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# Translocation a success, but poaching remains a problem for Amur tigers

**Several recent publications have strongly criticized using translocation of carnivores as a management tool for conflict situations. Here we report on another successful translocation of an Amur tiger *Panthera tigris altaica* and detail the conditions that make this a valuable tool for managers in the Russian Far East. We took advantage of the high spatial and temporal resolution provided by GPS collars to closely monitor and assess translocation success after release. We argue that translocation of conflict animals can be successful and remains a viable option for consideration by managers obligated to otherwise remove individuals from a critically endangered population. Regardless, as this example showed, without reducing poaching pressure, managers will be unable to recover populations on the edge.**

Translocation (also called relocation) is a commonly used management tool to mitigate carnivore-human conflicts (Griffith et al. 1989, Linnell et al. 1997, Massei et al. 2010) and while it is a preferred non-lethal management option by the public, translocation attempts are often met with mixed results (Griffith et al. 1989). Problems often associated with translocation include high costs and degree of expertise required, resumption of depredation by translocated animals, return of translocated animals to their original home ranges (e.g., homing), increased risk of disease transmission, potential confrontations with local dominant animals, and reduced survival or reproduction. Few have monitored translocated animals to determine its effectiveness and even fewer have tried to elucidate the reasons for success or failure. Consequently, translocation has been heavily (and often justifiably) criticized as a management tool (Massei et al. 2010, Athreya et al. 2011, Fonturbel and Simonetti 2011). However, criticisms of translocation often ignore the desperate nature of conservation measures for critically endangered species such as tigers, where the goal is to not only reduce conflict, but also increase survival of individual tigers, where every individual counts. Here, we report on a successful tiger translocation in the Russian Far East (RFE) and discuss what we believe are the reasons for success and the efficacy of translocation for reducing human-tiger conflict and associated tiger mortality.



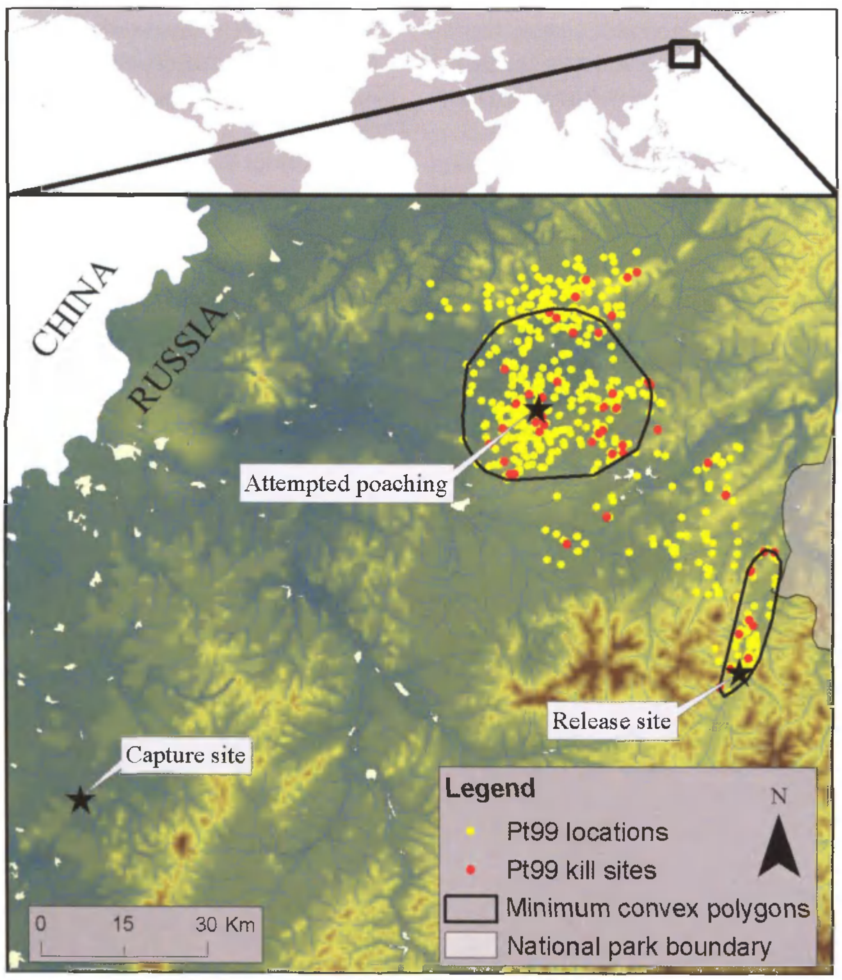


**Fig. 1.** Movements of Pt99 post-release with 2 locations per day displayed and 2 Minimum Convex Polygons, one for the 3 months after release and the second for the territory she eventually settled into north of the Bolshaya Ussurka River.

In February 2010, the Wildlife Conservation Society Russia Program and the Primorski Krai Wildlife Management Department responded to a human-tiger conflict near the village of Orlovka in Lesozavodski Raion (county). Early in the morning of 15 February, a tiger approached a farm on the outskirts of the village, wounded a horse, and was promptly scared away by the landowner. The horses were not secured in a barn at night but were fenced in a large pasture approximately 20 m from the house. The tiger returned several hours later, killed a different horse, and ate approximately four kilograms of meat before the landowner scared the tiger away and secured the carcass inside a barn. Later that evening the tiger returned and killed another horse. The tiger dragged the carcass to a fence ten meters away before being scared away by the landowner. The tiger returned an hour later and consumed about 6 kg of meat. This was a low to normal consumption rate compared to tigers preying on wild ungulates (5-15kg/day; Pikunov 1988). On 16 February, the tiger returned to eat twice and was not disturbed by barking dogs five meters away or people in a truck shining a spotlight on the carcass. The tigress was most likely forced to eat domestic prey and willing to tolerate human presence, due to very low wild prey populations in the surrounding forests.

Based on an agreement with the Primorski Krai Wildlife Department, and a capture permit obtained from the Ministry of Natural Resources, our team arrived on 17 February and captured a female tiger (identified as Pt99) the following morning in an Aldrich foot snare set on a trail leading to the carcass. Capture and anesthesia followed established protocols (Goodrich et al. 2001). Tracks of the captured female matched pugmarks at the depredation site and further snow tracking surveys suggested only a single tiger occupied the general area. Thus, we were confident that the captured tigress was responsible for killing the horses (Fig. 3), and potentially also for a cattle depredation 11 km away that occurred several months earlier. The tigress weighed 130 kg (large for female Amur tiger), was in good body condition, and was estimated to be between six and eight years old based on tooth wear.

Considering the importance of prime-age females for population growth (Chapron et al. 2008), we agreed to attempt a translocation. We fitted her with a Vectronic GPS PLUS collar (VECTRONIC Aerospace GmbH; Berlin, Germany) for subsequent monitoring. The collar was programmed to collect locations at three-hour intervals. With a GPS collar we were able to monitor her closely while our field teams focused their energy on field investigation of movements and putative kill sites. This real-time data acquisition would prove extremely valuable in assessing and intervening on her behalf.

On the morning of 19 February 2010, we released Pt99 approximately 121 km northeast of the capture site just south of Udeghe Legend National Park along the Perevalnaya River, a tributary of the Bolshaya Ussurka River (Fig. 1, 2). The release site was within the current range of tigers and chosen because of its remoteness (the nearest village was 25 kilometers away), sufficiently high prey densities, and ease of monitoring. Surprisingly, she killed and consumed a roe deer *Capreolus pygargus* on the day of release. She then spent the entire winter - nearly three months – using a 142.9 km$^2$ area of this drainage (90% minimum convex polygon, n = 533 locations), while moving an average of 2.1 kilometers per day. During the second week of May, she moved out of the Perevalnaya River drainage and spent the subsequent five weeks traveling an average of 7.1 kilometers per day, making two major excursions to the northwest. She crossed the Bolshaya Ussurka River in mid June and settled into an area northwest of the release site where she remained through June 2011. From mid June 2010 to mid June 2011, she used a well-defined area of 825.7 km$^2$ area (90% minimum convex polygon, n = 2381 locations) and moved an average of 5.3 kilometers per day. We estimated two minimum convex polygons from the two distinct concentrations of locations described above and selected 90% minimum convex polygon home range estimates to screen out occasional wide-ranging movements common during translocations.

**Fig. 2.** Release of a male Siberian tiger after rehabilitation (Photo J. Goodrich/WCS).

On 21 December 2010, Pt99 was chased off a wild boar *Sus scrofa* kill by a hunter with two dogs. While the hunter claimed that the tiger attacked unprovoked, snow tracking revealed that the hunter tracked her away from the kill site for about two kilometers, where he shot Pt99 through an opening in the forest. Wounded and provoked, Pt99 charged the hunter. Although the man apparently shot again, this did not stop her from severely mauling him. The two dogs distracted the tigress and most likely saved the poacher's life. Pt99 moved about 600 meters to the west and rested for nearly a day. Bed sites near where she was shot indicated that she had been wounded in the chest and possibly the hind quarters, but later bed sites were bloodless. We attempted to obtain visual contact and assess her condition on December 23 by approaching in a logging skidder. While unsuccessful, the attempt demonstrated that Pt99 was still capable of movement (she moved three kilometers in



**Table 1.** Number of documented kills by an adult female tigress, Pt99, from 19 February 2010 to 15 June 2011, Primorski Krai, Russia.

| Prey Species | Number of kills located | Percentage of total kills |
|---|---|---|
| **Roe deer** *Capreolus pygargus* | 17 | 34 |
| **Wild boar** *Sus scrofa* | 13 | 26 |
| **Red deer** *Cervus elaphus* | 11 | 22 |
| **Badger** *Meles leucurus* | 4 | 8 |
| **Domestic feral dog** *Canis familiaris* | 3 | 6 |
| **Brown bear** *Ursus arctos* | 1 | 2 |
| **Asiatic black bear** *Ursus thibetanus* | 1 | 2 |
| **Total** | **50** | **100** |

**Fig. 3.** Horse killed by tigress Pt99 (Photo I. Seryodkin/WCS).

response to this disturbance), and her gait appeared normal. The GPS collar enabled us to promptly respond to this human-tiger conflict situation and closely monitor her movements. Given her injury and previous history, we feared she would approach a village in search of easy domestic prey and the specter of another attack on people was of great concern. Two small villages were only ten kilometers to the northeast and northwest of the site where the shooting occurred. However, she kept her distance from villages and killed a first-year wild boar on 2 January, consuming it completely. On 16 January she killed an adult female boar and spent ten days at the site. While resting and healing for the first ten days after the shooting, her daily movement rate dropped to < 2 kilometers per day, significantly less than she moved during the month prior to the shooting ($P < 0.0001$). Both kill rate and movement rates dropped in the three months after the shooting, but picked up again during late spring and remained at a normal level when the collar prematurely died in mid June 2011.

During 481 days of continuous monitoring, from February 19, 2010 to June 15, 2011, we received 3452 locations out of 3810 attempts, for a 90.6% fix-rate. Using these location data, we have identified and searched 194 potential kill sites and documented 50 kills (Table 1). After release, Pt99 has survived primarily on wild ungulates and has avoided depredations on domestic animals near settlements. We do not consider the dogs she killed as depredations because they were free-ranging, far from human habitations, and apparently feral.

We define success in translocation efforts in a stepwise fashion as: 1) reliance on wild prey; 2) cessation of depredation on domestic animals; 3) survival through the first winter (for northern climates) and first year; 4) establishing a home range; and ultimately, 5) successful reproduction (Goodrich & Miquelle 2005). Based on her activities after release, we consider the translocation process a conditional success - Pt99 consumed wild game and feral dogs, avoided human settlements, survived her first year, and has apparently established a territory, albeit a territory that was more than twice as large (825.7 km$^2$) as the mean for female Amur tigers reported in the protected area complex of Sikhote-Alin Biosphere Zapovednik (390 km$^2$; Goodrich et al. 2010). The cause for this large home range size is unknown, but could be related to the translocation itself or lower prey densities outside of protected areas. Although the causes for her initial depredations are difficult to determine, snow-tracking surveys led us to believe that a paucity of wild prey in her original home range was to blame. By placing this tigress into a forest with healthy prey populations and far from human settlements, we gave her the opportunity to kill wild prey without relying on domestic animals. While her recent attack on a hunter was a conflict situation, it was also clearly provoked by the hunter while Pt99 was feeding on wild prey 12 kilometers from the nearest village. Further, there have not been any additional human-tiger conflicts reported in the area around Orlovka since we translocated Pt99.

Of the five tigers we have translocated, none, including Pt99, displayed homing behavior (Goodrich & Miquelle 2005). However, our previous translocations were of cubs (<1 year) or subadults (1-3 years), whereas Pt99 was an adult, whom we would expect to be more likely to display homing behavior, especially given a translocation distance (121 kilometers) well within the range of dispersal movements for tigers (Goodrich et al. 2005). However, release in mid-winter, with snow depths exceeding 50 centimeters, may have impeded any immediate homing movements.

High tiger poaching rates in Russia probably create vacant territories for translocated animals to settle in, especially in the unprotected state forest lands where we normally release tigers. Such conditions may not exist in some areas (Barlow et al. 2010, Loveridge et al. 2010), but high rates of tiger poaching in many countries has resulted in many forested areas devoid of tigers or with densities likely below carrying capacity (e.g. Laos, Sumatra; Johnson et al. 2006, Wibisono & Pusparini 2010). Indeed, translocation (but not of conflict animals) is being used to repopulate Panna and Sariska Reserves in India after tigers were extirpated by poaching (Sankar et al. 2010). With careful planning, translocation of conflict animals could be used to supplement depleted populations (where measures have been taken to reduce poaching and increase prey populations) or facilitate genetic exchange between isolated populations. However, disease transmission is an important concern for translocation, especially if animals are to be released into small populations. Because of their interactions with domestic animals, conflict animals may have a higher probability of harboring infectious diseases not endemic in wild populations. Further, there is at least anecdotal evidence that infectious disease, especially canine distemper, may result in poor body condition and bold behavior in tigers, and hence cause them to come into conflict with humans (Quigley et al. 2010, authors, unpubl. data).

Three recent papers have presented data strongly arguing against translocation in most cases (Massei et al. 2010, Athreya et al. 2011, Fonturbel & Simonetti 2011). However, translocation of large cats has been conducted successfully and can be a useful tool for endangered species management in some situations if conducted correctly (Hunter et al. 2007, Trinkel et al. 2008). Three of five translocations of Amur tigers were successful (Goodrich & Miquelle 2005), meaning that translocation can be used to increase survival when tigers would otherwise be removed from the wild. We believe keys to our success are sufficiently long translocation distances, release of tigers in remote areas with sufficient prey, and naturally low tiger densities (<1 tiger/100 km$^2$, Miquelle et al. 2010). Young tigers (<3 years) are most suitable because translocation mimics natural dispersal patterns of animals in this age group (Loveridge et al. 2010). Females should be given priority because of the high value of breeding females to population persistence (Goodrich & Miquelle 2005, Loveridge et al. 2010). Translocated animals should be released into forests with lower tiger densities such as areas where poaching has recently reduced tiger densities (assuming the threat of poaching has been reduced) to increase the likelihood for establishing a territory. After confirming that the captured animal is responsible for the management situation, all translocated tigers should be equipped with GPS collars with remote data download capabilities that enable researchers to evaluate the success of the translocation, closely monitor movements, and quickly respond to any potential conflicts in the future.

The attempted poaching incident that Pt99 survived clearly demonstrates the perils all wild tigers currently face. Goodrich et al. (2008) reported that 75% of radiocollared tiger mortalities were attributed to poachers in the RFE. Recent necropsies conducted on tigers in the RFE suggest that a surprising number of tigers carry bullets from poaching attempts (Kerley & Salkina, pers. comm.). Three of five tigers we translocated are known or suspected to have been killed by poachers, with Pt99 surviving an attempted poaching. Clearly, all conservation efforts, including translocations, will be meaningless if current poaching rates continue.

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**References**

Athreya V. R., Odden M., Linnell J. D. C. & Karanth K. U. 2011. Translocation as a tool for mitigating conflict with leopards in human-dominated landscapes of India. Conservation Biology 25, 133-141.

Barlow A. C. D., Greenwood C. J., Ahmad I. U. & Smith J. L. D. 2010. Use of an action-selection framework for human-carnivore conflict in the Bangladesh Sundarbans. Conservation Biology 24, 1338-1347.

Chapron G., Miquelle D. G., Lambert A., Goodrich J. M., Legendre S. & Clobert J. 2008. The impact on tigers of poaching versus prey depletion. Journal of Applied Ecology 45, 1667-1674.

Fonturbel F. E. & Simonetti J. A. 2011. Translocations and human-carnivore conflicts: problem solving or problem creating? Wildlife Biology 17, 217-224.

Goodrich J. M., Kerley L. L., Miquelle D. G., Smirnov E. N., Quigley H. B. & Hornocker M. G. 2005. Social structure of Amur tigers on Sikhote-Alin Biosphere Zapovednik. In Tigers of Sikhote-Alin Zapovednik: Ecology and Conservation. Miquelle D. G., Smirnov E. N. & Goodrich J. G. (Eds). PSP, Vladivostok, Russia, pp. 50-60. (In Russian)

Goodrich J. M., Kerley L. L., Schleyer B. O., Miquelle D. G., Quigley K. S., Smirnov E. N., Nikolaev I. G., Quigley H. B. & Hornocker M. G. 2001. Capture and chemical anesthesia of Amur tigers. Wildlife Society Bulletin 29, 533-542.

Goodrich J. M., Kerley L. L., Smirnov E. N., Miquelle D. G., McDonald L., Quigley H. B., Hornocker M. G. & McDonald T. 2008. Survival rates and causes of mortality of Amur tigers on and near the Sikhote-Alin Biosphere Zapovednik. Journal of Zoology 276, 323-329.

Goodrich J. M. & Miquelle D. G. 2005. Translocation of problem Amur tigers *Panthera tigris altaica* to alleviate tiger-human conflicts. Oryx 39, 454-457.

Goodrich J. M., Miquelle D. G., Smirnov E. N., Kerley L. L., Quigley H. B. & Hornocker M. G. 2010. Spatial structure of Amur (Siberian) tigers (*Panthera tigris altaica*) on Sikhote-Alin Biosphere Zapovednik, Russia. Journal of Mammalogy 91, 737-748.

Griffith B., Scott J. M., Carpenter J. W. & Reed C. 1989. Translocation as a Species Conservation Tool: Status and Strategy. Science 245, 477-480.

Hunter L., Skinner J. D., Pretorius K., Carlisle L. C., Rickleton M., Walker C. & Slotow R. 2007. Reintroducing lions *Panthera leo* to northern Kwazulu-Natal, South Africa: short-term biological and technical successes but equivocal long-term conservation. Oryx 41, 196-204.

Johnson A., Vongkhamheng C., Hedemark M. & Saithongdam T. 2006. Effects of human–carnivore conflict on tiger (*Panthera tigris*) and prey populations in Lao PDR. Animal Conservation 9, 421-430.

Linnell J. D. C., Aanes R., Swenson J. E., Odden J. & Smith M. E. 1997. Translocation of carnivores as a method for managing problem animals: a review. Biodiversity and Conservation 6, 1245-1257.

Loveridge A. J., Wang S. W., Frank L. G. & Seidensticker J. 2010. People and wild felids: conservation of cats and management of conflict. In Biology and Conservation of Wild Felids. MacDonald D.W. & Loveridge A.J. (Eds). Oxford University Press, Oxford, United Kingdom, pp. 161-195.

Massei G., Quy R. J., Gurney J. & Cowan D. P. 2010. Can translocations be used to mitigate human-wildlife conflicts? Wildlife Research 37, 428-439.

Miquelle D. G., Goodrich J. M., Smirnov E. N., Stephens P. A., Zaumyslova O.Y., Chapron G., Kerley L., Murzin A. A., Hornocker M. G. & Quigley H. B. 2010. The Amur tiger: a case study of living on the edge. *In* The Biology and Conservation of Wild Felids. MacDonald D. W. & Loveridge A. J. (Eds). Oxford University Press, Oxford, United Kingdom, pp. 325-339.

Pikunov D. G. 1988. Eating habits of the Amur tiger (*Panthera tigris altaica*) in the wild. *In* Proceedings of the 5th World Conference on Breeding Endangered Species in Captivity. Dresser B. L., Reece R. W. & Maruska E. J. (Eds.). Cincinnati, Ohio, pp. 185-190.

Quigley K. S., Evermann J. F., Leathers C. W., Armstrong D. L., Goodrich J. M., Duncan N. M. & Miquelle D. G. 2010. Morbillivirus infection in a wild Siberian tiger in the Russian Far East. Journal of Wildlife Diseases 46, 1252-1256.

Sankar K., Qureshi Q., Nigam P., Malik P. K., Sinha P. R., Mehrotra R. N., Gopal R., Bhattacharjee S., Mondal K. & Gupta S. 2010. Monitoring of reintroduced tigers in Sariska Tiger Reserve, Western India: preliminary findings on home range, prey selection and food habits. Tropical Conservation Science 3, 301-318.

Trinkel M., Ferguson N., Reid A., Reid C., Somers M., Turelli L., Graf J., Szykman M., Cooper D., Haverman P., Kastberger G., Packer C. & Slotow R. 2008. Translocating lions into an inbred population in the Hluhluwe-Umfolozi Park, South Africa. Animal Conservation 11, 138–143.

Wibisono H. T. & Pusparini W. 2010. Sumatran tiger (*Panthera tigris sumatrae*): A review of conservation status. Integrative Zoology 5, 309-318.

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