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SHORT COMMUNICATION

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Observations on the year-round communal use of an artificial structure by Northern Pacific rattlesnakes *Crotalus oreganus oreganus* in coastal Central California

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Communal gatherings of snakes have been recorded in temperate regions of the Northern Hemisphere, and species documented in such congregations include several species of *Crotalus* (Fitch, 1949; Hirth, 1966; Brown & Parker, 1976; Prior & Weatherhead, 1996). These congregations are typically observed in and around communal hibernacula, usually in high altitude or high latitude environments (Hamilton & Nowak, 2009). In these locations, seasonal climatic conditions are unfavourable for year-round snake activity so that hibernation is essential for some months of the year. Suitable hibernation sites are limited and as a consequence high densities of snakes may be observed in small areas (Drda, 1968; Klauber, 1997; Gienger & Beck, 2011). Such congregations dissipate during the active season as individuals disperse into different habitats to forage and reproduce (Fitch, 1949; Gannon & Secoy, 1985; Putman et al., 2013). While congregations during the active season are known for several species of snakes, these have been of gravid females in communal breeding sites (Graves & Duvall, 1995). Evidence of year-round communal living in snakes appears to be lacking.

Here, we report observations of a small group of Northern Pacific rattlesnakes (*Crotalus oreganus oreganus*) living communally throughout the year in an artificial pit in Central California. Our observations were made on the University of California Fort Ord Natural Reserve (FONR), located in Monterey County, California. The FONR is a protected research reserve built around the former Fort Ord Army Base and it harbours remnants of artificial structures related to past military activities. These wood and concrete structures are now broken down and covered in vegetation; they provide shelter for small animals.

While conducting herpetological surveys on the FONR on 8th April 2018, we observed two adult *C. o. oreganus* basking around the edges of a degraded concrete pit (36.6856° N, 121.7755° W; WGS 84). The entrance of the pit was covered by poison oak (*Toxicodendron diversilobum*). Subsequent observations in the following weeks found several individuals using the pit communally. From May, we conducted visual encounter surveys (VES) around the pit on a daily basis between 11:00 h and 14:00 h. We considered marking individuals using a method such as painting of rattle segments (Putman et al., 2013) to document the number of rattlesnakes using the structure, but to avoid unnecessary handling we instead photographed the dorsum of all individuals encountered around the pit. By slowly approaching basking individuals from behind with a camera, we were able to photograph rattlesnakes from a safe distance. Photographs of dorsal patterns were sufficient to recognise individuals, as dorsal patterns of rattlesnakes have unique combinations of blotches varying in size and shape. We also recorded approximate snout-to-vent length (approx. SVL) for all identified individuals. In July, we installed a trail camera (Bushnell Corporation, USA) approximately four meters away from the pit entrance to observe rattlesnake behaviours in and around the pit with minimum disturbance. The camera was set to activate with the detection of movement and was retrieved after 10 days.

Throughout mid-April to late September, we identified at least eight different individuals using the pit through our VES (Fig. 1). These individuals varied in growth stage from neonate (~ 17 cm approx. SVL) to fully-grown adult (~ 85 cm approx. SVL). Both our VES and video recordings showed that rattlesnakes came out from the pit to bask from approximately 10:00 h to 13:00 h. During this time, the snakes were frequently observed basking on concrete surfaces of the pit with their bodies extended. No rattlesnakes were observed around the pit after 14:00 h. Although regular observations of this group ended by December 2018, the same snakes were observed again basking in April 2019, suggesting that this group is not an ephemeral congregation.

One possible explanation for this congregation is security of the pit. The pit had numerous cracks and holes, and we observed snakes readily retreating into these places. The poison oak brush covering the broad entrance of the pit from above may provide additional protection from aerial predators and other carnivores of the reserve. Snakes may potentially also use internal structures of the pit as a hibernaculum. Snakes often travel long distances to reach suitable hibernacula (Hirth et al., 1969; Brown & Parker, 1976; Brown et al., 1982) and can be exposed to predation during migration (Kingsbury & Coppola, 2000; Rudolph et al., 2007).

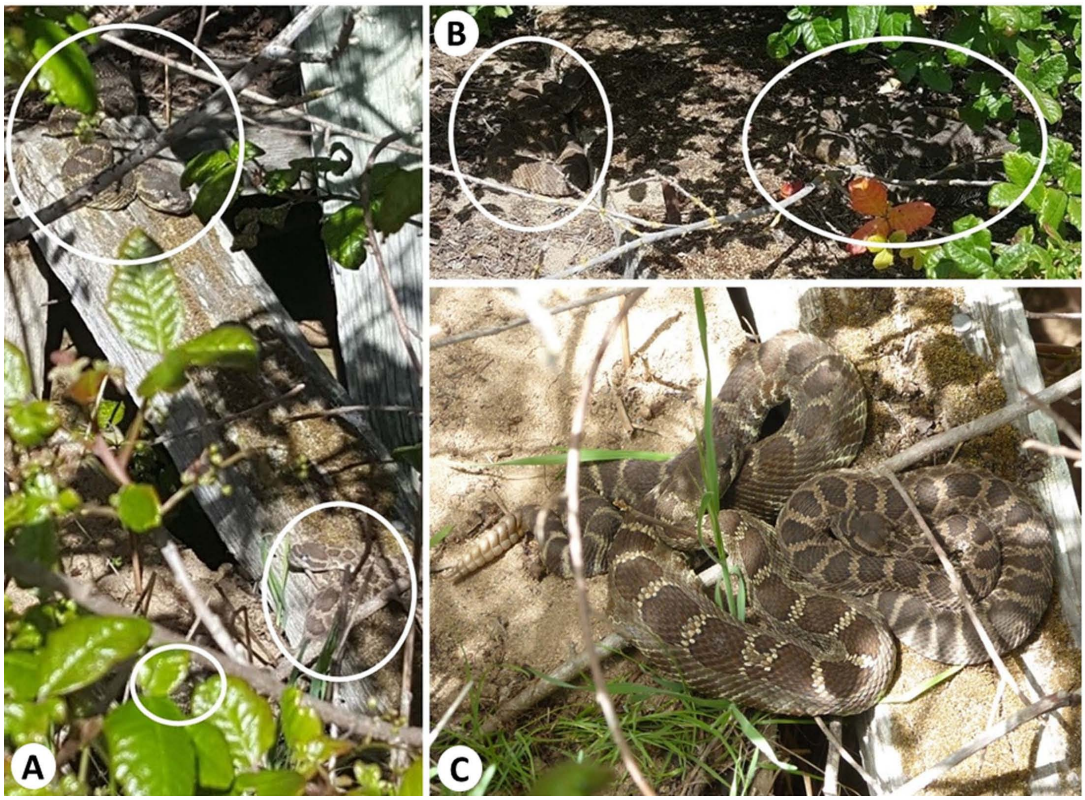

Figure 1. Communal use of man-made pit by *Crotalus oreganus oreganus* individuals of different ages – **A.** Three individuals of different ages basking together on 20th April 2018. Large adult (top), subadult (bottom left, hidden under leaves), and juvenile (bottom right), **B.** Two adults basking together on 18th June 2018, **C.** Subadult (left) and juvenile (right; same juvenile from A.) basking together on 28th April 2018.

If the pit provides both security and a suitable hibernaculum, the snakes can avoid unnecessary migration to hibernacula and risk of predation. However, we did not determine the extent of internal structuring of the pit or whether snakes actually use the pit as a hibernaculum, although this is highly likely.

Another potential explanation for the year-round congregation is the abundance of diverse food resources in the area. For example, through VES, video recordings, and separate faunal surveys of the FONR, we recorded eight species of rodents (*Chaetodipus californicus*, *Dipodomys heermanni*, *Neotoma fuscipes*, *Peromyscus californicus*, *P. maniculatus*, *P. truei*, *Reithrodontomys megalotis*, *Thomomys bottae*), one species of rabbit (*Sylvilagus bachmani*), and three species of lizards (*Elgaria multicarinata*, *Phrynosoma blainvillii*, *Sceloporus occidentalis*) in and near the pit. Regular monitoring of rodents in the shrublands directly adjacent to the pit yield approximately 20 rodents in a 0.25 ha area. Although we did not observe foraging near the pit, the diversity of prey items could benefit snakes across a range of growth stages.

Our observations indicate that *C. o. oreganus* may live communally throughout the year, given favourable conditions. Furthermore, to the best of our knowledge this report is the first to document year-long communal living in a rattlesnake species. Additional groups of *C. o. oreganus* living in similar conditions may be found with further surveys. Although our report is descriptive and limited to visual observations, detailed research using individual marking and radio telemetry may help to determine the stability of such congregations and activity dynamics throughout the day and year.

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