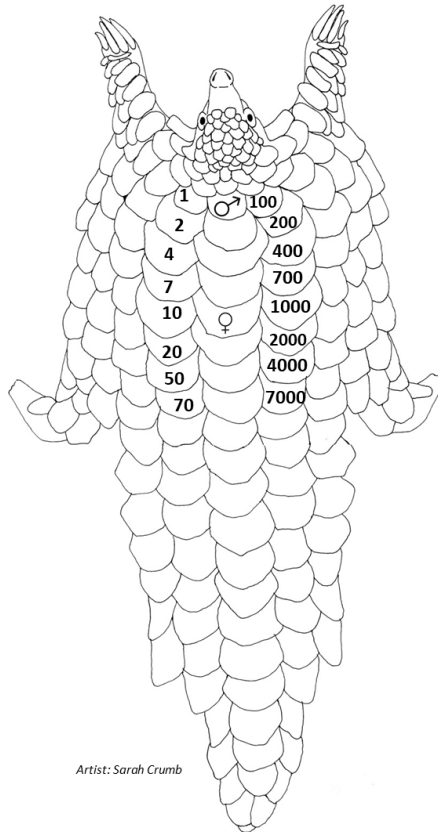


## Appendix A: Pangolin Universal Notching System SOP

Tools needed:

- Drill
- Drill bits of varying sizes
- File, leather punch, ear punch, or other alternative marking tools if drill is unavailable
- Cleaning and disinfecting materials
- 10cm x 10 cm (2in x 2in) thin board for place under scale while drilling - this will vary by pangolin size but board should be large enough to protect soft tissue area under scale
- Marker or wax pencil
- Small rag or towel for protecting the pangolin's eyes

Scale code



Pangolin universal notching system applied to a Temminck's pangolin (*Smutsia temminckii*), also known as the ground pangolin, as viewed in anatomical position: Dorsally on its stomach with anterior end at top of image. The first scale immediately left of the midline scale row at the pectoral girdle (shoulder) and the first scale immediately right of the midline scale row at the pectoral girdle are always 1 and 100, respectively. The first midline row scale is male and the second midline row scale is female. Eight scales on each side of the medial scale row are used to allow for scale number variability between species, and identified scales are limited between the pectoral and pelvic girdles to prevent confusion from drill marks made during transmitter placement. Drill marks should be placed centrally in the scale and drill bit diameter should be no greater than  $\frac{1}{3}$  the total width of the most narrow part of the scale to prevent damage to the scale margins. In the event that an alternate marking tool needs to be used, care should be given to try to limit impacts to scale margins when possible. Regardless of tools used, no pangolin should be marked prior to weaning.

Drill preparation:

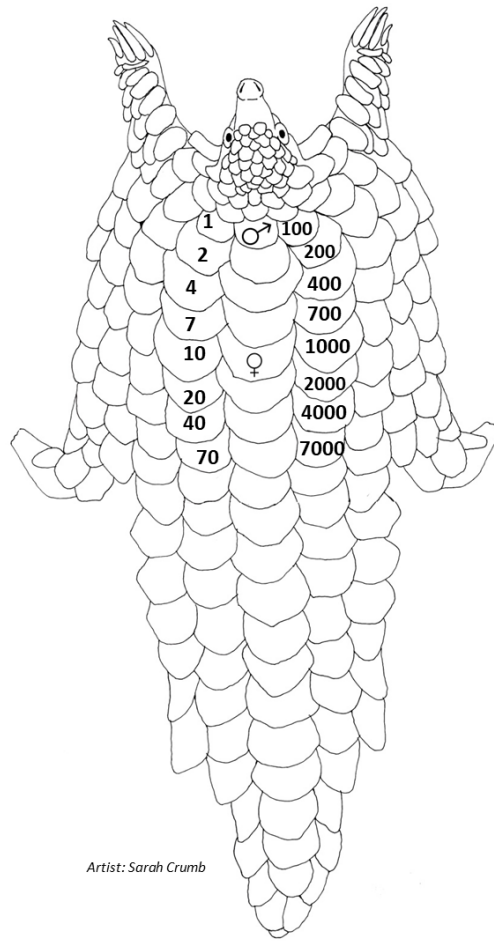
- Ensure drill is in good operational condition and battery is appropriately charged.
- Choose appropriately sized drill bits and attach to the drill. \*Note: Drill bit should be no greater in diameter than one-third the total size of the narrowest width of the scale chosen for marking.
- Wipe drill bit clean with alcohol wipe before use if possible.

Cleaning and scale prep:

- *For general field cleaning:* Remove any debris present and rinse scale with water.
- *For basic disinfection:* Remove debris, rinse scale, and wipe with alcohol or disinfectant wipes.
- *For full surgical-level disinfection:* Remove debris and rinse scale with water. Alternate cleaning top, bottom, and margins of scale with 7.5% betadine scrub (or alternative) and alcohol a minimum of three times each. \*
- Once the scale is clean, place a small board or other barrier underneath to prevent damaging tissues below with the drill.  
\*As the marking is made through the inert part of the scale, there is no infection risk and this level of disinfection is technically not needed, therefore, this should be reserved for marking occurring in hospital, as part of hospital best practice because it will increase handling time needed.

## Marking scales:

- Don appropriate personal protective gear, gloves and safety glasses are recommended.
- After palpating and locating the scapula, identify scales to be marked based on PUNS code, marking the drill location with a pencil or felt marker.
- Clean scales to be marked.
- Ensure the board or barrier device is in place between the scale and soft tissue.
- Cover the pangolin's eyes with a small towel to reduce stress without blocking the nares or the ability for it to breathe.
- If the pangolin rolls into a ball, allow it to stay curled.
- Place the drill as close to the center of the identified scale as possible.
- Drill through scale gently ensuring that tissue underneath and scale attachment area is not compromised.
- Wipe scale clean with water or alcohol wipe to remove any debris.
- Repeat for each letter in the code. See example #7238.
- 3-D printing scans of practice scales are available at [www.thingiverse.com](http://www.thingiverse.com) (see Appendix D for individual model access links) to make scales for practicing.



Notching example: Male Individual #7238 marked with the Pangolin Universal Notching System (PUNS).: To identify number 7238, the 7000, 200, 20, 10, 7, and 1 scales as well as the first scale in the midline indicating male are marked.

Welfare and safety considerations:

- Ensure every individual is healthy enough for handling prior to marking scales.
- Conduct a thorough inspection of the pangolin for any signs of injury, prior notching, or existing damage to needed scales.
- Always provide a barrier of some sort between the scale and body to prevent injury from the drill bit. Suggested material: Wood or steel (paint scraper), Avoid: Cardboard and plastic.
- When handling and marking pangolins, use appropriate techniques to minimize stress whenever possible and only fully trained and experienced personnel should complete marking.
- While handling, cover the pangolin's eyes to minimize stress.

- If the pangolin rolls into a defensive position, allow them to stay curled.
- Minimize handling time- assign codes (program leaders only) for potential use ahead of capture and bring reference diagrams as needed.\*
- Utilize appropriate personal protective gear as available: gloves and safety glasses are recommended.

\*Line diagrams of representative species are available (Appendix F) to be used for training and can be printed in advance, marked with selected codes, and shared with field teams prior to departure.

For more information, please view our full manuscript here:  
<https://ecoevorxiv.org/repository/view/6274/>