Bringing the Tiger Back from the Brink—The Six Percent Solution

Joe Walston1*, John G. Robinson1*, Elizabeth L. Bennett1, Urs Breitenmoser2, Gustavo A. B. da Fonseca3, John Goodrich1, Melvin Gumal4, Luke Hunter5, Arlyne Johnson6, K. Ullas Karanth1, Nigel Leader-Williams7, Kathy MacKinnon8, Dale Miquelle9, Anak Pattanavibool10, Colin Poole1, Alan Rabinowitz5, James L. D. Smith11, Emma J. Stokes1, Simon N. Stuart12, Chanthavy Vongkhamheng6, Hariyo Wibisono13

1 Wildlife Conservation Society, Bronx, New York, United States of America, 2 IUCN/SSC Cat Specialist Group, University of Bern, Bern, Switzerland, 3 Global Environment Facility, Washington, D.C., United States of America, 4 Wildlife Conservation Society, Kuching, Sarawak, Malaysia, 5 Panthera, New York, New York, United States of America, 6 Wildlife Conservation Society, Vientiane, Lao People’s Democratic Republic, 7 University of Cambridge, Cambridge, United Kingdom, 8 The World Bank, Washington, D.C., United States of America, 9 Wildlife Conservation Society, Vladivostok, Primorski Krai, Russia, 10 Wildlife Conservation Society, Jakarta, Jakarta, Indonesia, 11 University of Minnesota, St. Paul, Minnesota, United States of America, 12 IUCN/SSC, University of Bath, Bath, United Kingdom, 13 Wildlife Conservation Society, Bogor, Indonesia

The Decline of the Tiger

Despite a long history of concern for wild tigers, both their range and total number have collapsed: fewer than 3,500 animals now live in the wild, occupying less than 7% of their historical range [4]. Of these, approximately 1,000 are likely to be breeding females [5].

In most countries, overhunting has been the driver of the decline in tigers and their prey [6,7]. Additionally, loss and fragmentation of habitat was locally important [8]. Nevertheless, beginning in the early 1970s, conservation initiatives helped establish a large number of tiger reserves, particularly in India, Nepal, and, to a lesser extent, in Thailand, Indonesia, and Russia. Probably the most successful of these, at least initially, was Project Tiger in India, which was launched in 1972 with the political support of Prime Minister Indira Ghandi. The apparent success of these reserves prompted, in the 1990s, many conservationists [4,9,10] (including some of the co-authors of this report) to shift their focus to a landscape approach, which sought to conserve tigers well beyond protected areas, so as to maintain the genetic and demographic viability of populations of this low-density, wide-ranging species. Conservation investments subsequently increased, but the array of activities was complex, less directly related to tigers, and spread thinly across large landscapes [11]. With hindsight, it also became clear that protection and management of many reserves remained inadequate (the extirpation of tigers in the Indian tiger reserves of Sariska, reported in 2004, and Panna, reported in 2010, is illustrative) and this, coupled with an increased demand for tiger parts [12], meant that poaching of tigers and prey decimated populations across Asia, both inside and outside reserves.

Protecting Source Sites

While approximately 1.5 million square kilometers of suitable habitat still remain in Asia ([9], Figure 1), tigers today are distributed heterogeneously [7,13] and, except in the Russian Far East, are now restricted to small pockets, mostly in protected areas. The recent analysis ([13], Table S1) identified 42 “source sites,” so termed because these areas contain concentrations of tigers that have the potential to repopulate larger land-
scapes. Source sites were defined as having the potential to maintain >25 breeding females, being embedded in a larger landscape with the potential to contain >50 breeding females, having an existing conservation infrastructure, and having a legal mandate for protection (Text S1). These sites contain the majority of the world’s remaining tigers.

Strategies to save the tiger must focus first and foremost on protecting these remaining concentrations of tigers. These 42 sites contain almost 70% of all remaining wild tigers ([13], Table S1) so have a disproportionate importance to the survival and recovery of the species. Nevertheless, collectively they cover < 100,000 km², which is less than 0.5% of their historical range and just 6% of even their current distribution. If Russia is excluded from the analysis, 74% of the world’s remaining tigers live in less than 4.5% of current tiger range. Therefore, protecting source sites offers the most pragmatic and efficient opportunity to conserve most of the world’s remaining wild tigers.

Source sites are not evenly distributed across the tiger’s range (Figure 1). Most are in India (18), Sumatra (eight) and the Russian Far East (six). Based on available data, no source site was identified in Cambodia, China, DPR Korea, or Vietnam [13]. Surveys in Bhutan and Myanmar have thus been too limited for their status to be assessed. Nevertheless, potential source sites in some of these countries warrant further investigation. Even source sites, however, have depressed tiger populations. Only five, all of which are in India, maintain tiger populations close (>80%) to their estimated carrying capacity [13]. Thus, the recovery of populations in source sites alone would result in a 70% increase in the world’s tiger population.

While recognizing that the long-term goal is to conserve an Asia-wide network of large, tiger-permeable landscapes, the immediate priority must be to ensure that the last remaining breeding populations are protected and continuously monitored. Without such protection, all other efforts are bound to fail. The similarly dramatic decline in African rhinoceroses in the 1980s provides useful lessons on how best to respond to a decline in a species of high commercial value. Where conservation efforts were geographically diffuse, the cost–risk ratio greatly favored the illegal hunter [14]. Only where protection efforts either were focused on small- to medium-sized areas (e.g., Kenya’s rhino sanctuaries), or were well financed (e.g., Kruger National Park), did rhinos persist [15].

While tigers have larger spatial requirements than rhinos, the challenge is the same.

Actively protecting tigers at source sites is feasible and pragmatic, and has been demonstrably successful in many reserves across India between 1974 and 1986 [16]. The Malenad–Mysore tiger landscape currently maintains >220 adult tigers, one of the greatest concentrations in the world, mainly due to intensive protection of its source sites such as Nagarahole National Park, where tiger numbers have increased by 400% after protection began in the early 1970s [17,18], and has now maintained a high density for 30 years ([19], unpublished data). Across India, tiger abundance is strongly correlated with prey density [20] and both depend on strict controls on hunting. The Tigers Forever program [21] has supported governmental protection effort, aided by MIST (Management Information System) law enforcement monitoring [22], in Thailand, Lao PDR, and Malaysia, and hunting has been reduced and tiger populations stabilized. However, these results require greater levels of law enforcement, surveillance, and monitoring than typically is found in national protected areas. In the Russian Far East, traditionally a stronghold for tigers, annual monitoring detected a dramatic decline in tiger numbers over the last five years, which was associated with a decline in enforcement [23,24]. Recent declines in tiger numbers in the once thriving source sites in Nepal were also associated with reduced emphasis on protection [25].

The Cost of Protection

We assessed the costs of protecting source sites, including increased law enforcement, biological and law enforcement monitoring, and where appropriate, community engagement, informant networks, and trade monitoring. Costs were sourced,
where possible, from those responsible for managing source sites such as protected area authorities, supplemented by published national government figures. Included costs were limited to those supporting the core activities of protection and monitoring of source sites. These include law enforcement, law enforcement monitoring, general management, and the monitoring of tigers and their prey. One-time conservation infrastructure development, and costs related to the relocation of communities within source sites, were not included in the analysis (Text S2).

Protecting source sites is financially attainable. Our analysis [13] estimates the average cost of protecting and monitoring tigers effectively at all 42 source sites at $82 million per year or $930/km² per year, within the range of effective protected area costs in general (from $130 to >$5,000/square kilometer/year for densely settled regions in Asia) [26]. More than half of these funds ($47 million, almost US$500/km²) is already being committed by range-state governments and, to a far lesser extent, international donors and NGOs. However, much of the total governmental financial commitment comes from and is spent in India. When India is excluded from the analysis, the average current commitment drops to US$265/km² per year. This leaves an overall shortfall of US$35 million a year for all source sites.

A Pragmatic Strategy

While protecting source sites is essential to reverse tiger declines, this is but one element of a long-term recovery strategy. For wide-ranging, low-density species like the tiger, conservation planning at the landscape level is necessary, landscapes need to remain permeable to tiger movements, and source sites have to remain embedded in those larger landscapes. This will require strict limits on habitat conversion and infrastructure development. In addition, conservation efforts need to target the illegal trade, as site-based protection will be increasingly costly if the global demand for tiger products is not curtailed [27,28]. All of this will require concerted, orchestrated and politically bold commitments by range-state governments, supported by the general public and the international community, and sustained over decades.

However, with so few wild tigers remaining, almost entirely clustered in a few small areas, the most immediate need is to protect populations in the remaining source sites. For financially valuable species like the tiger, intensive protection is paramount, and the success of such protection has been demonstrated. Commitments made at the Russian Summit must refocus on the protection of source sites—a strategy that is financially realistic, politically feasible, and will deliver the greatest return on conservation investments. Only when we are able to stop the slide in tiger numbers at source sites will we be successful at managing tigers across the wider landscape.

Supporting Information

Table S1 Source sites listed by country.

| Country | Source Sites |
|---------|-------------|
| India   | 20          |
| Nepal   | 10          |
| China   | 9           |
| Thailand| 7           |
| Russia  | 6           |
| Vietnam | 5           |

Text S1 Definition of source sites.

Text S2 Estimating financial costs for effective protection and monitoring at source sites, and present expenditures.

References

1. Damania R, Seidensticker J, Whitten T, Sethi G, MacKinnon K, et al. (2008) A future for wild tigers. Washington, D.C.: World Bank and Smithsonian’s National Zoological Park. 36 p.
2. Wikramanayake E, Dinerstein E, Forrest J, Loucks C, Seidensticker J, et al. (2010) Road to recovery or catastrophic loss: How will the next decade end for wild tigers? In: Tilson RL, Nyuhu PJ, eds. Tigers of the World: The science, politics and conservation of Panthera tigris. London: Academic Press. pp 493–506.
3. Chundawat RS, Habib B, Karanth KU, Kawanashi K, Ahmad Khan J, et al. (2010) Panthera tigris. In: IUCN 2010, IUCN Red List of Threatened Species. Version 2010.2. Available: http://www.iucnredlist.org. Accessed 14 July 2010.
4. Sanderson E, Forrest J, Loucks C, Ginsberg J, Dinerstein E, et al. (2006) Setting priorities for the conservation and recovery of wild tigers 2005–2015. A technical report. New York and Washington, D.C.: Wildlife Conservation Society, World Wildlife Fund, Smithsonian, and National Fish and Wildlife Foundation-Save the Tiger Fund. 206 p.
5. Karanth KU, Goodrich JM, Vaidyanathan S, Reddy GV (2010) Landscape scale, ecology-based management of wild tiger populations. Washington, D.C.: Global Tiger Initiative, World Bank, and Wildlife Conservation Society.
6. Karanth KU, Stith BM (1999) Prem deprecation as a critical determinant of tiger population viability. In: Seidensticker J, Christie S, Jackson P, eds. Riding the Tiger: Conservation in human-dominated landscapes. Cambridge: Cambridge University Press. pp 170–177.
7. Jhala YV, Gopal R, Qureshi Q (2008) Status of tigers, co-predators and prey in India. New Delhi and Dehradun, India: National Tiger Conservation Authority and Wildlife Institute of India. 152 p.
8. Linkie M, Chapron G, Martyr D, Holden J, Leader-Williams N (2006) Assessing the viability of tiger subpopulations in a fragmented landscape. J Appl Ecol 43: 576–596.
9. Wikramanayake ED, Dinerstein E, Robinson JG, Karanth KU, Rabinowitz A, et al. (1998) An ecology-based method for defining priorities for large mammal conservation: The tiger as a case study. Cons Biol 12: 865–868.
10. Wikramanayake ED, Dinerstein E, Robinson JG, Karanth KU, Rabinowitz A, et al. (1999) Where can tigers live in the future? A framework for identifying high-priority areas for the conservation of tigers in the wild. In: Seidensticker J, Christie S, Jackson P, eds. Riding the Tiger: Tiger conservation in human-dominated landscapes. Cambridge: Cambridge University Press. pp 235–272.
11. Christie S (2006) NGO investment in tiger conservation units, 1998–2005. In: Sanderson E, et al., eds. Setting priorities for the conservation and recovery of wild tigers 2005–2015: A technical report. New York and Washington, D.C.: Wildlife Conservation Society, World Wildlife Fund, Smithsonian, and National Fish and Wildlife Foundation-Save the Tiger Fund. pp 116–119.
12. Nowell K, Xu Ling (2007) Taming the tiger trade: Wildlife products since the 1993 domestic trade ban. In: Tilson RL, Seal US, eds. Tigers of the world: The biology, biopolitics, management and conservation of an endangered species. New Jersey: Noyes Publications. pp 110–117.
13. Karanth KU, Sunquist M, Chinnapa KM (1999) Long-term monitoring of tigers: lessons from Nagarhole. In: Seidensticker J, Christie S, Jackson P, eds. Riding the Tiger: Tiger conservation in human-dominated landscapes. Cambridge: Cambridge University Press. pp 114–122.
14. Karanth KU (2002) Nagarhole: Limits and opportunities in wildlife conservation. In: Terborgh J, Van Schaik C, Davenport L, Rao M, eds. Making parks work: Strategies for preserving tropical nature. Washington, D.C.: Island Press. pp 189–202.
15. Karanth KU, Nichols JD, Kumar NS, Hines JE (2004) Assessing tiger population dynamics using photographic capture-recapture sampling. Ecology 85: 2925–2937.
16. Leader-Williams N, Albon SD (1988) Allocation of resources for conservation. Nature 336: 533–535.
17. Panwar HS (1987) Project Tiger: the reserves, the tigers and their future. In: Tilson RL, Seal US, eds. Tigers of the world: The biology, biopolitics, management and conservation of an endangered species. New Jersey: Noyes Publications. pp 110–117.
18. Wikramanayake ED, Dinerstein E, Robinson JG, Karanth KU, Rabinowitz A, et al. (1999) Where can tigers live in the future? A framework for identifying high-priority areas for the conservation of tigers in the wild. In: Seidensticker J, Christie S, Jackson P, eds. Riding the Tiger: Tiger conservation in human-dominated landscapes. Cambridge: Cambridge University Press. pp 235–272.
19. Christie S (2006) NGO investment in tiger conservation units, 1998–2005. In: Sanderson E, et al., eds. Setting priorities for the conservation and recovery of wild tigers 2005–2015: A technical report. New York and Washington, D.C.: Wildlife Conservation Society, World Wildlife Fund, Smithsonian, and National Fish and Wildlife Foundation-Save the Tiger Fund. pp 116–119.
20. Nowell K, Xu Ling (2007) Taming the tiger trade: Wildlife products since the 1993 domestic trade ban. In: Tilson RL, Seal US, eds. Tigers of the world: The biology, biopolitics, management and conservation of an endangered species. New Jersey: Noyes Publications. pp 110–117.
21. Leader-Williams N, Albon SD (1988) Allocation of resources for conservation. Nature 336: 533–535.
22. Panwar HS (1987) Project Tiger: the reserves, the tigers and their future. In: Tilson RL, Seal US, eds. Tigers of the world: The biology, biopolitics, management and conservation of an endangered species. New Jersey: Noyes Publications. pp 110–117.
23. Karanth KU, Sunquist M, Chinnapa KM (1999) Long-term monitoring of tigers: lessons from Nagarhole. In: Seidensticker J, Christie S, Jackson P, eds. Riding the Tiger: Tiger conservation in human-dominated landscapes. Cambridge: Cambridge University Press. pp 114–122.
24. Karanth KU (2002) Nagarhole: Limits and opportunities in wildlife conservation. In: Terborgh J, Van Schaik C, Davenport L, Rao M, eds. Making parks work: Strategies for preserving tropical nature. Washington, D.C.: Island Press. pp 189–202.
25. Karanth KU, Nichols JD, Kumar NS, Hines JE (2004) Assessing tiger population dynamics using photographic capture-recapture sampling. Ecology 85: 2925–2937.
26. Leader-Williams N, Albon SD (1988) Allocation of resources for conservation. Nature 336: 533–535.
23. WCS Russia [16 October 2009] Danger signals for the Siberian tiger. Available: http://www.wcsrussia.org/aboutus/NewsArchive/tabid/2041,aspx.

24. Miquelle DG, Yu M, Danishenko DA, Zvyaginnev DA, Darenky AA, et al. (2009) A monitoring program for the Amur tiger. Twelfth Year Report, 1998–2009. 54 p.

25. Karki JB, Jhaawali SR, Sheelha R, Pandey MB, Gurung G, et al. (2009) Tigers and their prey base abundance in Terai Arc landscape, Nepal. Kathmandu: Government of Nepal, Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation, and Department of Forests. 12 p.

26. Balmford A, Gaston KJ, Blyth S, James A, Kapos V (2003) Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. Proc Natl Acad Sci U S A 100: 1046–1050.

27. Mills JA, Jackson P (1994) Killed for a cure: a review of the worldwide trade in tiger bone. Cambridge, UK: TRAFFIC International. 64 p.

28. Wasser RM, Jiao PB (2010) Understanding the motivations: the first step toward influencing China’s unsustainable wildlife consumption. Hong Kong: TRAFFIC East Asia. 56 p.