks on humans; (ii) hunting; and (iii) tracks. Where a record or records referred to multiple tiger observations within a year at a single location, we entered only 1 observation per location per year. We geolocated the observations through comparison of coordinates provided by the *Gazetteer of the People’s Republic of China* (Place Name Institute 1995) for each county. We used modern county locations that are roughly, if not exactly, similar to the historical locations. The geolocated historical records were then imported into Arcview GIS 3.x (Environmental Systems Research Institute, Redlands, CA) to build historical distribution maps. We then compared the distribution of those records with various biome and ecoregion types described by Olson *et al.* (2001). They allow us to make meaningful comparisons across time, despite the known major land use changes that have occurred in China over the past 2000 years. To examine whether there were trends in the number of records found between and among different time periods, we aggregated data into 50-year time peri-

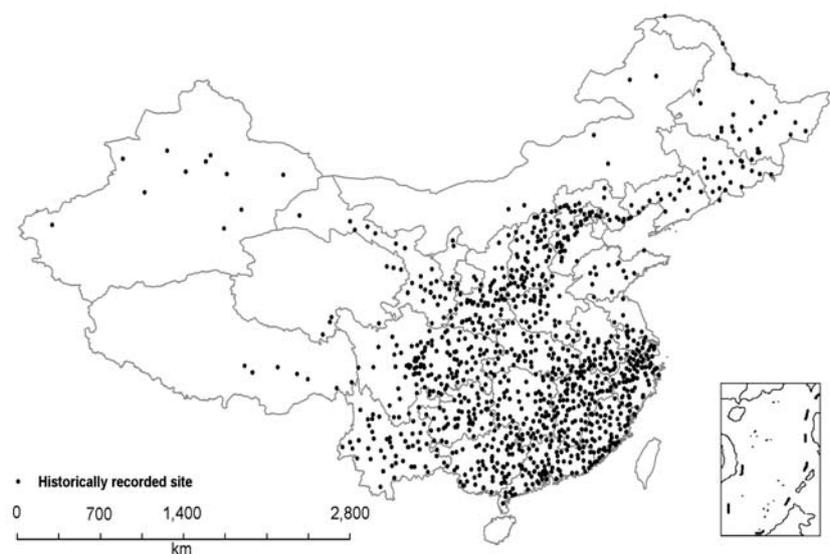


Figure 1 Distribution of tigers in China as recorded in historical documents 604 BCE to 1990.

ods beginning with 1090 CE.

In our analysis, 3 main biases were identified. First, the same name might be used to describe different historical and modern locations and we were not always able to differentiate between the historical and modern locations. Second, our main data is from chorographies, which were written mostly by local researchers who were not trained as scientists and might not have had natural historical knowledge. Although perhaps lacking in scientific technique, given that tigers are such iconic animals, and have unique size and markings, we assumed that even non-professionals could convincingly identify a dead tiger or accurately report a human death thought to be caused by a tiger. Third, we use modern maps of ecoregional distributions and compared them to historical distributions, and we do not know how well these modern maps represent the historical distribution of ecosystems. We suggest that apart from small-scale changes, the changes in the potential distribution are much less important than changes in the actual distribution of these ecosystems, given the vast scale of land use change in China over the timeframe we examined.

RESULTS

We collected and examined a total of 2635 tiger records between 604 BCE and 1990 CE. Most of these recorded tiger tracks (85%), while 9% were records of tiger at-

tacks and 6% of tiger hunting. Figure 1 shows that tiger distribution was once nearly continuous in tropical and temperate ecoregions of China, particularly in north, central and southeast China. It is impossible to infer numbers because of the paucity of observations, and because it is difficult to obtain historical records from remote places. Compared to other parts of China, there were relatively few residents in these remote places and the records systems were less developed. Therefore, the earliest records in extreme northeast China in our collection appeared after 1641. In Tibet, the earliest record is from 1660. In Xinjiang, the earliest record is from the year 1762 (He 1996).

The highest frequency of tiger observations in the historical record occurs between 1641 and 1690 (Fig. 2), when 430 separate tiger observations were recorded. In contrast, between 1941 and 1990 there were only 96 reports of tigers. From 2000 to the present, there were 279 reports of wild tigers, most of them of Amur tigers in extreme northeastern China. Of course, differences in record keeping standards under different political regimes might bias observations in different time periods. Nevertheless, the modern decline in tigers is apparent from these data.

It is interesting to note that most historical records describing tigers are from central, east-central and southeast China. By contrast, current distribution information (after the year 2000; Fig. 3) shows that tiger populations

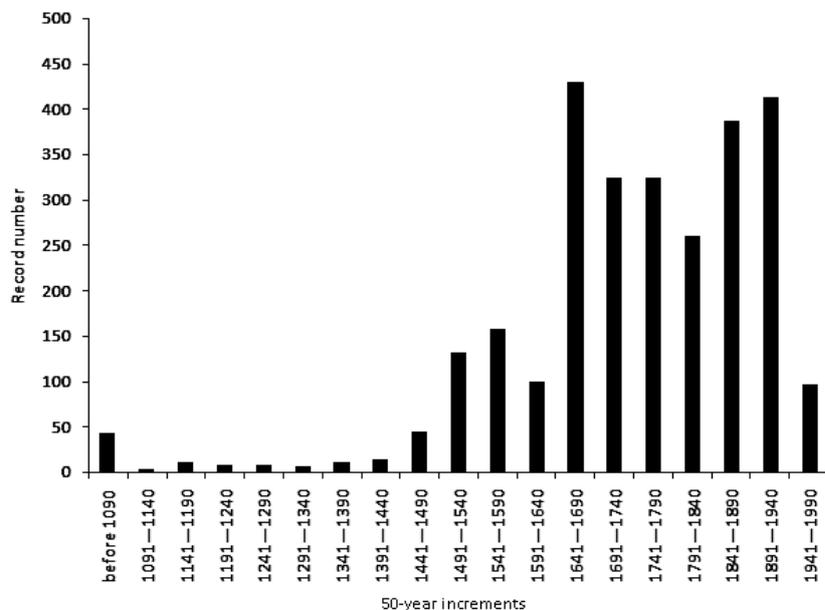


Figure 2 The number of historical records referring to tiger tracks, attacks or hunting in 50-year periods from 1091 to 1990. Before 1090, records are sparse; therefore, we combined the records of that period.

remain in 3 regions: northeast China (Wildlife Conservation Society 2007, unpublished data), the southwest corner of Yunnan Province in southern China (Su & Zhang 2005; Feng *et al.* 2008) and Medog County in southeastern Tibet (Zhang *et al.* 2000; Zhang *et al.* 2002), and nowhere within what was once the core of the tiger's range in China. The modern observations indicate that in China the tiger has been pushed to transboundary areas with Russia in the north and with India and Myanmar in the south. A Sino–American survey of the South China tiger (*P. tigris amoyensis*) conducted between 2001 and 2002 found no evidence of this unique subspecies of China in the wild (Tilson *et al.* 2004).

To understand the relationship between tiger distribution and habitat types, we counted both historical ($n = 2635$) and current observations ($n = 279$) in our comparison of potential biome distributions (Fig. 4). There were 7 types of biomes with historical tiger records. The number of tiger records in tropical and subtropical broadleaved forests and temperate broadleaf and mixed forests were approximately equal, accounting for 46 and 47% of all observations, respectively. The occurrence was the lowest in wetlands. In comparison, current tiger observations show that tigers have disproportionately disappeared from forest habitats.

On an evolutionary scale, 2000 years is the blink of an eye, but for an ecological historical analysis such a data run is extensive. Across such a long period, it is not surprising that there is large variation in the way in which

records were kept and the standards used by record keepers. Therefore, the record of historical distribution shown here gives a rough picture of the range, and the change in range across China. It shows that the distribution of tigers was once nearly continuous in China, (especially in north, central and southeast China). Only in the past 100 years has the tiger dramatically lost range in China, a phenomenon that is widely observed (Dinerstein *et al.* 2007) but for which extensive historical data either do not exist, or have not been collated and analyzed.

DISCUSSION

By geolocating historical records of tiger tracks, attacks and hunting we have shown that for millennia tigers enjoyed extensive distribution throughout the region that is today modern China. Many factors might have influenced the distribution and relative abundance of tigers over the past 2000 years. Records from the last few decades point to reasons for the recent dramatic negative changes in tiger distribution. We believe 2 main factors, hunting and habitat loss, have influenced tiger population changes over the past 60 years.

Hunting

Tiger hunting appears to have become quite serious in the mid-20th century. From the 1950s through the 1960s, local governments gave rewards to people who killed

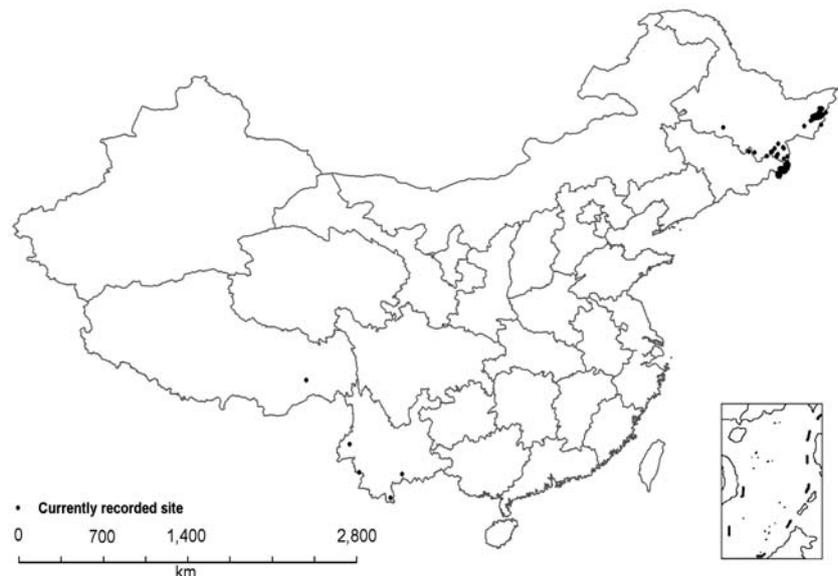


Figure 3 Current distribution of tigers in China, 2000–2009

tigers. During that period, the number of tigers killed for reward in 3 provinces (Hunan, Jiangxi and Fujian) in south China was over 670 (Wang *et al.* 1999). Provincial records kept by the Guizhou Government show that the collection of tiger skins amounted to 92 pieces in 1959 (Fang & Yang 1998). Large-scale hunting in the 1950s appears to have been a key factor in the dramatic decline of tigers (Shi 1998; Wang *et al.* 1999).

Habitat fragmentation and loss

Wikramanayake *et al.* (1999) identify 8 habitat types favored by the tiger. Of these, 6 are forest habitats. This suggests a close relationship between tigers and forests. Since the 1950s, China has experienced a huge loss of forests. This has led to serious habitat fragmentation for tigers and has undoubtedly contributed to their decline. Beginning in the 1950s, heavy logging began in forests across China. Ma *et al.* (1997) notes that forest cover declined from 60% in historical times to 21% in the early Qing Dynasty (around 1700), and to only 8.6% in the mid-20th century.

Loss of forest is related to the extension of human land use, including urbanization, agriculture and industrial uses. Extinction of local tiger populations is concentrated either where there are high human population densities, or where other human impacts, such as intensive agriculture, grazing and hunting, have been severe. Li *et al.* (2009) show the differences in land use between north-

east China and the Russian Far East led to striking differences between the wild Amur tiger population in the 2 countries.

FUTURE RESEARCH

Kitchener & Rees (2009) use a deduced distribution model (DDM) to reconstruct the contemporary and palaeo-distributions of wildcats. Our current data, especially those that are more than 1000 years old, contain certain biases (see Materials and Methods) and could not be introduced into a DDM directly. However, it would be very interesting to develop DDMs based on historical records and to combine them with population isolation factors and direct threat indexes. This could offer a broad picture of tiger distribution trends at the national level.

CONCLUSION

China has been arguably the most important country in the world for tigers over the past 2000 years. However, the once vast geographic range of these animals has been reduced to a few small areas along the border with Russia in the north and India and Myanmar in the south. The extinction of the last wild tiger populations in China would be a great loss to China's nature and culture. Given the current human population and land use practices in China, it will be very hard to recover wild tiger populations across

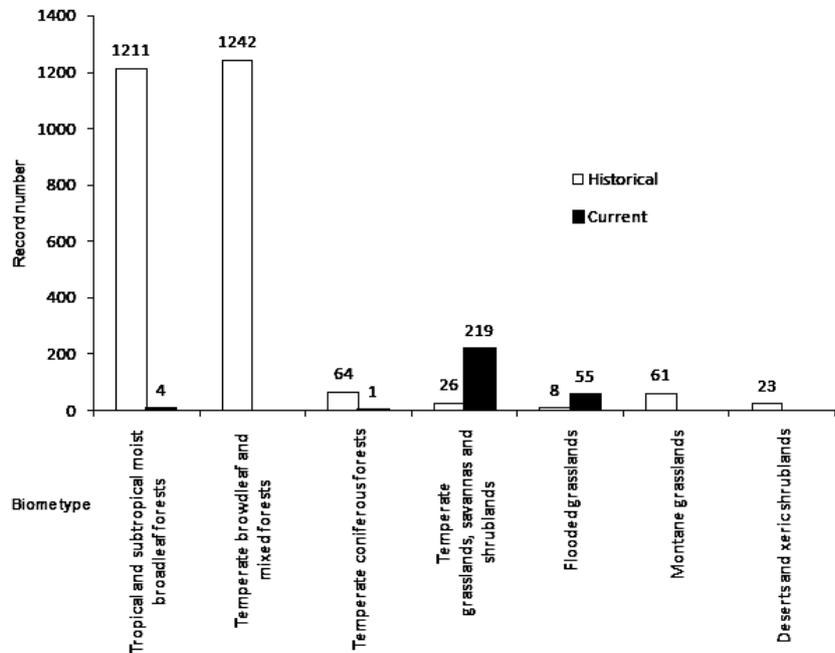


Figure 4 Comparison of historical (from 604 BC to 1990, $n = 2635$) and current numbers (from 2000 to present, $n = 279$) of tigers recorded in 7 biome types.

most of the areas in which, up until a century ago, tigers were found. The 3 areas in China where tigers still occur are in high quality forest habitats in the transboundary regions, where wild tiger populations are supported by international cooperation and effort. We believe China needs to play a central role in tiger conservation to avoid additional losses of wild tiger populations.

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