

Landmarks for Morphometrics

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Morphometric measurements

We take the following measurements on each frog specimen to analyze functional shape variation with regard to lifestyle or ecomorphology

Table 1: Morphometric measurements and their landmarks

Measurement	Landmarks
SVL	Tip of snout to vent
femur	Length of femur, from outer edges of knee to vent
tibiofibula	Length of tibiofibula, from outer edges of knee to ankle

Measurement	Landmarks
tarsus	Length of tarsus measured from flexed foot, mid heel to outer ankle
foot	Maximum length of extended foot, outer edge of heel to tip of longest digit
headW	Width of head at posterior edge of tympanum (external eardrum)
headL	Length of head from posterior edge of tympanum to nostril
humerus	Length of humerus from articulation with scapula to outer elbow
radioulna	Length of radioulna from flexed palm (mid-palm) to outer elbow
hand	Length of flexed hand, from outer edge of mid-palm to tip of longest digit

General advice

- These are very small frogs, begin by **learning the anatomical landmarks** so you know where to place the calipers.
- Learn the landmarks by **making sure you can repeat known measurements** on a frog.
- Generally bones are measured end-to-end on the outer edges.
- Frogs are also squishy and not generally bony. Start with the calipers a little too wide, then bring them in until they *just touch* the frog at the landmarks.
- Start with clean calipers that slide easily, clean them gently with 70% EtOH if needed.
- Keep the frog specimen moist with 70% EtOH at all times. *Do not let specimens dry out.*

SVL

SVL is measured by gently pressing the specimen on a flat surface to achieve maximum body length. Please be gentle and don't press any more than necessary. Start with the caliper open, place one edge along the backside, and slowly bring the front edge to a close. Stop when it just touches the specimen.

Femur

Femur length captures the end of the bone. Note that at the knee, the femur articulates with the tibiofibula, so please measure the femur. On the other end, it is hard to identify where

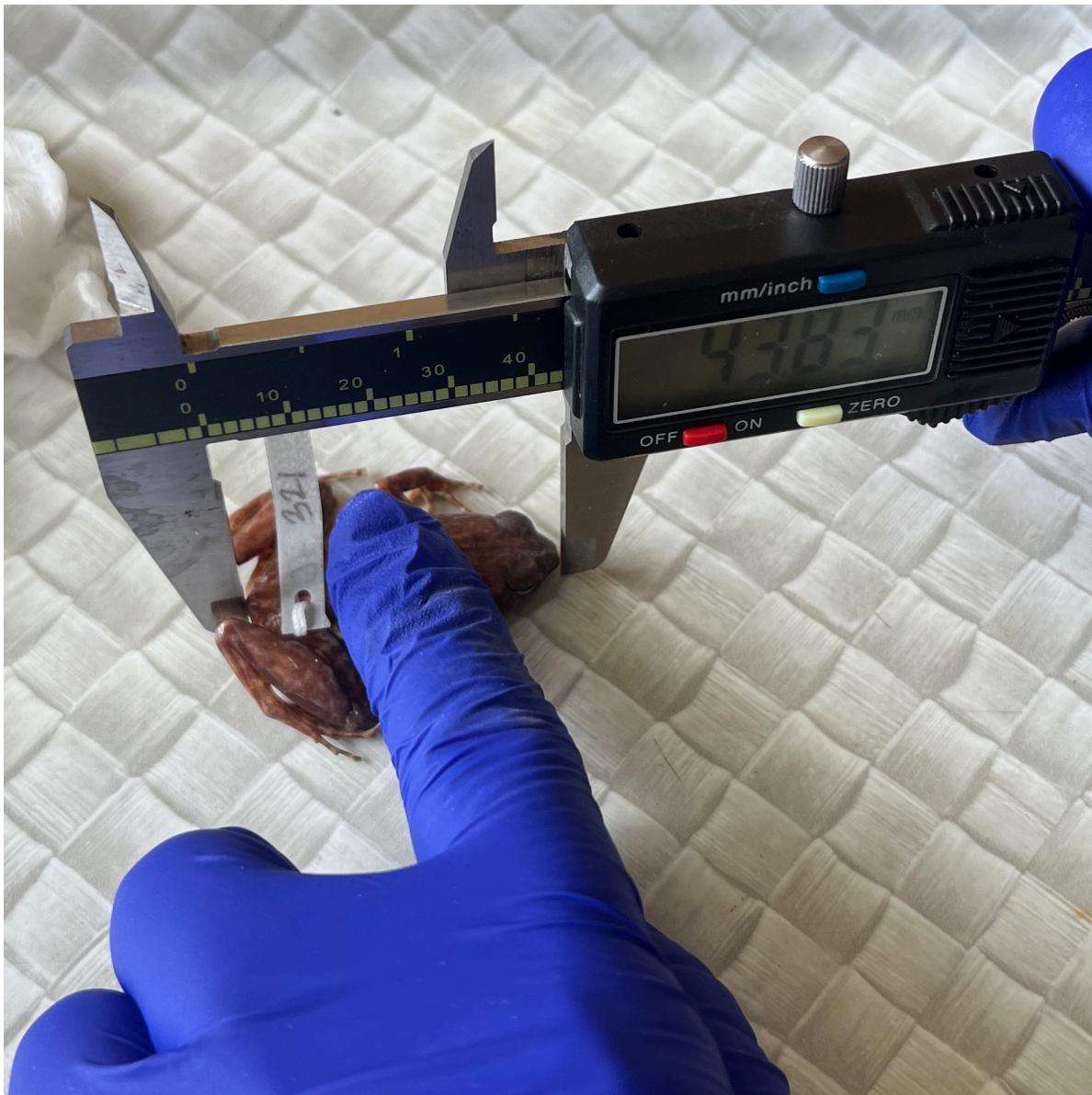


Figure 1: Measurement of SVL



Figure 2: Femur

the femur articulates at the pelvis, so we use the vent as a landmark for the midline. Return to Table 1.

Tibiofibula

The tibia and fibula on a frog is fused into one bone, called the tibiofibula. It is repeatable to measure, so long as you identify the heads of the ends of the tibiofibula. Pay attention to measuring the head of the tibiofibula at both the knee and the ankle (and not the head of the femur or the tarsus). Return to Table 1.

Tarsus

Measure the tarsus from the flexed foot to the outer edge at the ankle. Note that some frogs have prominent plantar tubercles (protrusions on their feet). Measure from the middle of the flexed foot (not the top of the tubercle) to the end of the tarsus at the ankle (outer edge). Return to Table 1.

Foot

The foot includes the entire plantar surface to the end of the longest digit. It is only challenging because the toes are delicate, but letting it rest on your finger helps. If it is curled, do your best to straighten it out before measuring. Return to Table 1.

Head Landmarks

Be sure that you can identify the tympanum (the external eardrum) on the side of the head behind the eye. The nares are the nostrils of the nose.

Head Width

Head width is measured in line with the posterior (tail end) of the tympanum. Return to Table 1.

Head Length

Head length is measured from the posterior end of the tympanum to the nares (nostril). Return to Table 1.

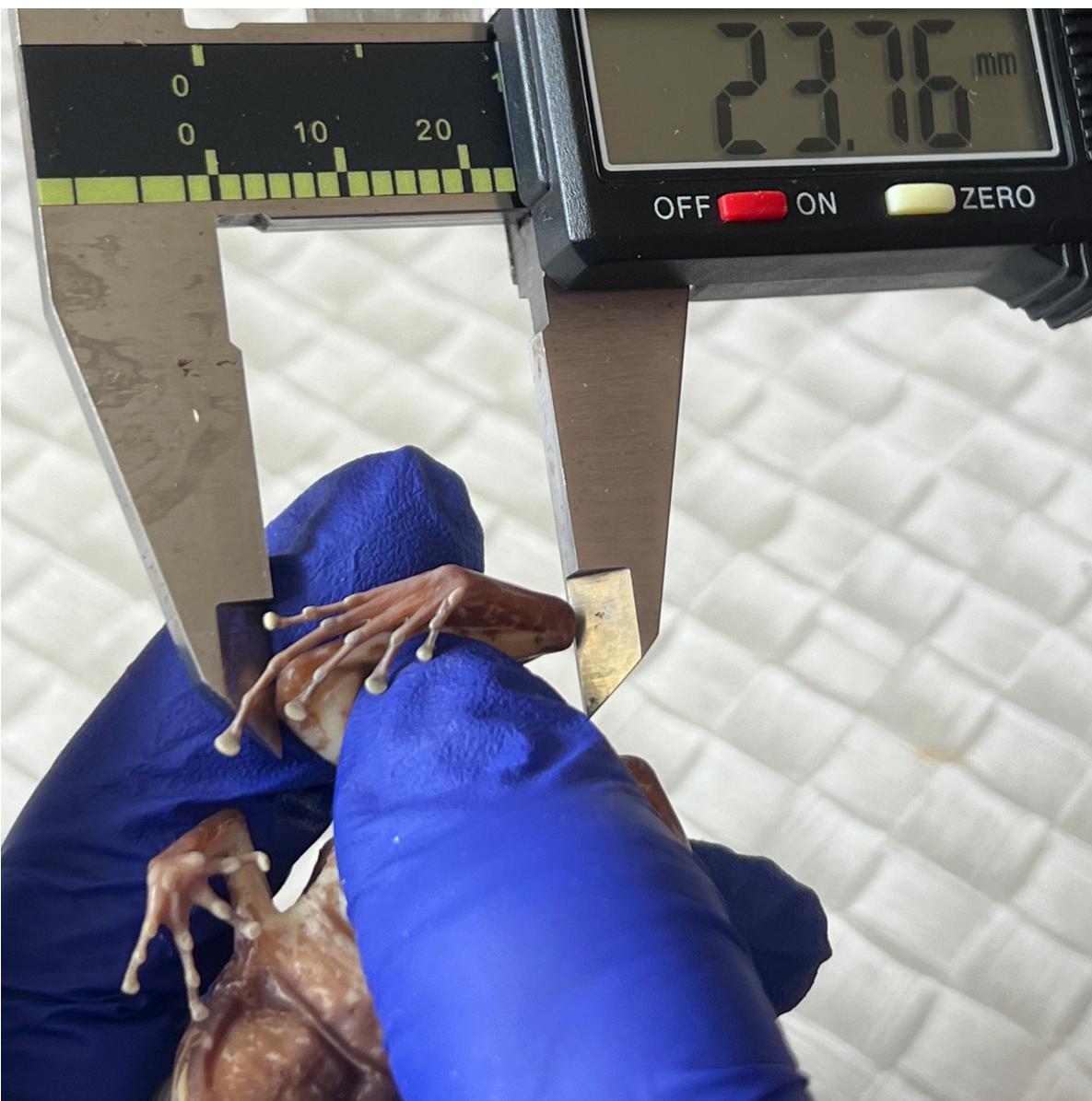


Figure 3: Tibiofibula



Figure 4: Tarsus

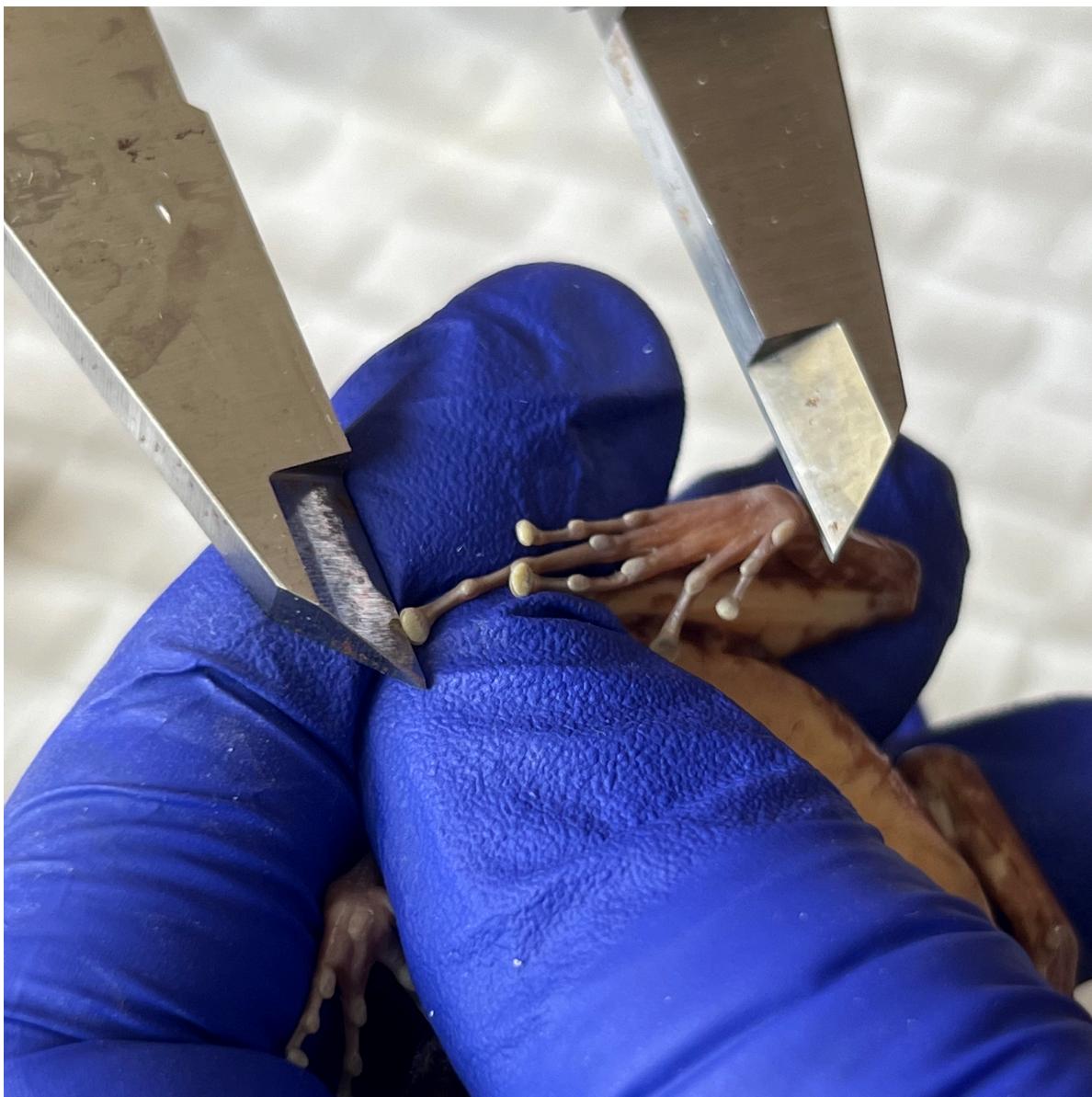


Figure 5: Foot



Figure 6: Landmarks on the head



Figure 7: Head width



Figure 8: Head length

Humerus

The humerus is the most difficult measurement because it takes some practice to indentify where the humerus articulates with the scalpula in the chest. It takes a little practice, but gently pressing the calipers into the chest will reveal arm movement when you hit the humerus. It is from the articulation with the scalpula to the end of the elbow. Return to [Table 1](#).

Radioulna

The radioulna is easy to identify, but sometimes frogs are preserved with their hands turned in or at an angle such that part of the palm (or a tubercle) may seem like an extension of the radioulna if you are not paying attention. Be sure to measure from the middle of the flexed palm to the elbow (outer edges). Return to [Table 1](#).

Hand

The length of the hand from the base of the palm to the tip of the longest finger. Fingers, like toes, are very delicate and sometimes curl during preservation. They should be straightened before measuring, do your best. Return to [Table 1](#).



Figure 9: Humerus



Figure 10: Radioulna



Figure 11: Hand