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Behavioral Response of Satellite-collared Elephants to the Tsunami in Southern Sri Lanka[1]

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ABSTRACT

After the Asian tsunami the media was inundated with reports of aberrant behavior among animals attributed to a "sixth sense" that allowed them to respond to the catastrophe ahead of the impact. We present behavior data from two satellite-collared Asian elephants that ranged close to the tsunami impact area in Sri Lanka. These data indicate that neither elephant behaved in a manner consistent with a "sixth sense" that allowed an early detection of the approaching tsunami.

Key words: Asian elephants; elephant movements; sixth sense; Sri Lanka; tsunami.

AFTER THE ASIAN TSUNAMI ON 26 DECEMBER 2004, the media was inundated with reports of a "sixth sense" among wild animals, which forewarned them of the earthquake and approaching wave and enabled them to flee to safety (*e.g.*, http://www.sciencenewsforkids.org/articles/20050413/Feature1.asp, http://news.nationalgeographic.com/news/2005/01/0104_050104_tsunami_animals.html, http://news.bbc.co.uk/2/hi/south_asia/4136485.stm, http://www.reuters.com/newsArticle.jhtml?type=scienceNews&storyID=7207207, Oldenburg 2005) . Elephants figure prominently in these reports. Scientific studies have shown that elephants are indeed able to detect and respond to seismic vibrations originating at distances of over 30 km (Hill 2001; O'Connell-Rodwell *et al.* 2000, 2001).

On the day of the tsunami, we were studying the movement behavior of Asian elephants (*Elephas maximus*) at Yala National Park in Sri Lanka by tracking them with GPS satellite collars. The park is located along the southeast coast of Sri Lanka (Fig.1), and its coastal area was impacted by the tsunami. Using the location data from these GPS collars we examined the individual movement patterns of the elephants on the day of the tsunami for aberrant behaviors that would suggest the early detection and flight response to the approaching tsunami. We hypothesized that if elephants responded to extra-sensory cues or even to long-distance seismic cues from the wave, they would have moved away from the coast long before the wave approached or impacted along it. These movements should also be longer and faster than average movements.

Both elephants were radio-collared with Telonics GPS-satellite transmitters (TGW-3780; Telonics 2004) using an ARGOS platform. The collars collected GPS locations at 4-h intervals, beginning at 0200 h, Sri Lanka time. One elephant was a juvenile male that ranged within 6 km of the coast before the tsunami, and the second was an adult female that used areas along the coastline (Fig. 1a). Each animal was associated with a herd, and their movement patterns also represent the movements of these respective herds, which comprised 30–35 animals in each and were led by matriarchs estimated to be about 30–40 yr of age. These associations were confirmed by periodic sightings.

Frequency distributions of the inter-GPS location distances indicate that the elephants usually moved about 500 m during the 4-h intervals (mean ± SD for the male was 515 ± 504 m; female was 573 ± 518 m). At 0200 h on December 26, the female was close to the coastline; about 105 m from the inshore boundary of the beach and 280 m from the water's edge (Fig. 1b). The first tsunami waves reached Sri Lanka's coast around 0900 h local time. By 1000 h the female had moved 177 m east, closer to the coast (Fig. 1b), suggesting she was still near the beach when the tsunami hit. Unfortunately, the 600 h GPS position for this elephant was lost due to a bad satellite uplink. After 1000 h she had moved inland in a counterclockwise arc, returning to the beach by 0200 h on December 27 (Fig. 1b). Her movement distances between GPS locations were 301 m from 1000 to 1400 h, 586 m from 1400 to 1800 h, 706 m from 1800 to 2200 h, and 874 m from 2200 to 0200 h. None of these distances was great enough to be indicative of flight behavior. The longer distances traveled were also during the evening and night of December 26, rather than immediately before or after the tsunami impact. They were also toward the beach, rather than away from it.

Three weeks after the tsunami, we mapped the inland boundary of the flooded area in Yala National Park by walking along the perimeter with a hand-held GPS (Fig. 1). These surveys indicated

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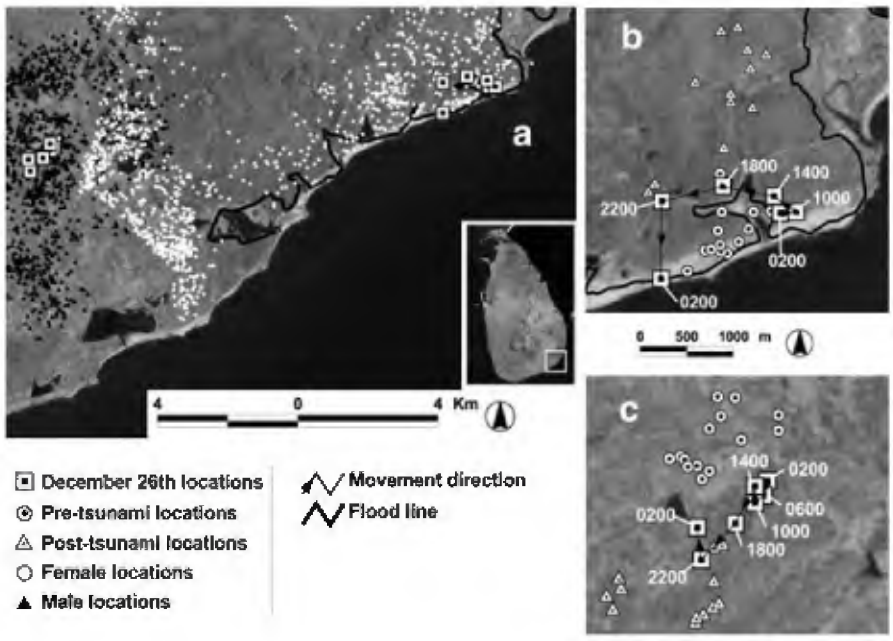

FIGURE 1. Satellite GPS radio-collar locations for the two elephants in Yala National Park (a). The map of Sri Lanka (inset) shows the relative position of the park, indicated by the square. The flood line indicates the boundary of wave intrusion. The positions of each elephant on 26 December are shown (b, c) with the times of the GPS locations. The locations of the elephants 3 d prior and 3 d after the tsunami are also indicated (b, c).

that the wave intruded to 105 m from the female's 0200 h position, and that her 1000 h location closer to the beach was not affected by the wave. Our ground surveys of the affected area also revealed that the wave intrusion was prevented by high sand dunes along the beach. The female's eastward movements had taken her to the lee of a dune, and thus to a refuge that was unaffected by the wave which intruded through the nearby lagoon outlet (Fig. 1b).

Because there were reports of animals showing aberrant behavior suggesting a premonition of the impending catastrophe several days ahead of the event (http://www.sciencenewsforkids.org/articles/20050413/Feature1.asp), we looked at the locations of the female 3 d prior to the tsunami, and 3 d after for comparison (Fig, 1b). These data show that during the 3 d prior to the tsunami the elephant was close to the shoreline, and only moved northward and away from the coast on 28 December, 2 d after the tsunami.

Further inland, the male elephant moved even shorter distances than the female. The distances between the three GPS locations from 0200 to 0600 h, 0600 to 1000 h, and 1000 to 1400 h were 161, 118, and 177 m, respectively. By 1800 h, he had moved 450 m southwest from the 1400 h position, and 532 m by 2200 h (Fig. 1c). The distance from its 0600 h position to the beach was less than 6 km (Fig. 1a). Elephants have the potential to detect seismic cues from distances greater than 6 km (O'Connell-Rodwell *et al.* 2000, 2001). But even if this elephant did detect any seismic vibrations he did not exhibit a flight response away from the incoming tsunami. During the 3 d preceding the tsunami, the male's locations were clustered 0.5–1 km north of its 26 December location, and the locations during the 3 d after the tsunami were clustered 1.5–2 km to the south (Fig. 1c). Thus, he moved closer to the beach during the days prior to the impending tsunami, and continued the southward movements during the subsequent 3-d period.

To our knowledge, this study provides the only systematically collected data on movements of wild animals during the Asian tsunami, and these empirical data strongly indicate that the movements of these free-ranging elephants are not consistent with flight behavior or other potentially aberrant behaviors attributable to extra-sensory perception or sixth sense, or even with an early response to seismic-borne detection of the earthquake and tsunami. It is unfortunate that the unsubstantiated reports in the press and other media have helped to disseminate and reinforce descriptions of wildlife and animal behavior with no reliable, scientific bases. One such website report specifically referred to Yala National Park and stated that "About an hour before the tsunami hit . . . people at Yala National Park observed three elephants running away from the Patanangala beach" (http://news.nationalgeographic.com/news/2005/01/0104_050104_tsunami_animals_2.html). This beach is only 4.5 km east of the location of the radio-collared female elephant.

Even though these data are from only two animals, a "sixth sense" would be an innate characteristic that would enable other individuals to respond to the impending catastrophe in a similar manner. And our observations show that neither one of the radio-collared animals fled away from the coast as would be expected of a "sixth sense" response or even as a reaction to seismic cues. The male's short-distance movements do not suggest a response to either a "sixth sense" or even to seismic cues that would have prompted him and other herd members to move further away from the tsunami. He was also too far inland to detect immediate sight,

sound, or olfactory cues from the wave as it began to flood parts of the coastline, whereas the female and her herd members, ranging close to the coast and in an area that was affected by the tsunami, could. Thus, the movement patterns of these two animals are more consistent with behaviors prompted by immediate cues generated by the approaching wave as it impacted along the coastline.

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