



Engineers and Architects: Shelter Construction by Male Visayan Warty Pigs (*Sus cebifrons negrinus*) in Negros Island, Philippines

Matthew Ward^{1,5*}, Emilio Luis Tan¹, Ysabella Montano-Ward¹, Guillermo McPherson¹, Justine Magbanua¹, John Carlo Redeña-Santos^{2,3,4}, and Anna Pauline O. de Guia⁴

¹ Talarak Foundation Inc., Negros Forest Park, South Capitol Road, Lacson Street, Bacolod City, Negros Occidental, Philippines

² D'ABOVILLE Foundation and Demo Farm Inc., Makati City, Philippines, 1200

³ Research Center for the Natural and Applied Sciences, University of Santo Tomas, España, Manila, Philippines, 1008

⁴ Animal Biology Division, Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, Laguna, Philippines, 4031

⁵ Faculty of Tropical Agrisciences, Czech University of Life Sciences, Prague, Czech Republic, 16500

*Corresponding author (Email: talarakconservationteam@gmail.com)

Citation – Ward, M., Tan, E. L., Montano-Ward, Y., McPherson, G., Magbanua, J., Redeña-Santos, J. C., & de Guia, A. P. O. (2025). Engineers and architects: Shelter construction by male Visayan warty pigs (*Sus cebifrons negrinus*) in Negros Island, Philippine. *Animal Behavior and Cognition*, 12(4), 576-582. <https://doi.org/10.26451/abc.12.04.06.2025>

Abstract – Shelter construction has been observed in many fauna but is most common in birds, mammals and insects. Whilst nest construction for birthing and rearing young has been observed in the Eurasian wild boar (*Sus scrofa*) and captive Visayan warty pigs (*Sus cebifrons negrinus*), non-nest structures are unheard of in suids until now. The Visayan warty pig is a critically endangered species that is currently restricted to two islands in the West Visayan faunal region of the Philippines. Furthermore, *in situ* ecological research on this species is severely limited, hampering conservation efforts as it is threatened with habitat loss and population decline. Here, we describe the novel discovery of a warty pig made structure with the potential function of providing thermoregulatory assistance and avoiding heavy rain. This structure appears to be constructed by male individuals in the Visayan warty pig, for assumed weather avoidance and environmental regulation, and whilst there is no conclusive proof of the species architectural ingenuity or structure use, we also highlight identical structures made and used in the same way by the sister species the Mindoro warty pig (*Sus oliveri*) from a separate corroborating observation. The Visayan warty pig was the first wild pig species to be recorded using tools, it is known for its complex social structures and high levels of intelligence, but now it has elevated its intellectual potential as the first pig species to create artificial structures for shelter.

Keywords – Warty pig, Construction, Ecology, Translocated, Research, Philippines, Architecture

Shelters are commonly constructed in nature by birds, mammals, and insects to provide relief from the elements and serve as safe areas for resting and giving birth (Deeming, 2023; Fernández-Llario, 2004; Lamprecht & Schmolz, 2004; Mayer, Martin, & Brisbin, 2002). Mammals use shelter or nest sites to adapt to their environments and provide themselves with favorable living conditions (Stewart et al., 2007). For example, ungulates choose their habitats by weighing the trade-off between foraging areas with high food availability and areas with a suitable protective cover (Schneider et al., 2013).

Nest construction in the Suidae family has been observed in the Eurasian wild boar (*Sus scrofa*) across Europe and Asia. These nests, excavated by sows, are created by making an oval-shaped depression before covering the nest with “bedding” material using the surrounding vegetation (Mayer et al., 2002). These nests are typically used for either farrowing or resting, and are commonly made in areas with dense

surrounding vegetation. This type of nest is regularly seen in Visayan warty pigs (*Sus cebifrons negrinus*) both in captivity and wild animals (Root-Bernstein et al., 2019), however the structures at the forefront of this article are not the standard nests as seen in other suids or *S. c. negrinus* for breeding, but a different structure altogether.

S. c. negrinus are endemic to the West Visayan faunal region of the Philippines and were once found across several islands (Cox, 1987). However, negative anthropogenic impacts such as poaching and persecution, and habitat destruction and land-use change, have restricted their wild populations to the islands of Negros and Panay. Apart from captive behavioral observations (Root-Bernstein et al., 2019), ecological research on this species has been poorly documented, especially in their natural habitats. Research on this species *in situ* is underway, with the Talarak Foundation researching this species in a managed nature reserve and monitoring wild populations to fill knowledge gaps in behavior, ecology and distribution.

Methods

Ethics Statement

The observations and activities detailed below followed the agreed upon activities from a Memorandum of Agreement with the land owner, the Bayawan City Local Government Unit, as part of the management of the reserve and on-site animals. The Department of Environment and Natural Resources were present and approved the release of the Visayan warty pigs onto the site, with no further permits required to conduct the observations and studies described. Observations and anecdotes about the Mindoro warty pig (*S. oliveri*) described in the below discussion session were conducted by a student of the University of Santo Tomas and University of the Philippines Los Banos, with ethical reviews approved by supervisors for the collection of data.

Study Site

In 2019, the Talarak Foundation Inc. partnered with the Bayawan City Local Government Unit to create a reintroduction site for five threatened endemic species to Negros Island, Philippines, namely; the Visayan spotted deer (*Rusa alfredi*), Visayan hornbill (*Penelopides panini*), Negros bleeding heart dove (*Gallicolumba keayi*), Blue naped parrot (*Tanygnathus lucionensis*), and the *S. c. negrinus*. The reintroduction site, named the Bayawan Nature Reserve, covers a 300 ha fenced area (Figure 1) and is considered as a secondary growth heterogeneous lowland forest (Ward, Montano-Ward, Magbanua, & Hart, 2021). This forested area was harvested of natural trees (and wildlife) between 1970-1990 and used intermittently as a timber plantation, coconut nursery, and eco-park, before being left for many years to naturally regrow. The Bayawan City Local Government donated the site to Talarak Foundation for use in conservation of native flora and fauna. This site is operated in collaboration with the Talarak Foundation and local government of Bayawan City under a memorandum of agreement, and the activities being conducted are supported by the necessary permits between the Talarak Foundation and Department of Environment and Natural Resources.

Study Animals

A cohort of ten male *S. c. negrinus* were released into the reserve in July 2020, with a cohort of eight females released into the area in January 2021, and two male *S.c. negrinus* maintained in captive enclosures at the site for research and tourism purposes. As part of the release, some of these individuals were fitted with telemetry collars for individual movement monitoring. 20-30 remote camera traps were placed within the site to record their behavior, individual health, and impact on the environment.

Pig Den

During monitoring surveys and tracking of released animals in September 2020, the research team found what appeared to be a constructed pig den; a dome-shaped structure composed of tall grass. We measured the internal (floor and walls) and external (entrance and top) surface temperature using an infrared thermometer. We also tested the water permeability of the walls and roof by pouring water atop. The dimensions, such as total area, height, and width of the internal cavity, were measured using a measuring tape. In September 2021, this pig den was revisited and all previously mentioned measurements were retaken to determine whether the site had degraded or changed. Interestingly, we were able to observe a second construction with a similar layout approximately 20 m away from the first shelter. Surveys were infrequent as the purpose of these field visits was for placement of camera traps (on a rotational program across the 300 ha site), with some field assessments being conducted annually for habitat assessments and occasional surveying for signs of the released animals.

Results

Figure 1

Map of the Discovered Den Locations in the Bayawan Nature Reserve, Philippines

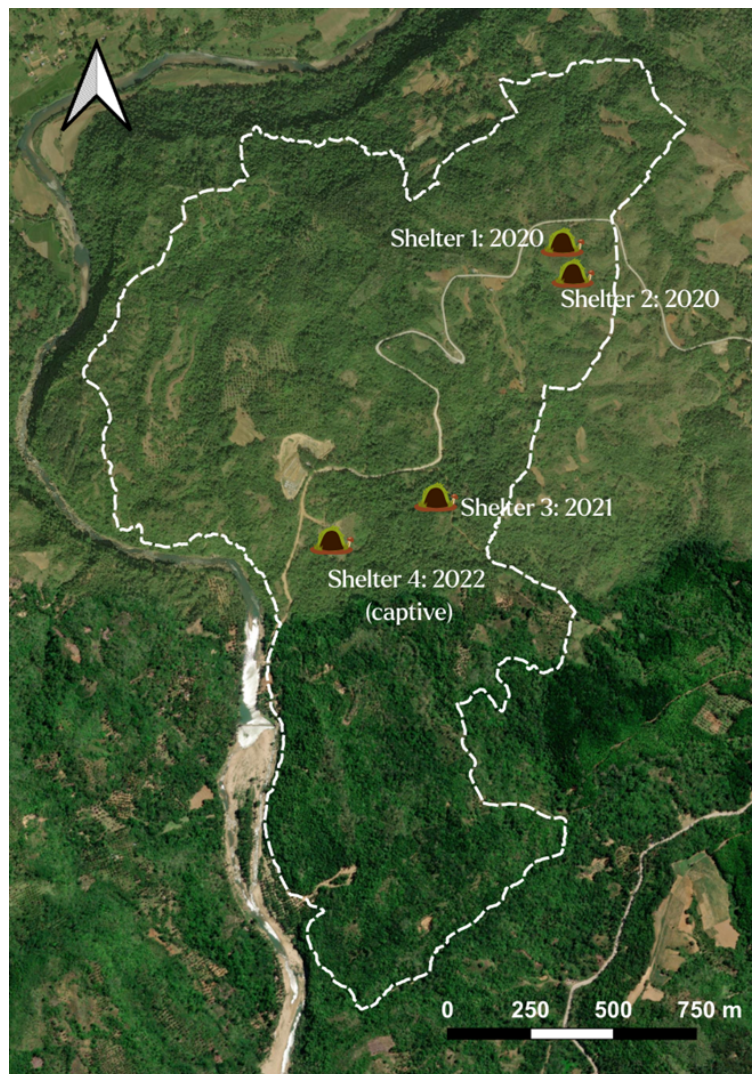
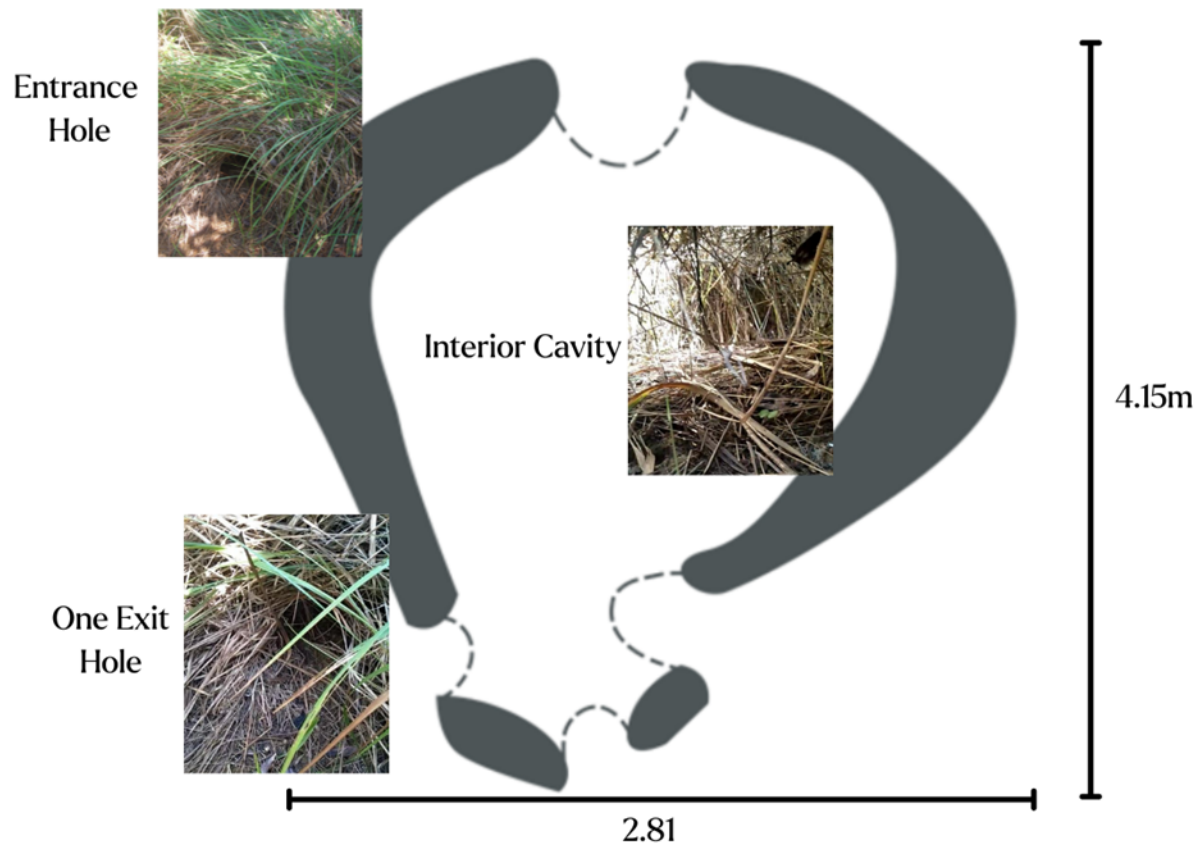


Figure 2*Measurements of Pig Den #1 from First Discovery (September 2020)*

Note. L: 4.15 m, 2: 2.81m and photos of the entrance hole, exit hole, and internal chamber. The structure's total area was 6.316 m². There were a total of four entrances within this shelter site. The average height and width of the entrances were 30.48 and 33.02 cm, respectively, which can fit an average-sized (height: 57 cm, width: 23 cm) adult male Visayan Warty Pig.

Evidence of Use by *S. cebifrons nigrinus*

In total, four similarly shaped shelters were found in grassland/shrubland habitats within the reserve (Figure 1), with dimensions and a shape that share a common design (Figure 2), varying only in the substrates used to create the structure. Only the first two shelters were measured thoroughly and tested for temperature and water permeability (Den #1 and Den #2), however the subsequent two shelters appeared to be almost identical in construction. Although the construction or use of the site by *S. c. nigrinus* was not captured by remote cameras, fresh pig tracks present at the entrance and within the shelter site suggest recent use. Furthermore, trails circling the dome-shaped shelter indicate that the construction was not being used as a pathway but rather for its structural properties. In 2022, our team of researchers were able to observe the same construction within an on-site captive warty pig enclosure. This solitary male was observed by researchers to use the construction as a shelter during midday and late evening. We were unable to obtain temperature data due to the male pig defending and chasing researchers when approaching the "den."

Temperature and Waterproofing

In September 2020, the researchers recorded the internal temperature of the shelter at $27 \pm 2^\circ\text{C}$, with the external temperature ranging from $32\text{--}44^\circ\text{C}$ around the shelter, indicating that the internal cavity provided cooler and more stable temperatures during this time. Additionally, a test of the structural integrity and waterproofing of the walls and roof (conducted by having one researcher lay inside the shelter whilst another poured water atop) indicated that there was a level of waterproofing within the walls and roof of the structure. This suggests that *S. c. negrinus* males could have constructed this site as a resting site away from the harshness of the elements. However, one year later (September 2021), we revisited the site after a long period of heavy rain and observed that the shelter site had degraded, and no such temperature variation was evident. This indicates that these structures degrade and are constructed annually. We also checked the temperatures for the second shelter and found that no temperature changes were evident due to the seasonal drop in temperature, however the internal area was significantly drier than the outside after a recent rain.

Structure Design and Construction

Each of the four individual structures found until present showed almost identical design features and construction. Each one had three to four entrance / exit holes spaced at the terminal ends of the structure, made from loose grass or vegetation, approximately 33 cm in diameter. The internal chamber measures approximately 1.5 – 2 m in diameter and a dome of 1 m at the center. The external walls were between 3.4 – 4.1 m long and reinforced with a thick layer of vegetation measuring around 30 cm. The material composing each shelter varied slightly, with tall grasses predominant in the structure: nearby shrubs and understory vegetation were also used where possible. In one instance a short (2.5 m) woody shrub was used as the base of one wall and roof as other vegetation was folded into and around this shrub. Construction materials were those available at the site, manipulated into shape and layered by the pigs, rather than being brought as pieces to assemble on site.

Discussion

Environmental Impacts of Warty Pigs

Warty pigs and other wild suids are known to be ecosystem engineers, changing the composition of forests and habitats they inhabit through seed dispersing, rooting, foraging, wallow creation, and other ecological interactions with the environment. These interactions not only benefit the pigs but provide much needed assistance for other species and the environment. Pigs provide ecosystem services such as burying seeds, cycling nutrients between soil layers, and providing access to buried food stuffs through their rooting behavior. Dispersing seeds in their dung helps increase food availability for other species and increasing distance from mother trees for seeds that germinate. Additionally, wallows that warty pigs create serve as important temporary pools or exposed mud or dust for many animals (Sandom et al., 2013). The creation of enclosed structures with internal cavities and wallows provides other species further protection from the elements, while the manipulation of the vegetation allows light and water to penetrate into new areas, promoting plant growth.

Other Species Dens

We suspect that these Visayan warty pig individuals have created multiple shelters within the reserve to protect themselves from the intense heat and heavy rain in this open habitat, emphasising their high level of intelligence (Root-Bernstein et al., 2019). Observations of the Mindoro warty pig (*Sus oliveri*) have found that they also create and use identical shelters further support our findings. In 2022, *S. oliveri* shelters were documented during surveys of the species in the Mt. Calavite Wildlife Sanctuary of northeast Mindoro Island. Although no camera footage of the creation or use of these shelters is available,

independent accounts of indigenous peoples within the area confirmed that these structures were created by male individuals of the *S. oliveri* species for sheltering away from disturbance and weather. The indigenous communities stated that “the male pigs create these structures (known locally as Remon) to avoid heavy rain during storm events”. Through personal observations these communities indicated that they are “aware of the structures occupancy when they see steam rising from the structure”, as warm pigs release water vapor into the cooler environment around them, further corroborating the thermoregulatory properties of these structures (pers. comm. Redeña-Santos). This anecdotal information corroborates the assumed methods and reasons for the shelter construction, with the designs of these structures also supporting this claim through near identical shape and design.

Warty Pig Intelligence

The *S. c. negrinus* is already known for its high levels of intelligence, social learning and complex social structure, and documented as the first wild pig species to use tools (Root-Bernstein et al., 2019). This evidence takes the intellectual potential of the species to new heights and redefines how we view the species (and its sister species) as the first observed suids to create artificial structures for shelter purposes. The final step is to verify through video documentation, likely camera traps or opportunistic finds, the construction and use of these shelters, and to continue investigating the thermoregulatory and waterproof limits of the discovered shelters wherever we can find them.

Acknowledgements

We would like to thank the Bayawan City Government for supporting Talarak in the creation and operation of the Bayawan Nature Reserve, creating a new haven for the endangered and endemic wildlife of Negros. We are thankful for the continued assistance and support shown by the Department of Environment and Natural Resources office that permit us to perform the necessary movements and research to help conserve our target species. Finally, we need to show our sincere appreciation for the acceptance shown by the people of Bayawan, especially those around the barangays of Nangka and Kolumboyan, who have displayed a strong willingness and desire to help us conserve the natural wildlife in their area but also establish new populations of our captive translocated individuals.

Author Contributions: **Matthew Ward** – Investigation, Writing (original, review, & edit), Supervision, Validation, Funding Acquisition, Resources; **Emilio Luis Tan** – Conceptualization, Investigation, Writing (original), Visualization; **Ysabella Montano-Ward** – Data Curation, Methodology, Visualization; **Guillermo McPherson** – Investigation, Data Curation; **Justine Magbanua** – Investigation, Data Curation, Project Administration; **John Carlo Redeña-Santos** – Investigation, Validation, Resources; **Anna Pauline O. de Guia** – Supervision, Validation.

Funding: We also need to give thanks to the many financial and technical partners we have had to enable the operations and research potential of the Bayawan Nature Reserve and our captive breeding efforts with the Visayan warty pigs, including; Disney Conservation Fund, Ocean Park Conservation Fund Hong Kong, Mandai Nature, Synchronicity Earth, Brevard Zoo, Toledo Zoo, Chester Zoo, Bristol Zoo Gardens, ZGAP (Zoologische Gesellschaft für Arten und Populationsschutz), Jacksonville Zoo, Zoo Wroclaw, Plzen Zoo, Liberec Zoo, North Carolina Zoo, the Wild Pig Specialist Group, the Conservation Translocation Specialist Group, and many more. Additionally, we need to thank the DOST-PCAARRD for its financial support of the MATAPAT Project, and the Mt. Calavite Wildlife Sanctuary Protected Area Management Office for granting permission to conduct surveys in their wildlife reserve.

Conflict of Interest: We declare that there are no conflicts of interest between all parties involved in this work.

References

- Cox, R. (1987). The Philippine spotted deer and the Visayan warty pig. *Oryx*, 21(1), 37–42. <https://doi.org/10.1017/S0030605300020469>
- Deeming, DC. (2023). Nest construction in mammals: a review of the patterns of construction and functional roles. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 378, 20220138. doi: [10.1098/rstb.2022.0138](https://doi.org/10.1098/rstb.2022.0138)
- Fernández-Llario, P. (2004). Environmental correlates of nest site selection by wild boar *Sus scrofa*. *Acta Theriologica*, 49(3), 383–392. <https://doi.org/10.1007/BF03192536>
- Lamprecht, I., & Schmolz, E. (2004). Thermal investigations of some bird nests. *Thermochimica Acta*, 415(1–2), 141–148. <https://doi.org/10.1016/j.tca.2003.08.029>
- Mayer, J. J., Martin, F. D., & Brisbin, I. L. (2002). Characteristics of wild pig farrowing nests and beds in the upper coastal plain of South Carolina. *Applied Animal Behavior Science*, 78(1), 1–17. [https://doi.org/10.1016/S0168-1591\(02\)00114-4](https://doi.org/10.1016/S0168-1591(02)00114-4)
- Root-Bernstein, M., Narayan, T., Cornier, L., & Bourgeois, A. (2019). Context-specific tool use by *Sus cebifrons*. *Mammalian Biology*, 98, 102–110. <https://doi.org/10.1016/j.mambio.2019.08.003>
- Sandom, C., Hughes, J. & Macdonald, D. (2013). Rewilding the Scottish Highlands: Do wild boar, *Sus scrofa*, use a sustainable foraging strategy to be effective ecosystem engineers? *Restoration Ecology*, 21(3), 336–343. <https://doi.org/10.1111/j.1526-100X.2012.00903.x>
- Schneider, T. C., Kowalczyk, R., & Köhler, M. (2013). Resting site selection by large herbivores - The case of European bison (*Bison bonasus*) in Białowieża Primeval Forest. *Mammalian Biology*, 78(6), 438–445. <https://doi.org/10.1016/j.mambio.2013.06.002>
- Stewart, F. A., Pruett, J. D., & Hansell, M. H. (2007). Do chimpanzees build comfortable nests? *American Journal of Primatology*, 69(2007), 930–939. <https://doi.org/10.1002/ajp.20432>
- Ward, M., Montano-Ward, Y., Magbanua, J., & Hart, C. (2021). Individual identification through lateral spot patterns in the Visayan spotted deer, *Rusa alfredi*. *DSG Newsletter*, 32, 3–14. doi: [10.1007/978-3-031-17756-9_13](https://doi.org/10.1007/978-3-031-17756-9_13)