

# A new viewpoint on antlers reveals the evolutionary history of deer (Cervidae, Mammalia)

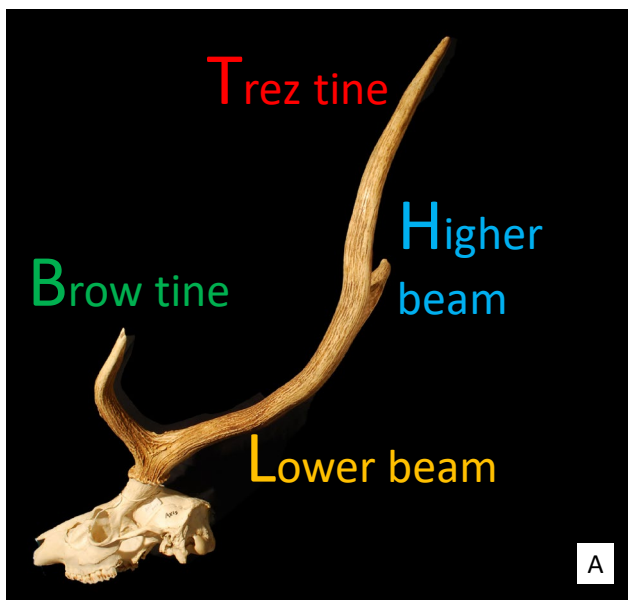
Yuusuke Samejima & Hiroshige Matsuoka

## Supplementary Information 3

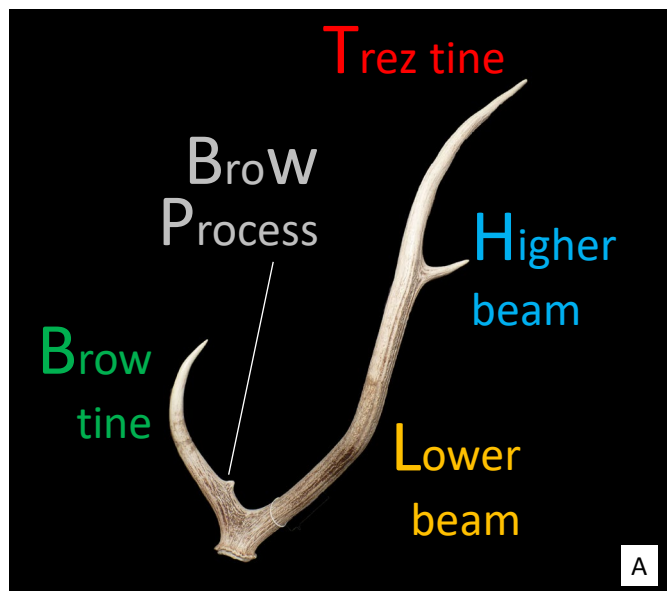
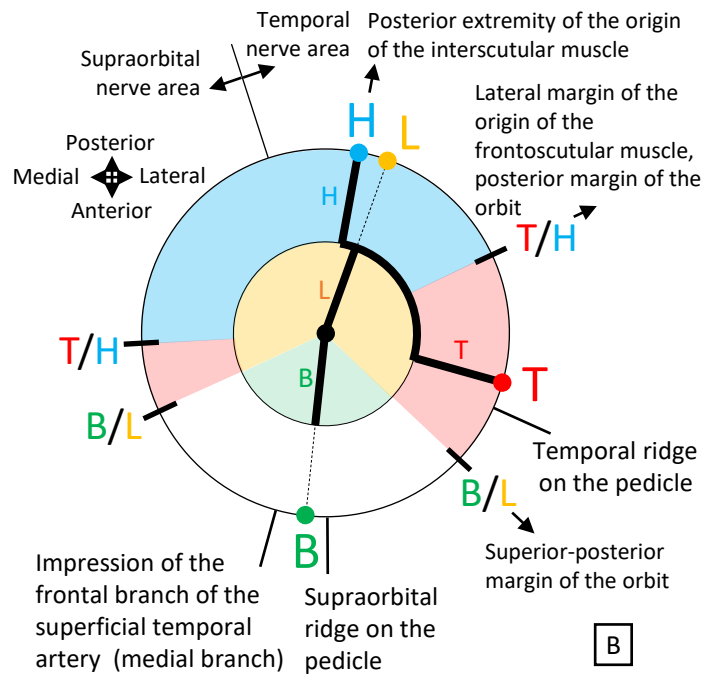
### Various types of antlers observed in this study

#### Note about the diagrams

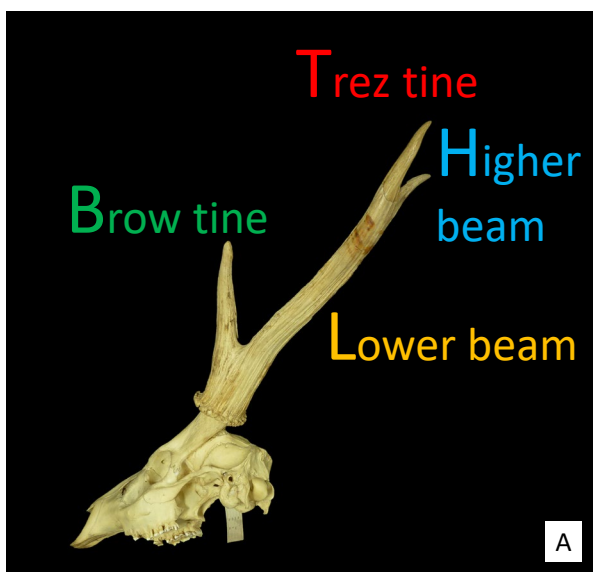
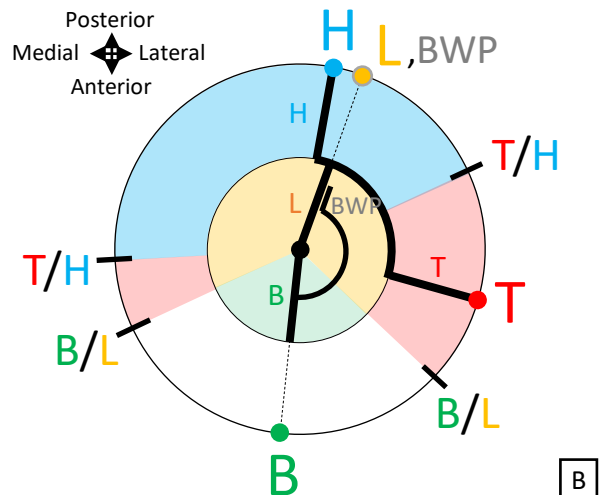
- The large circle represents the burr cross section.
- The dots are the branching direction of the tines.
- The short lines orthogonal to the circle are the positions of the forks.
- The painted areas are the zones of the tines.
- Inside the circle, the branching hierarchical order among the tines is represented.
- The central dot is the base of antler.
- Outside the circle, the positional relation with the skull is represented; thin lines are the ridges on the pedicle and the thin arrows are the position extended along the nerve impressions.
- Hatching in the circle means palmation.



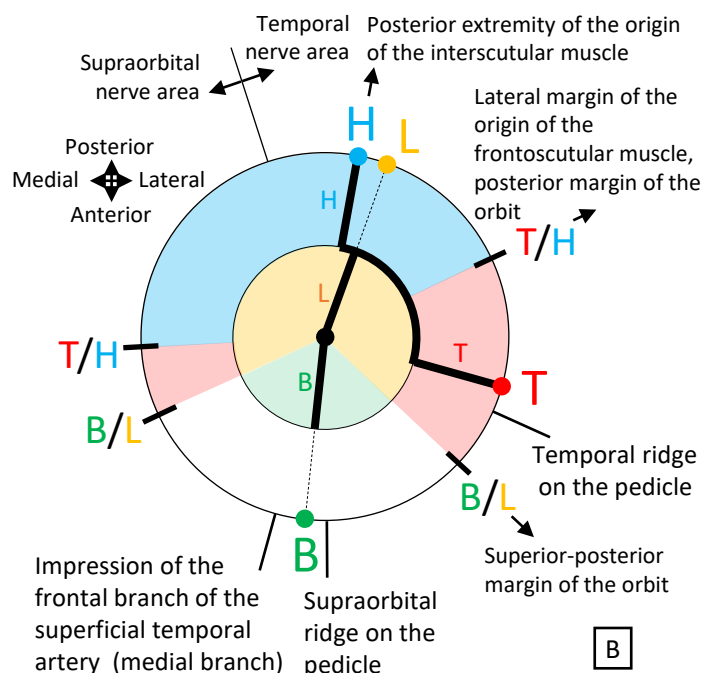
**Figure 1.** *Axis axis* (KUGM-RM014) A) Left antler, lateral view. B) Diagram of left antler.

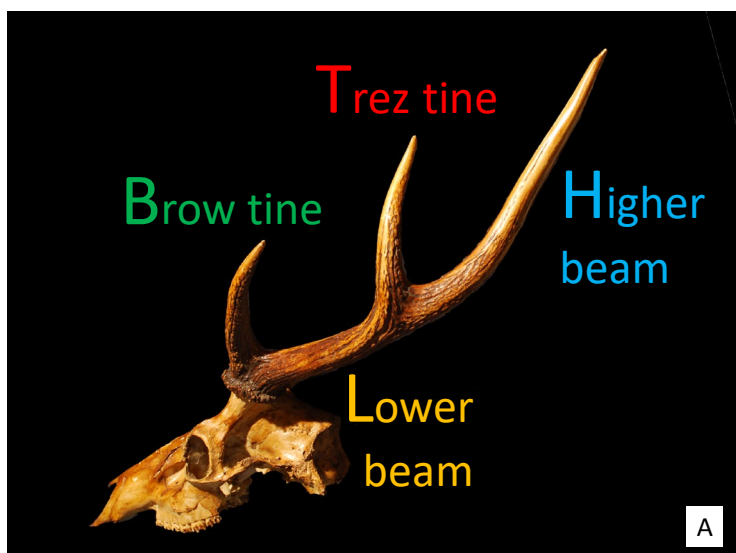


**Figure 2.** *Axis axis* (KUGM-RM046) A) Left antler, lateral view. B) Diagram of the left antler.

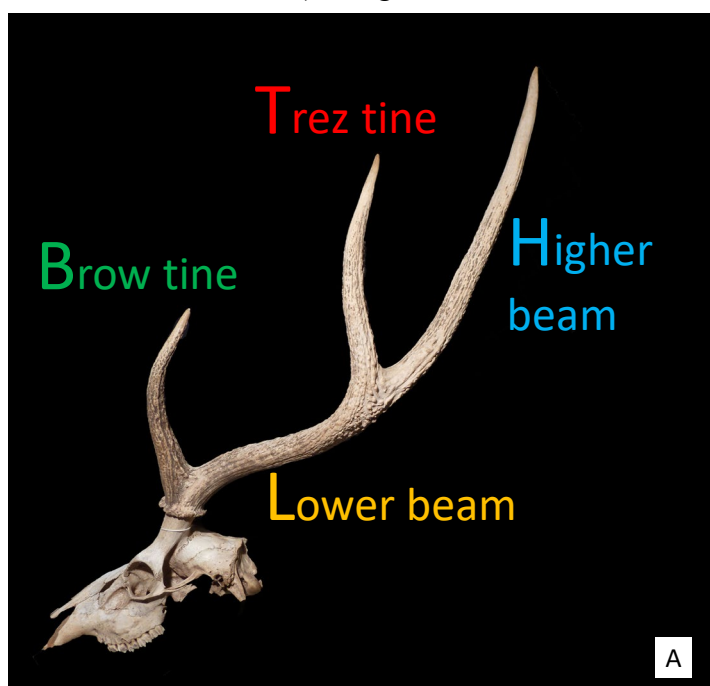
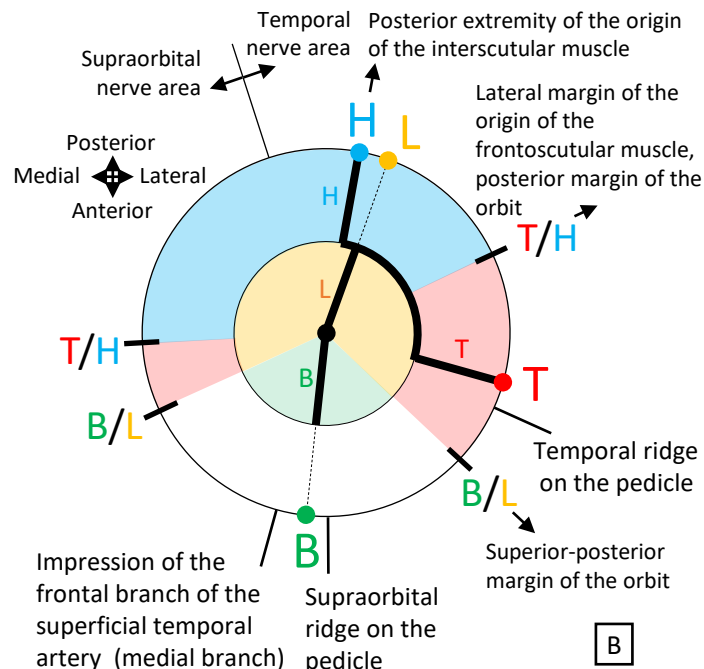


**Figure 3.** *Axis porcinus* (NSMT-M19849) A) Left antler, lateral view. B) Diagram of the left antler.

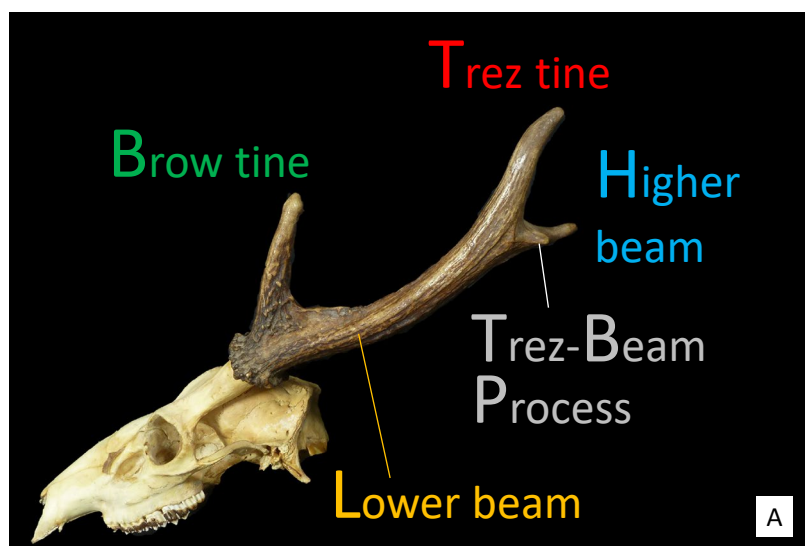
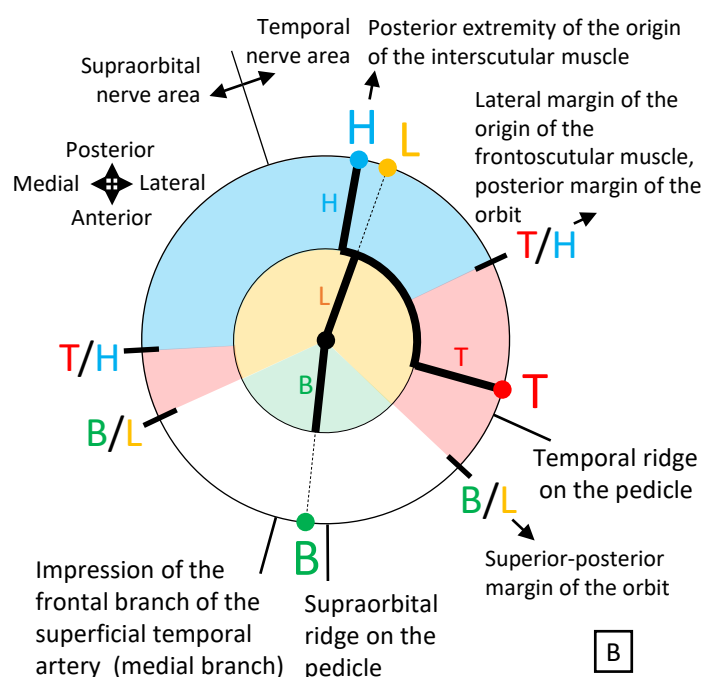




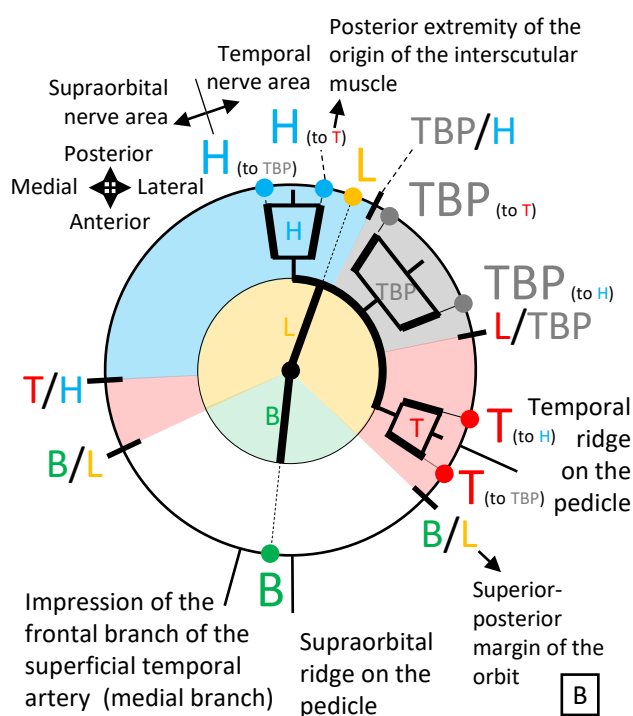
**Figure 4.** *Rusa timorensis* (KUGM-RM021) A) Left antler, lateral view. B) Diagram of the left antler.

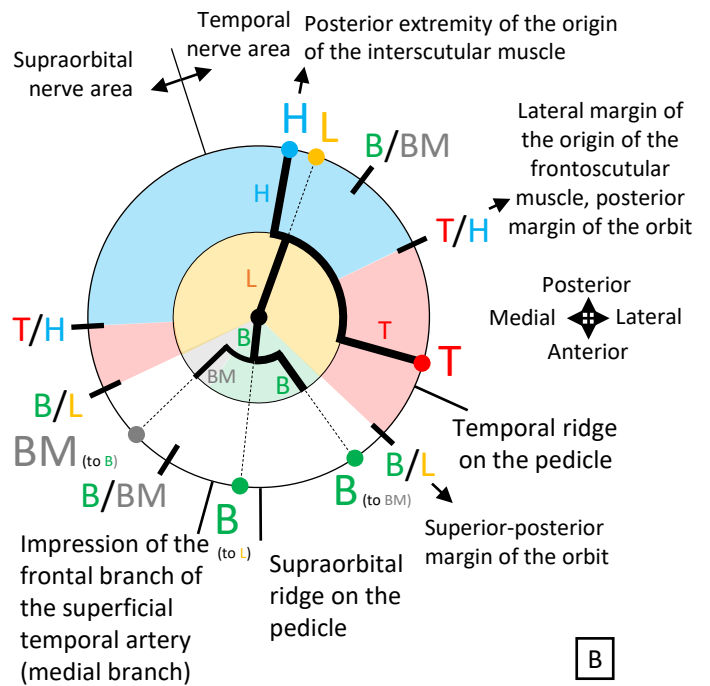
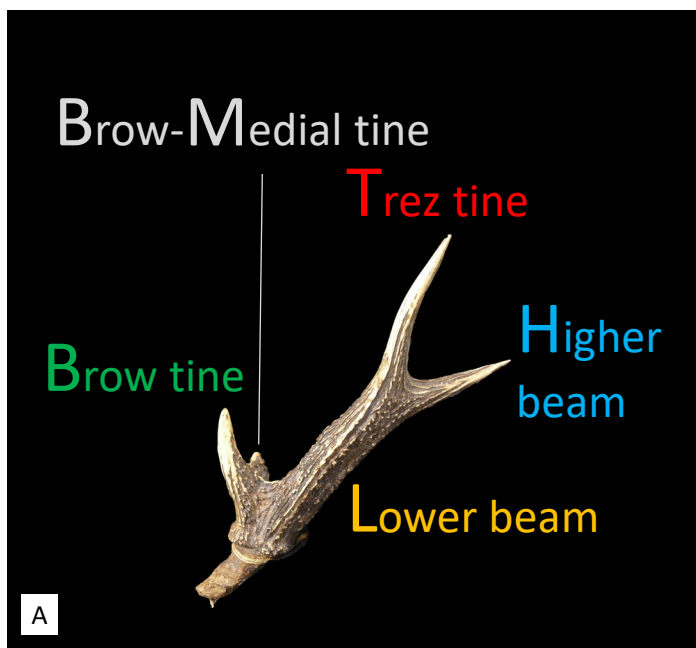


**Figure 5.** *Rusa unicolor* (KUGM-RM020) A) Left antler, lateral view. B) Diagram of the left antler.

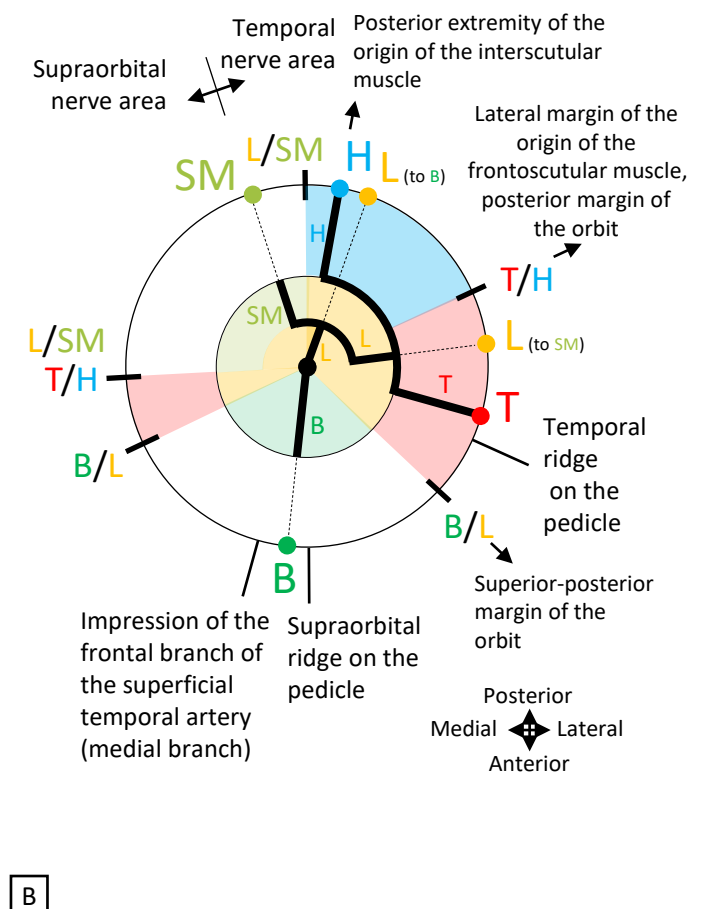
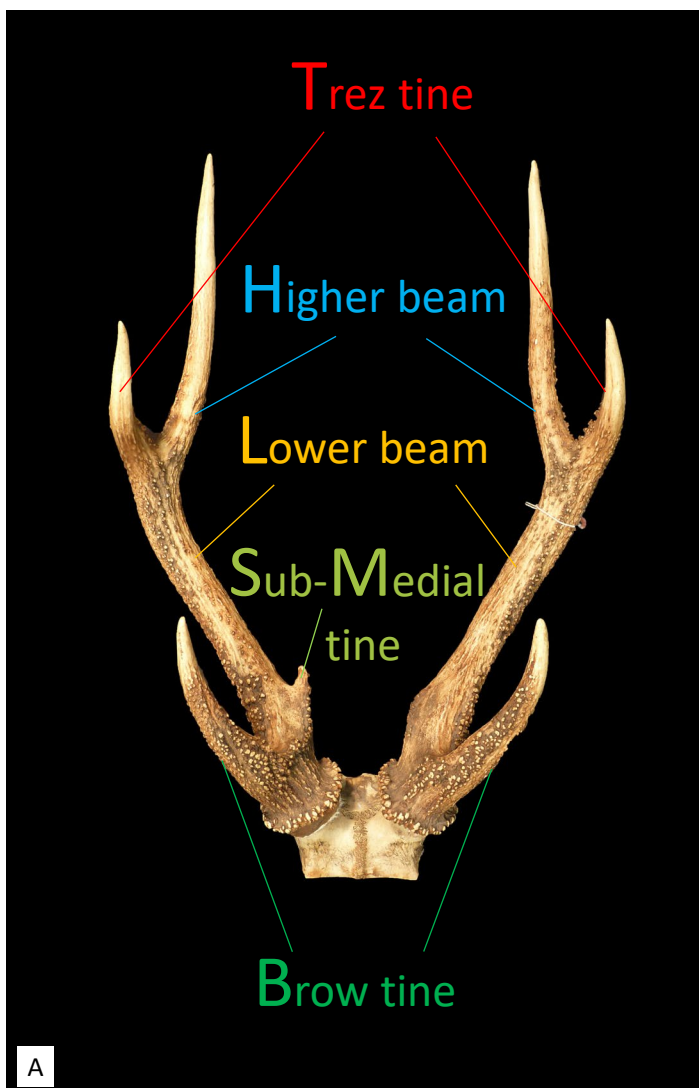


**Figure 6.** *Rusa marianna* (NSMT-M26698) A) Left antler, lateral view. B) Diagram of the left antler.

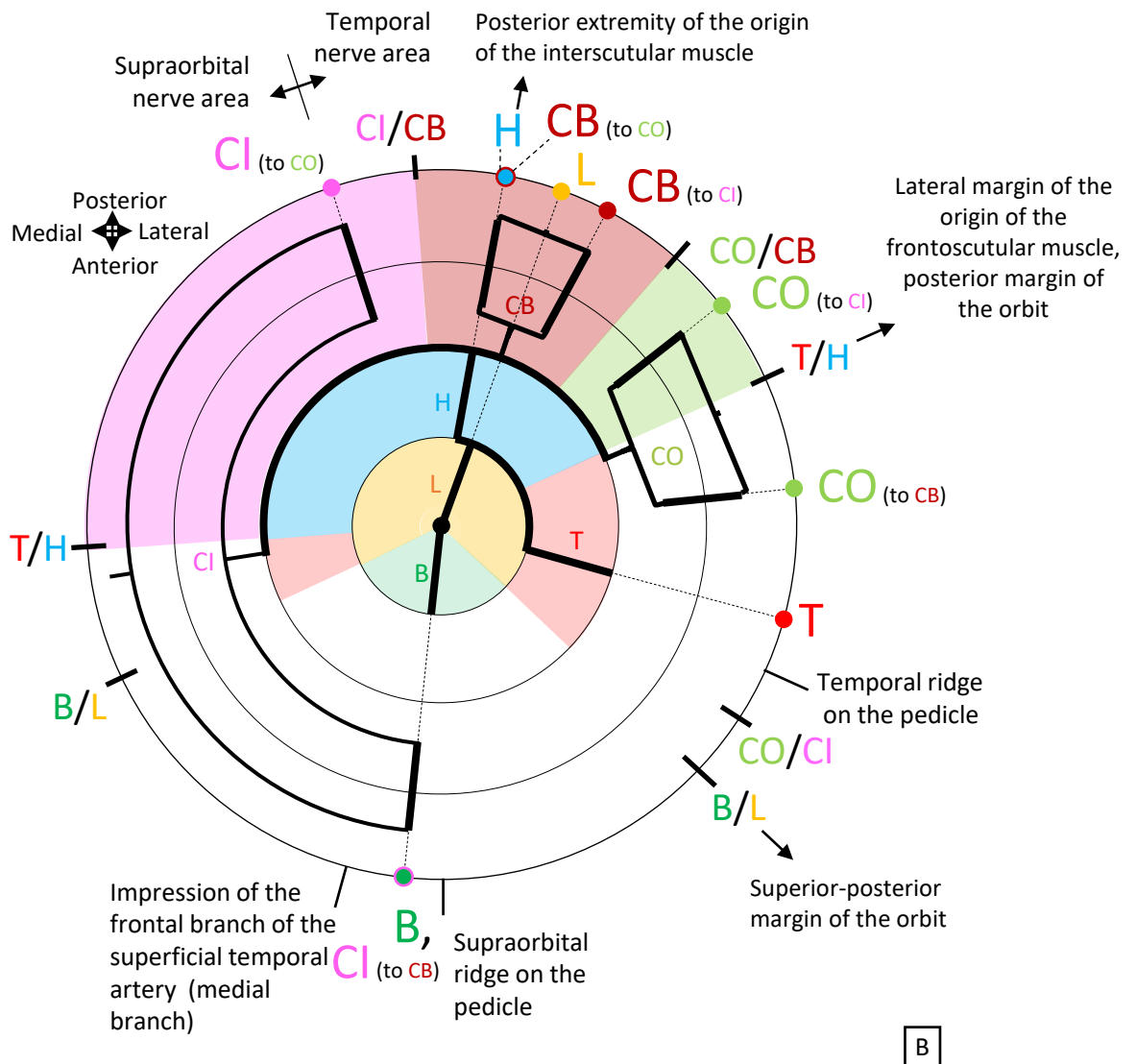
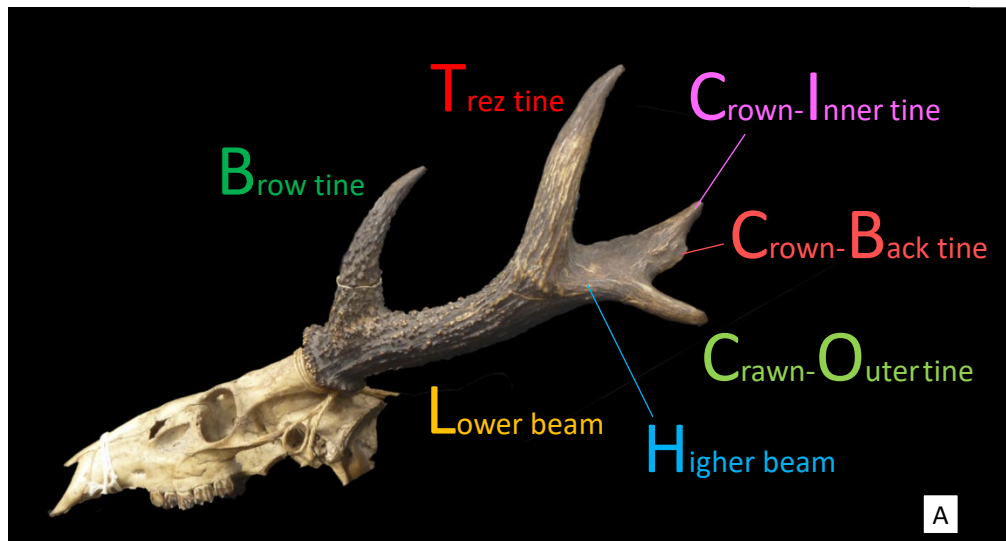




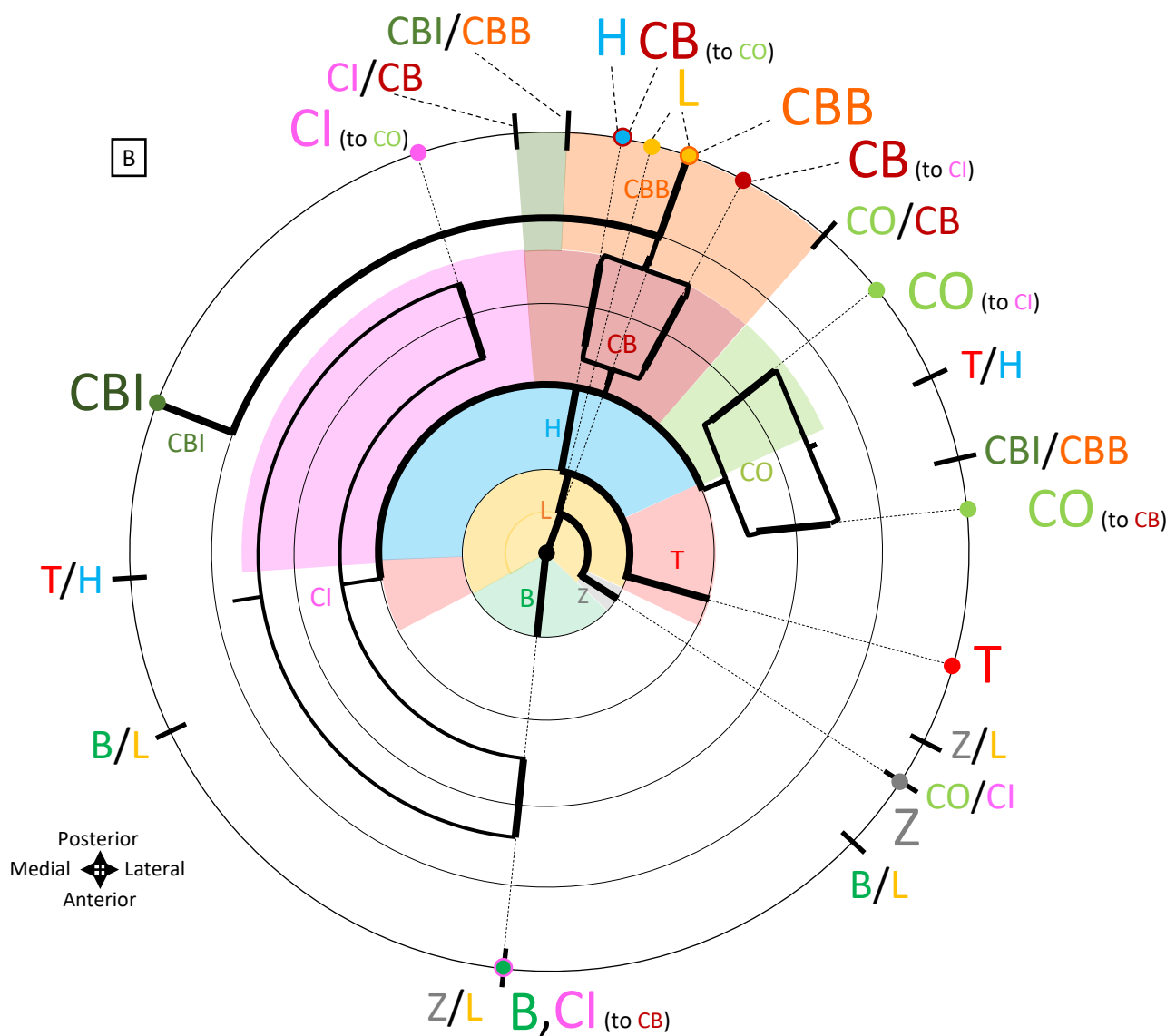
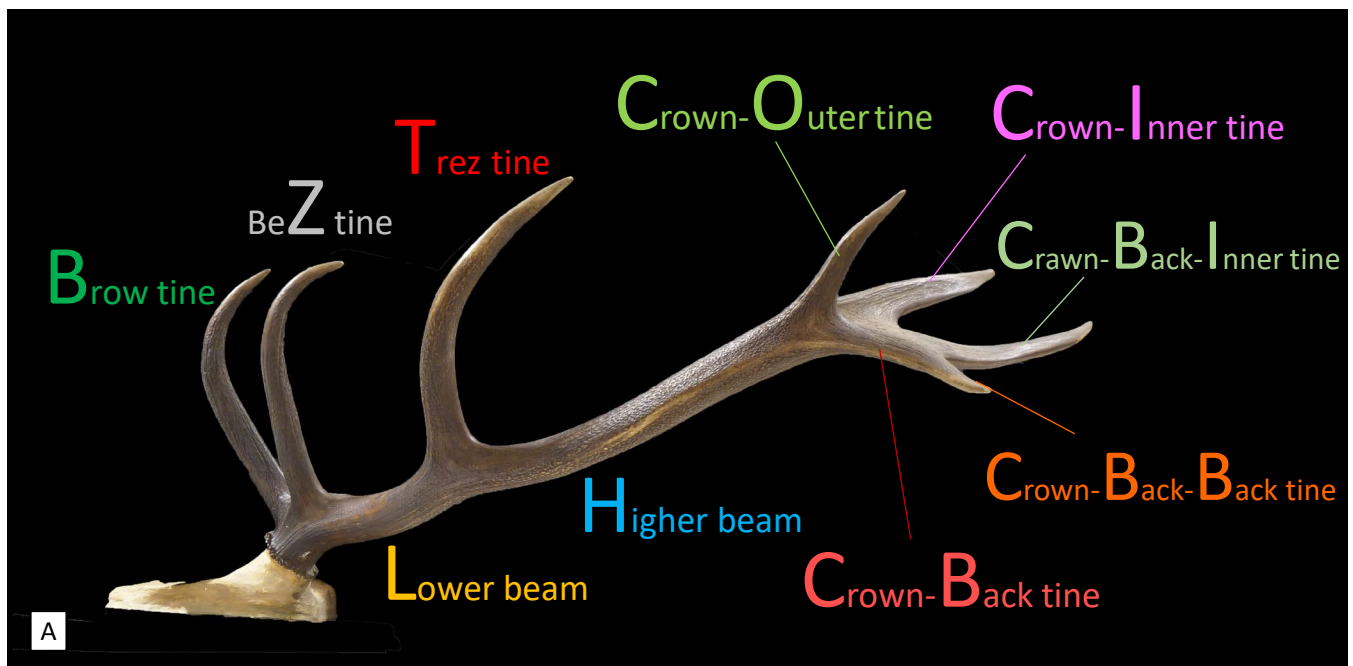
**Figure 7.** *Rusa mariaana* (NSMT-M08423) A) Left antler, lateral view. B) Diagram of the left antler.



**Figure 8.** *Rusa* sp. (KUGM-RM212) A) Dorsal view. B) Diagram of the right antler (horizontally flipped).



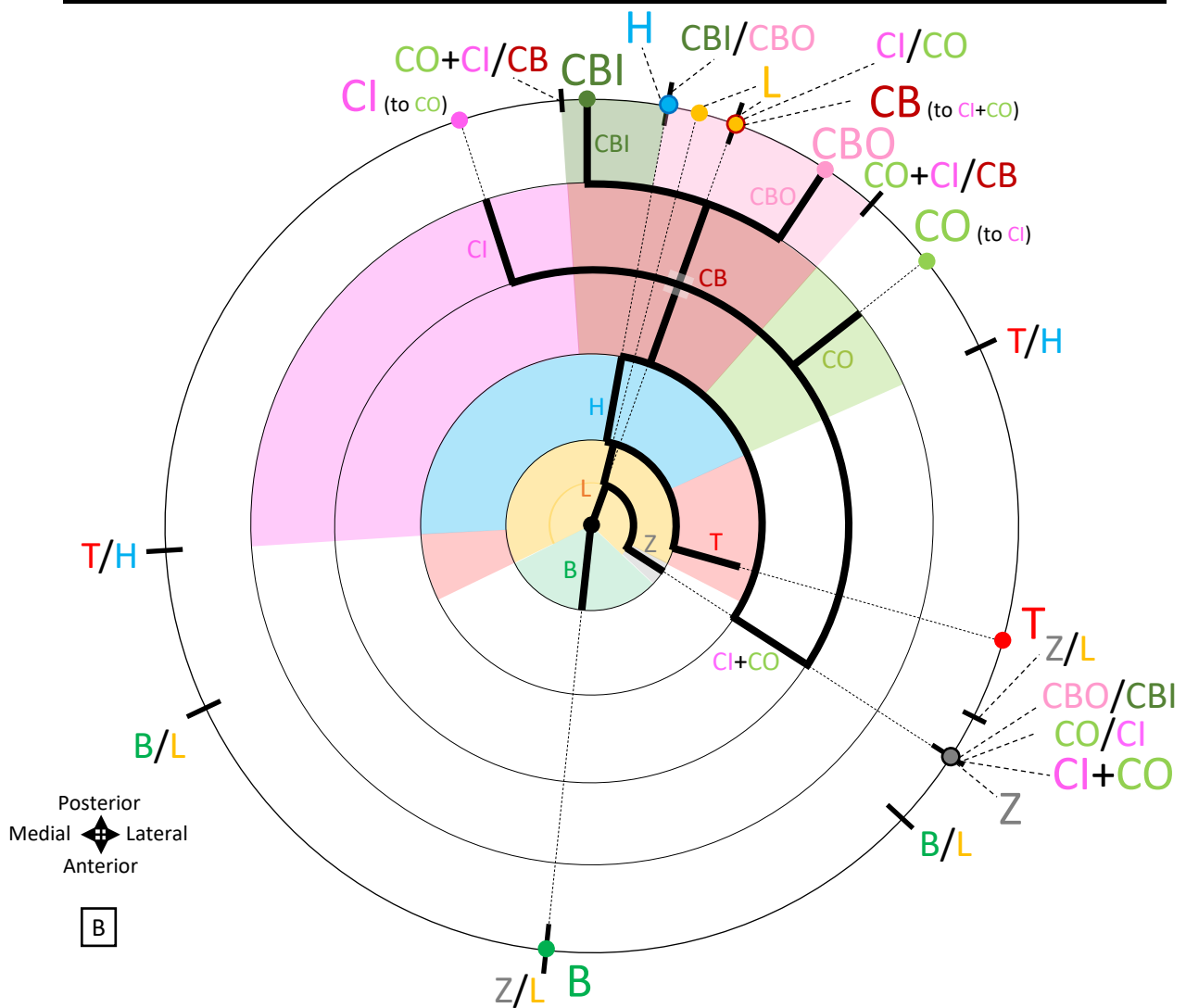
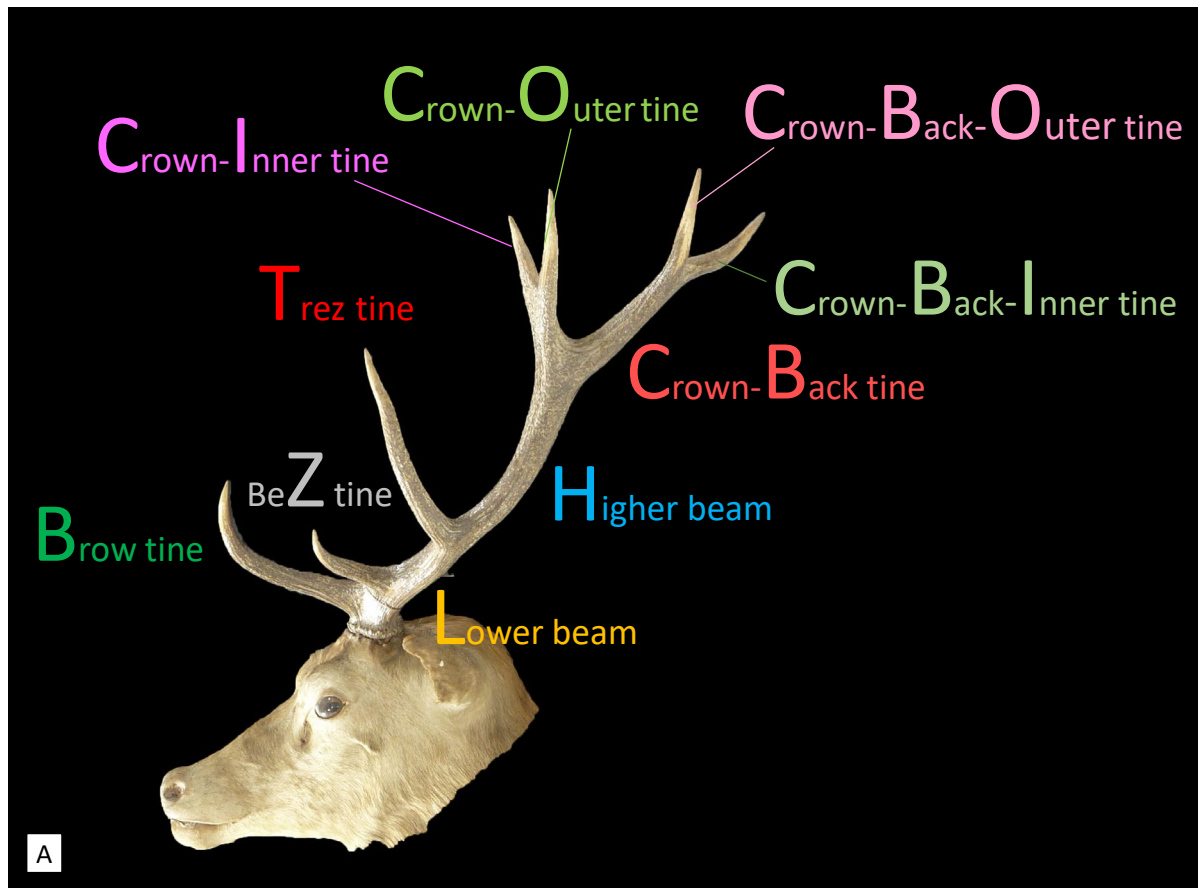
**Figure 9.** Non-typical antler of *Rusa unicolor* (NSMT-M08932) A) Left antler, lateral view. B) Diagram of the left antler.



**Figure 10.** *Cervus elaphus* (NSMT-M01162) A) Left antler, lateral view. B) Diagram of the left antler.

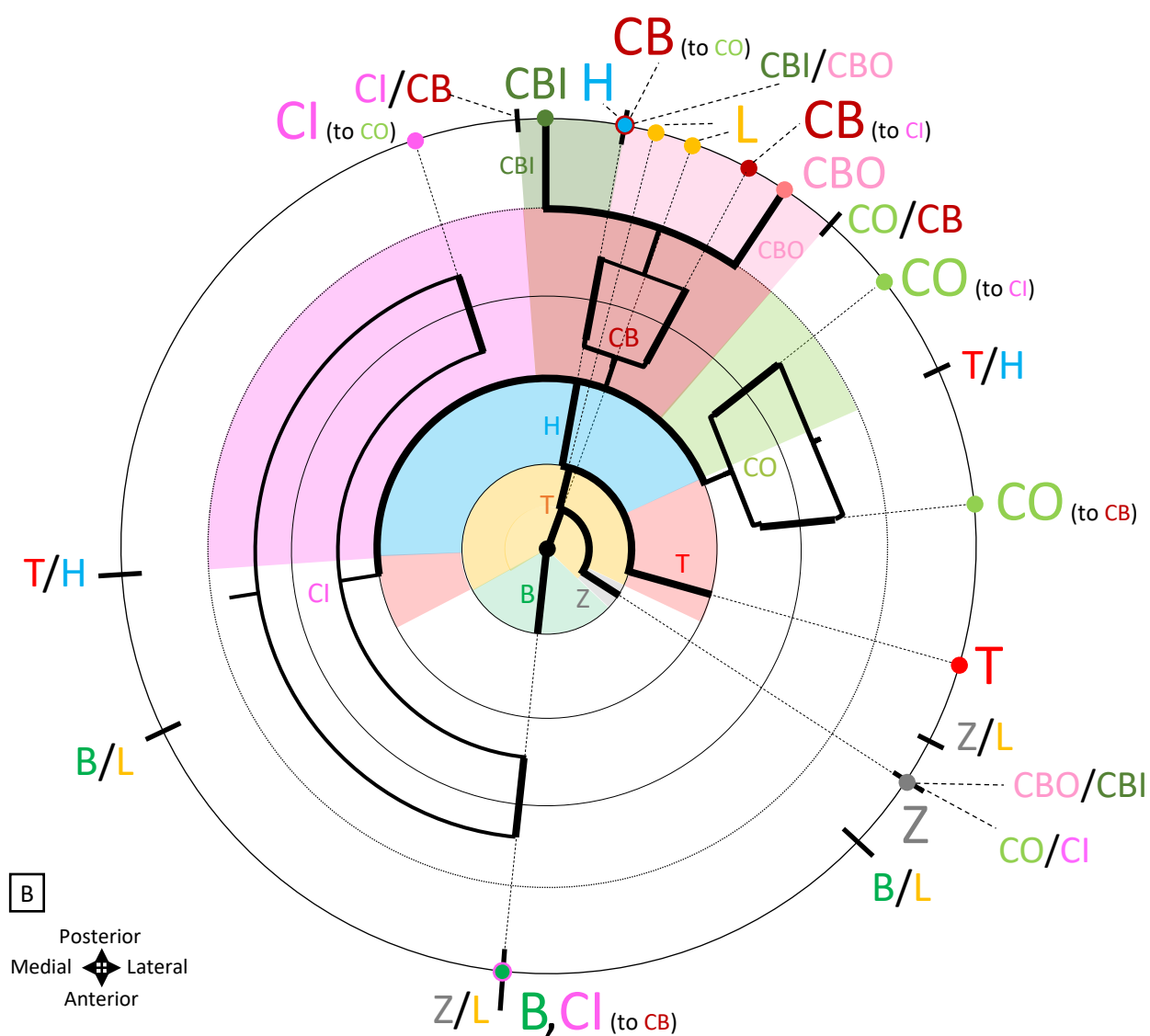
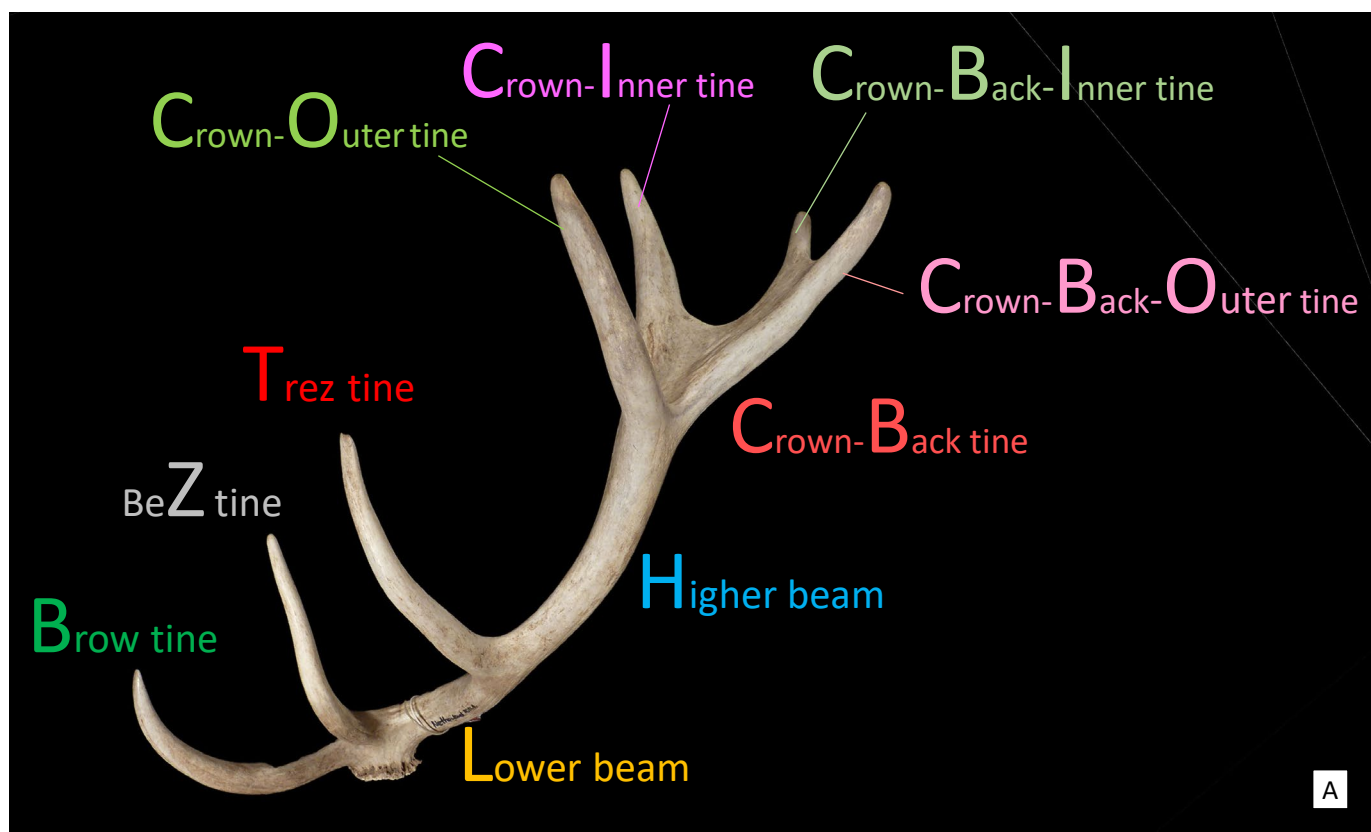




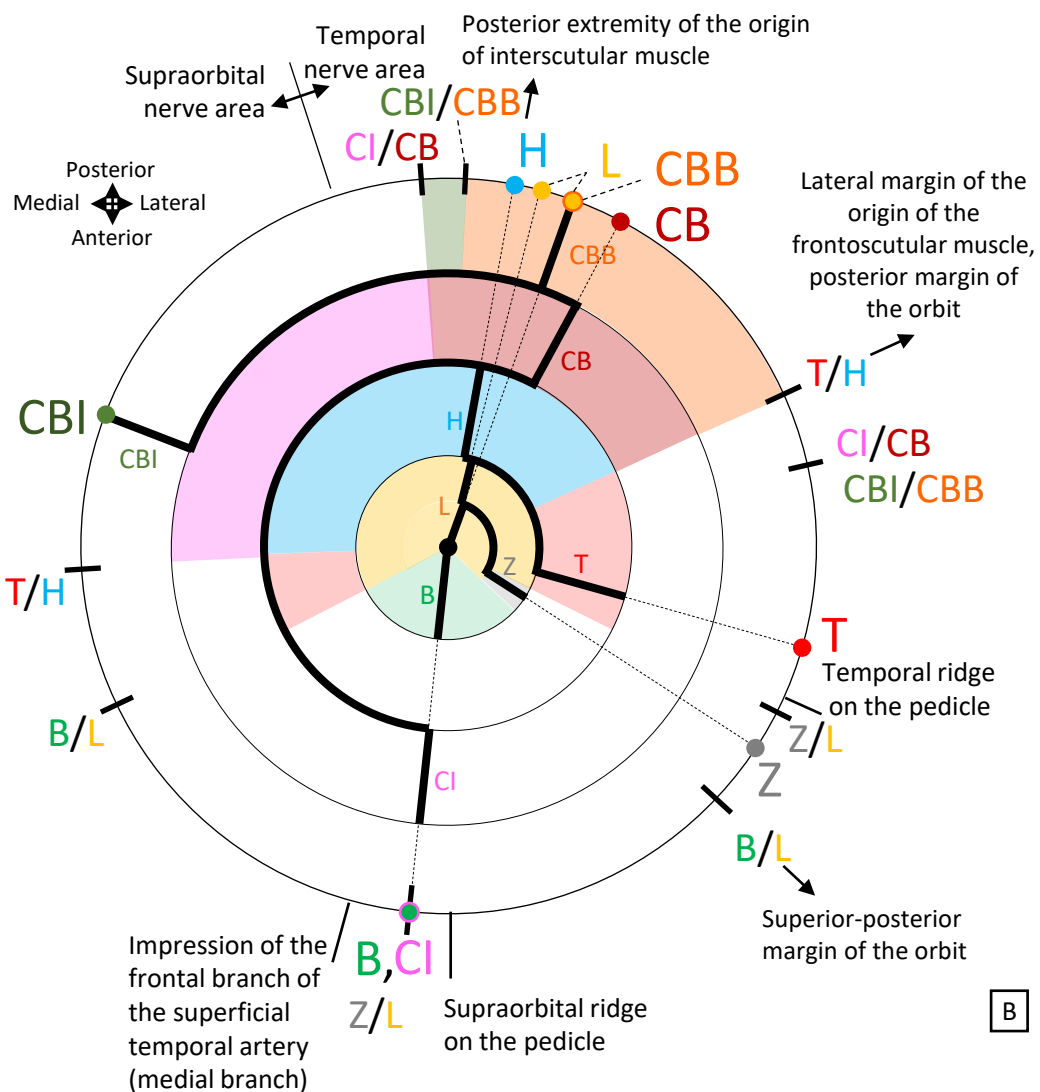
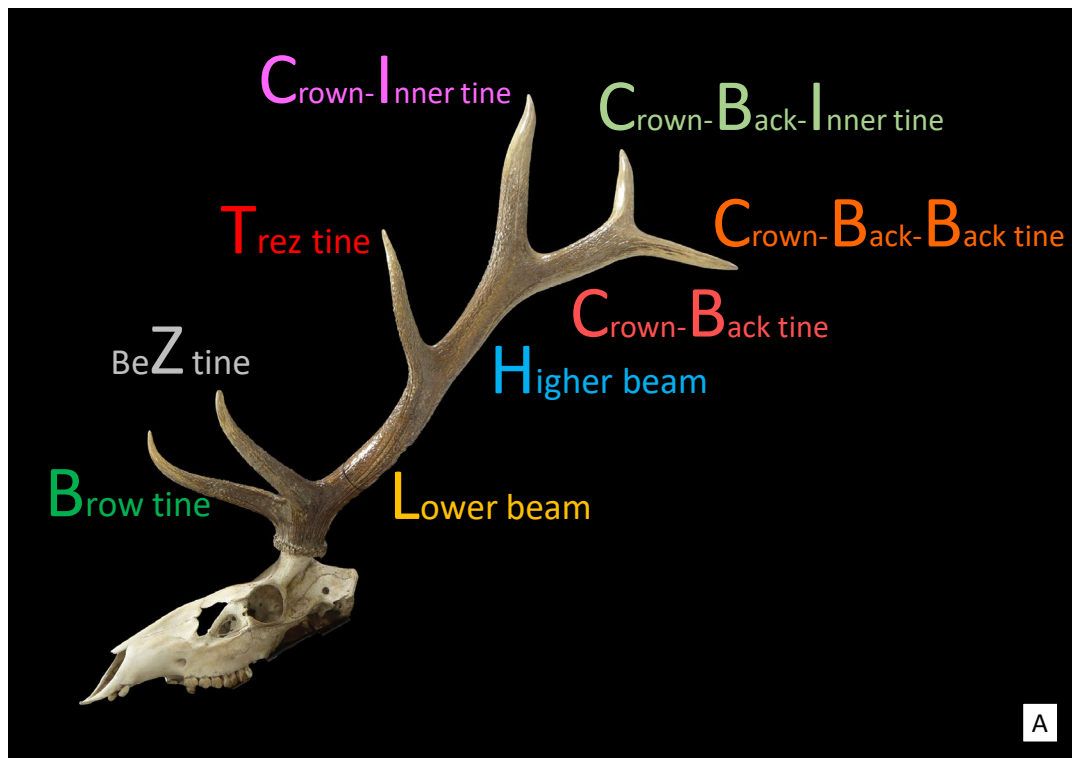


**Figure 12.** *Cervus elaphus* (NSMT-M43325) A) Left antler, lateral view. B) Diagram of the left antler.

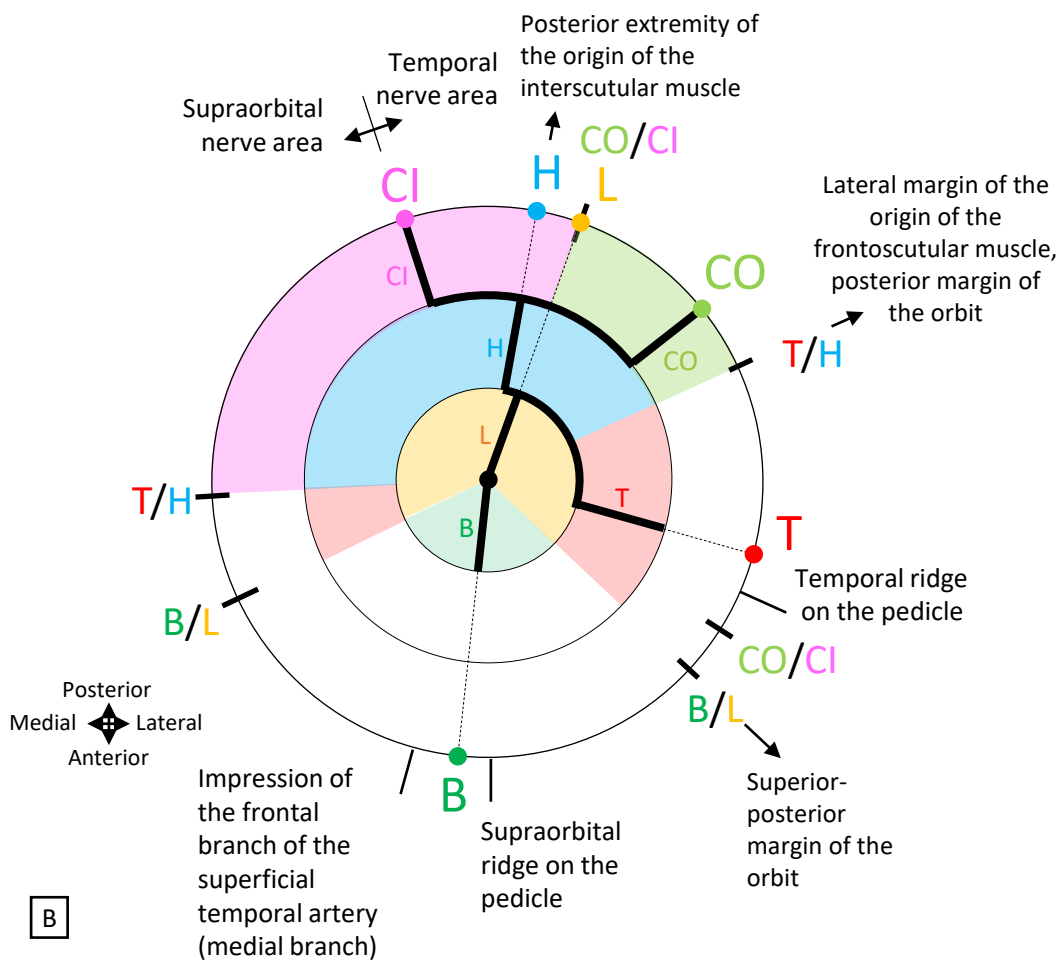
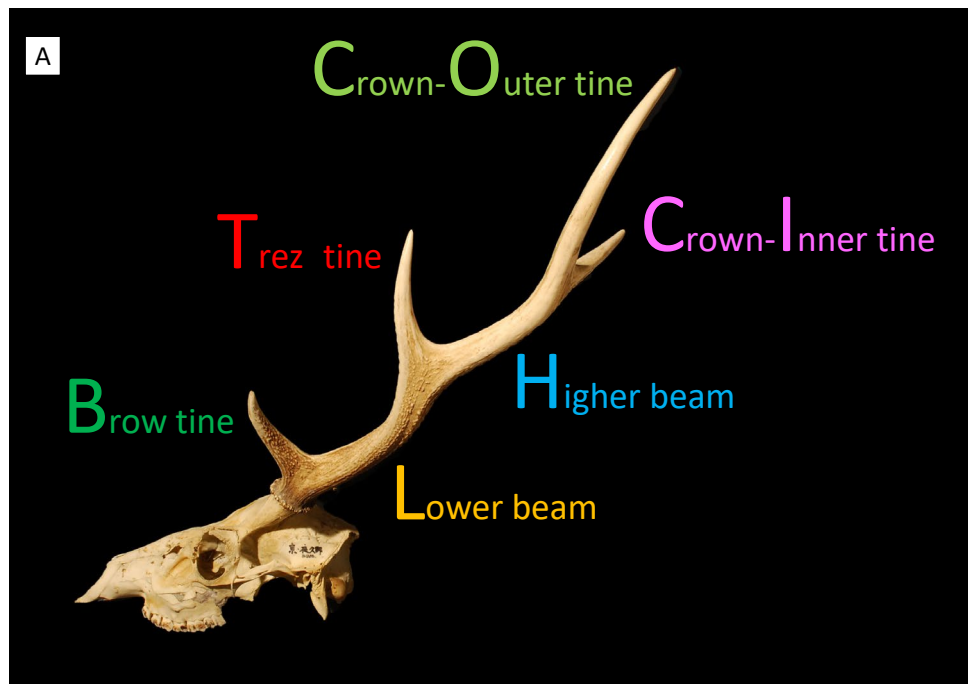




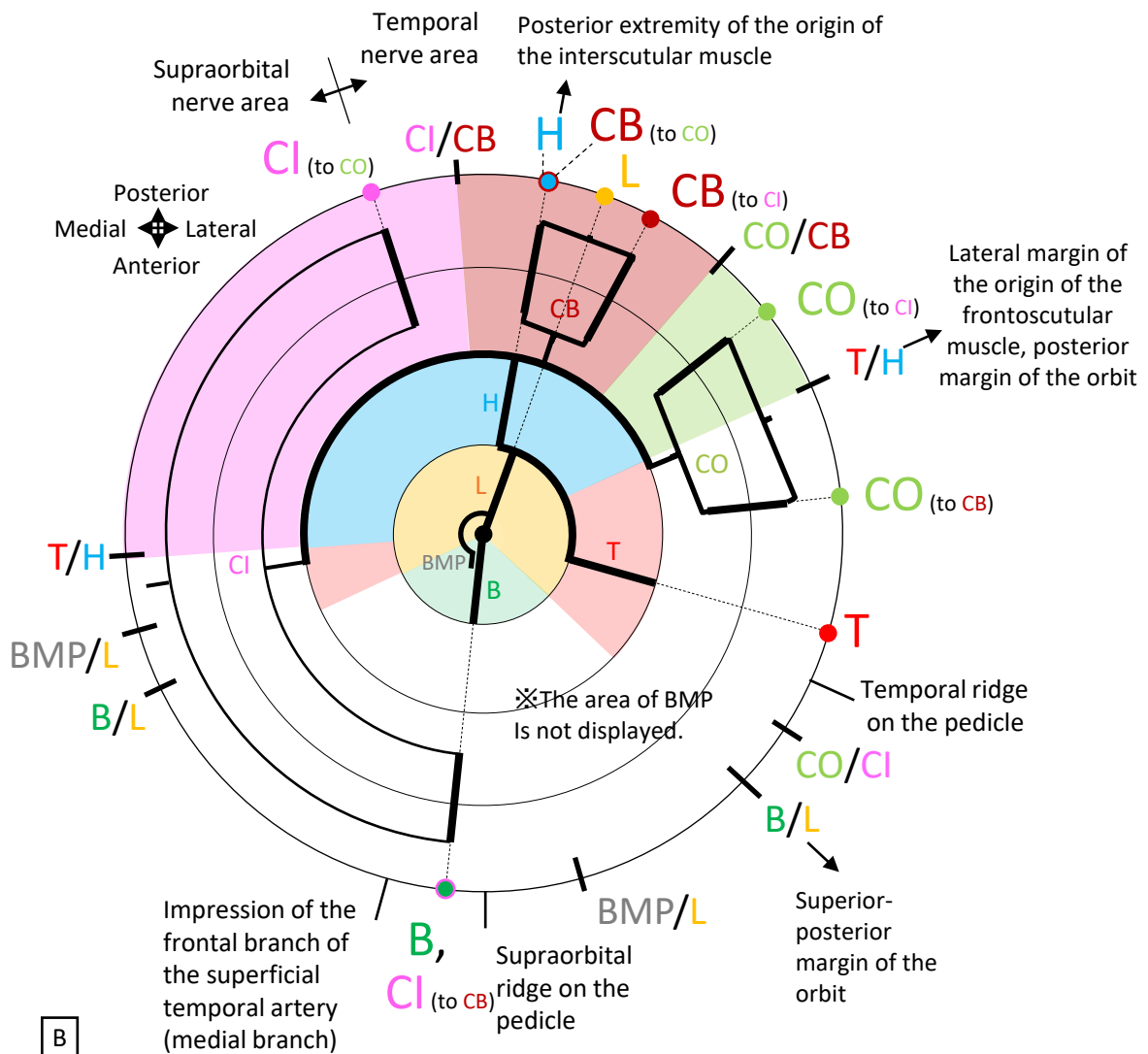
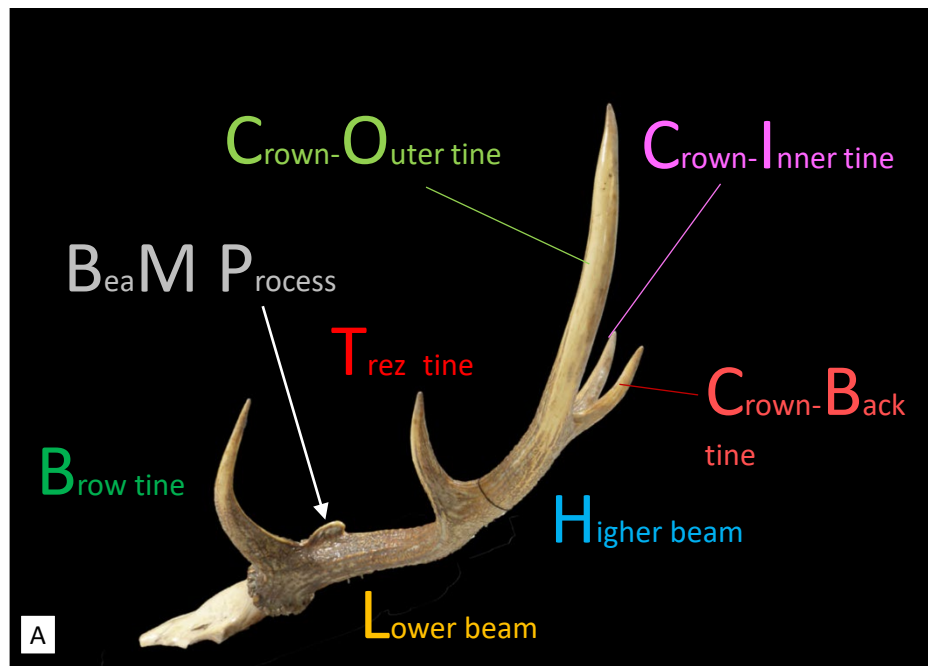
**Figure 13** *Cervus elaphus* (KUGM-RM048) A) Left antler, lateral view. B) Diagram of the left antler.



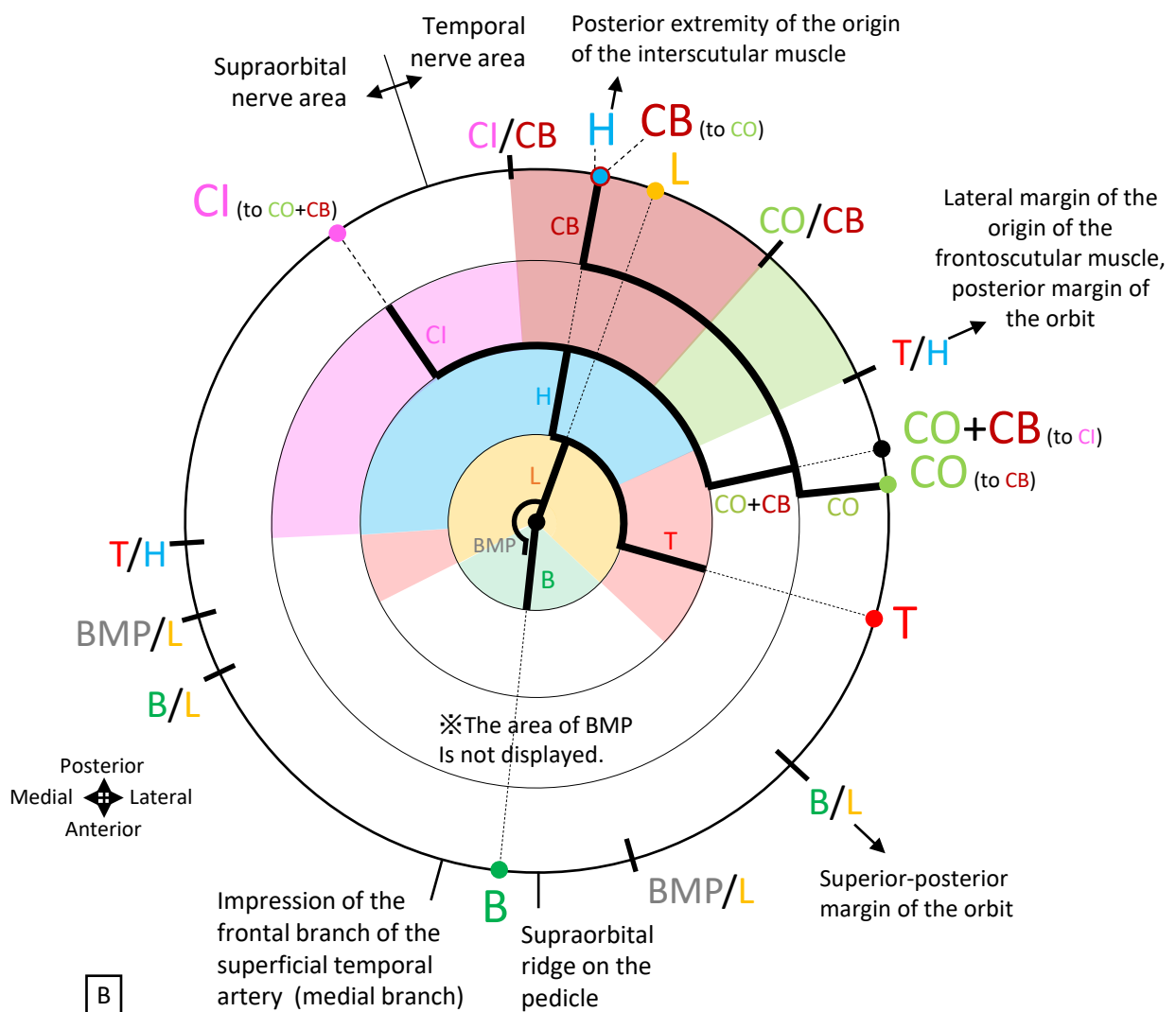
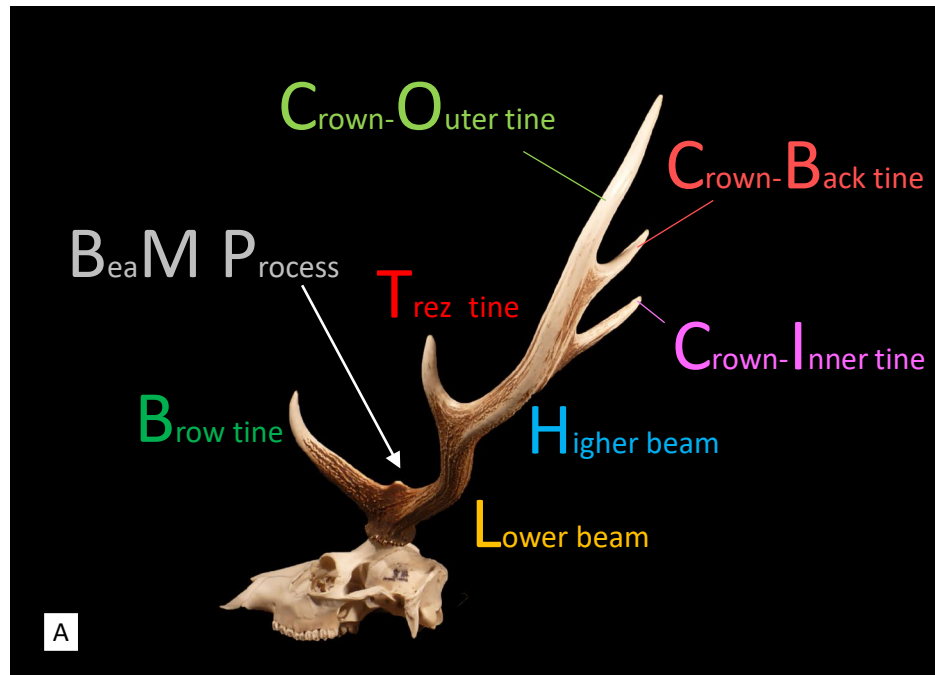
**Figure 14.** *Cervus canadensis* (NSMT-M43324) A) Left antler, lateral view. B) Diagram of the left antler.



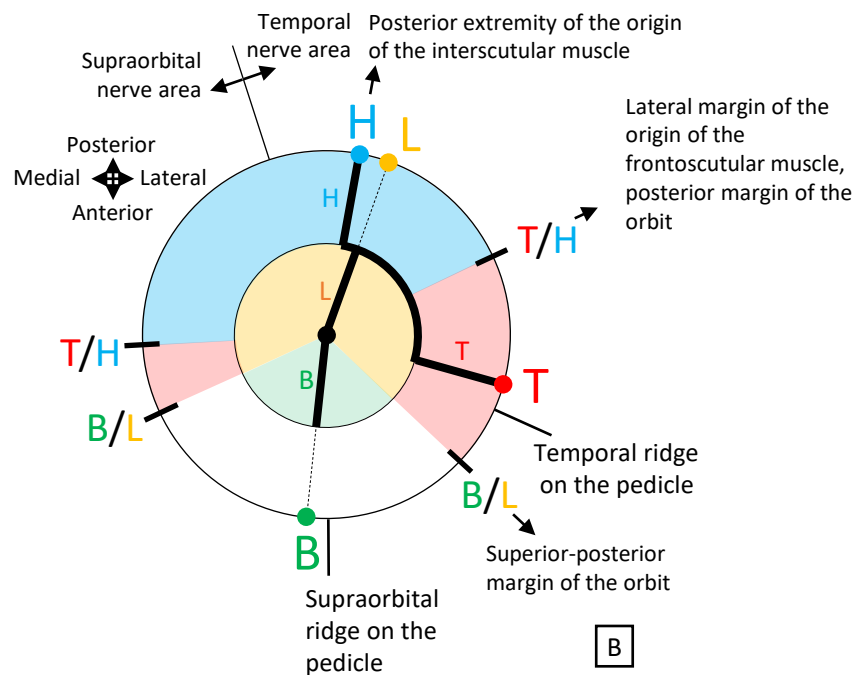
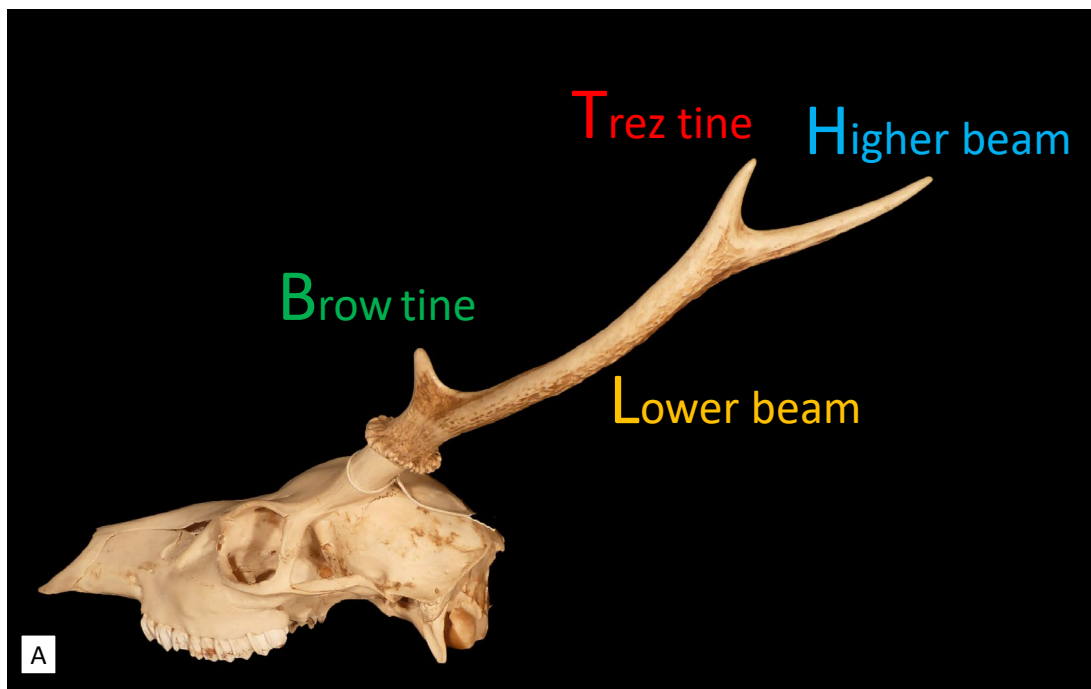
**Figure 15.** Typical antler of *Cervus nippon* (KUGM-RM003) A) Left antler, lateral view. B) Diagram of the left antler.



**Figure 16.** Non-typical antler of *Cervus nippon* (NSMT-M43307) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .



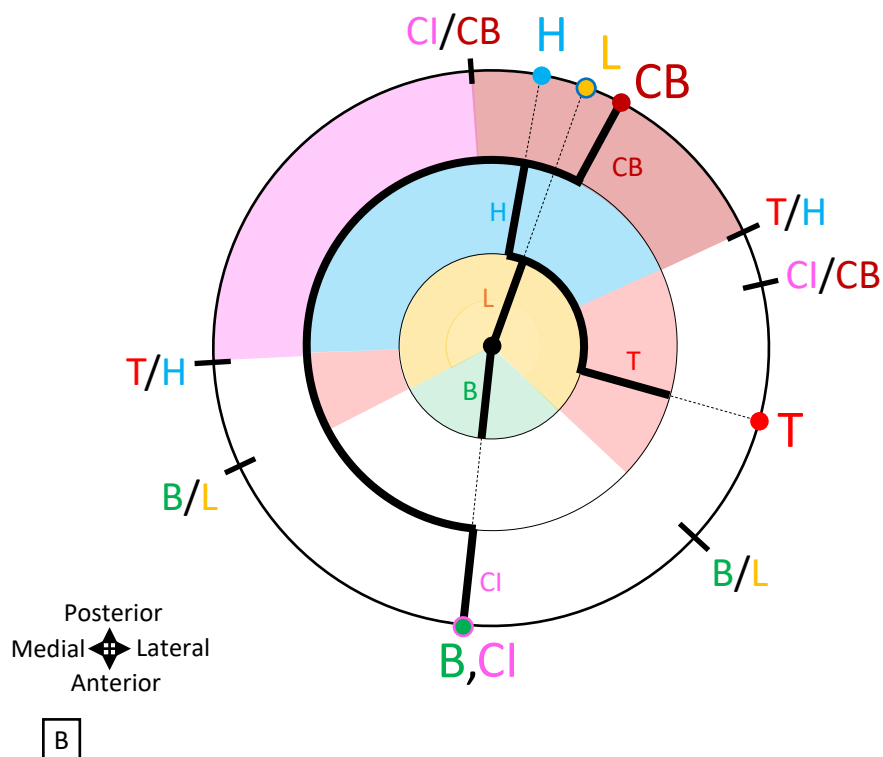
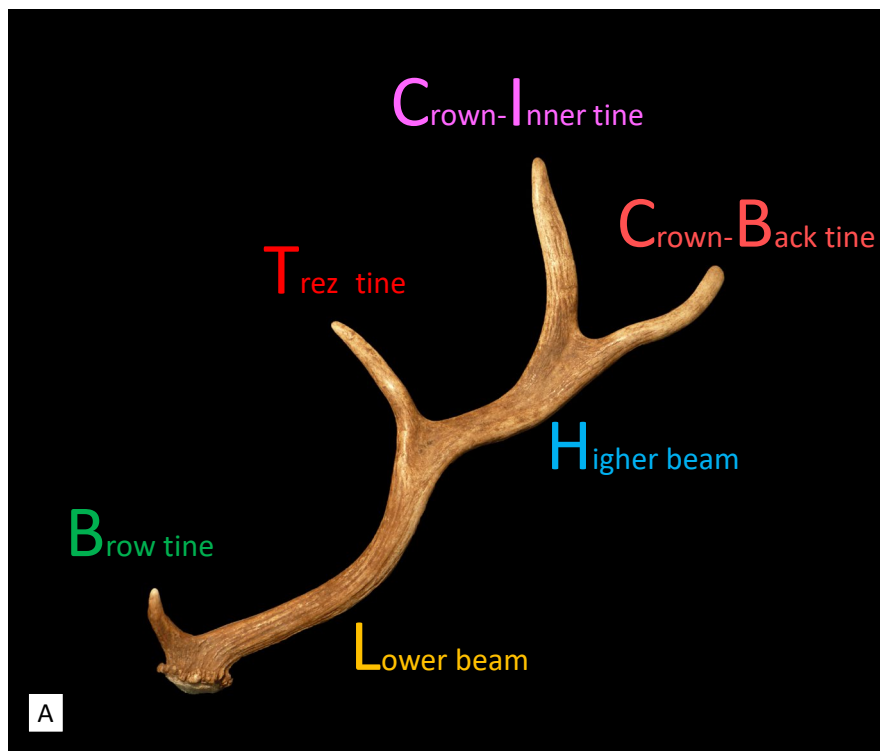
**Figure 17.** Non-typical antler of *Cervus nippon* (KUGM-RM016) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .



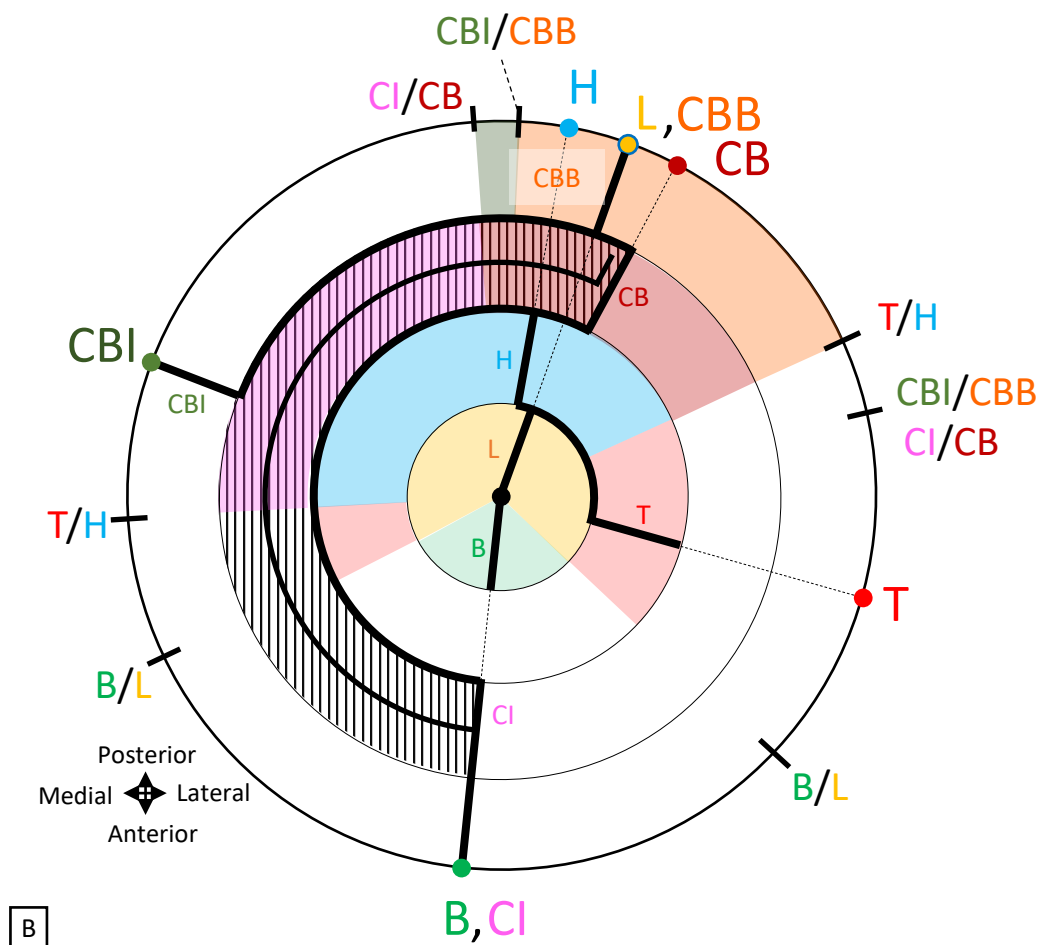
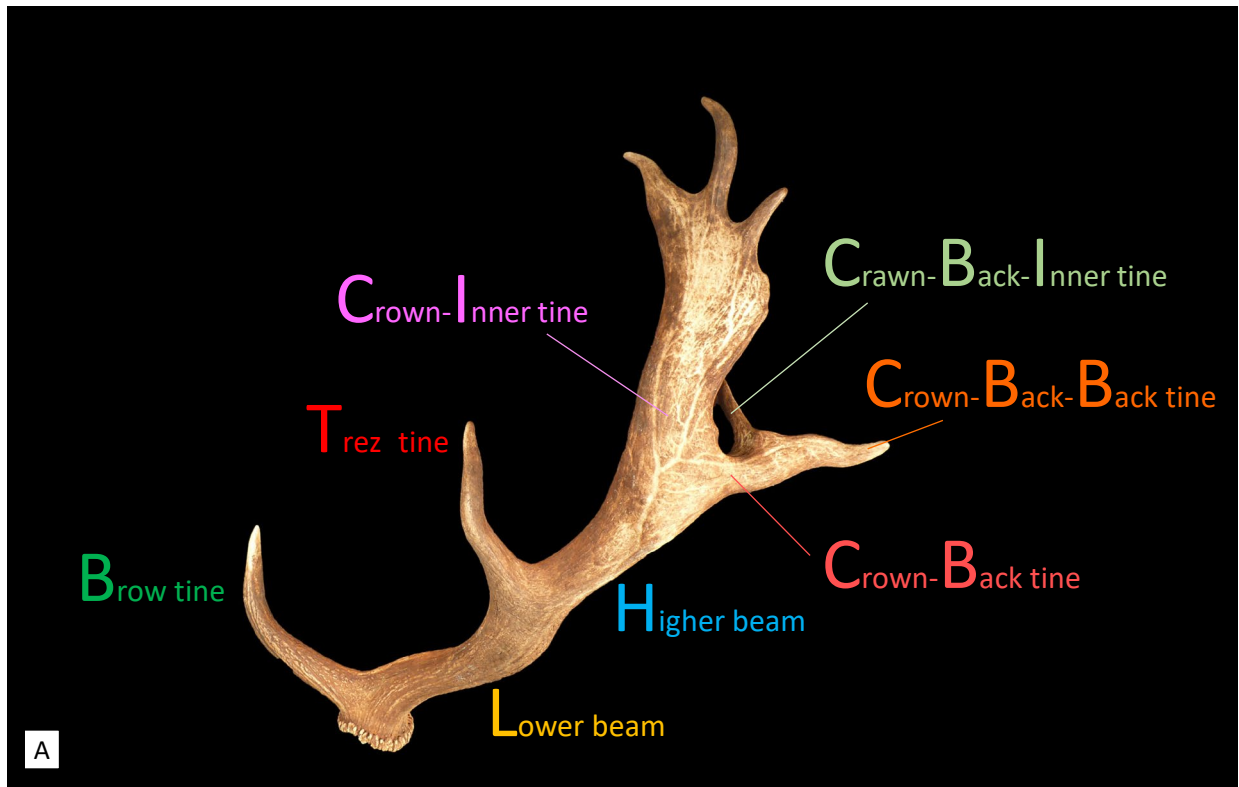
**Figure 18.** **A)** A juvenile *Cervus nippon* (KUGM-RM008) . Estimated 2 to 3 years old. Left antler, lateral view. **B)** Diagram of the left antler.



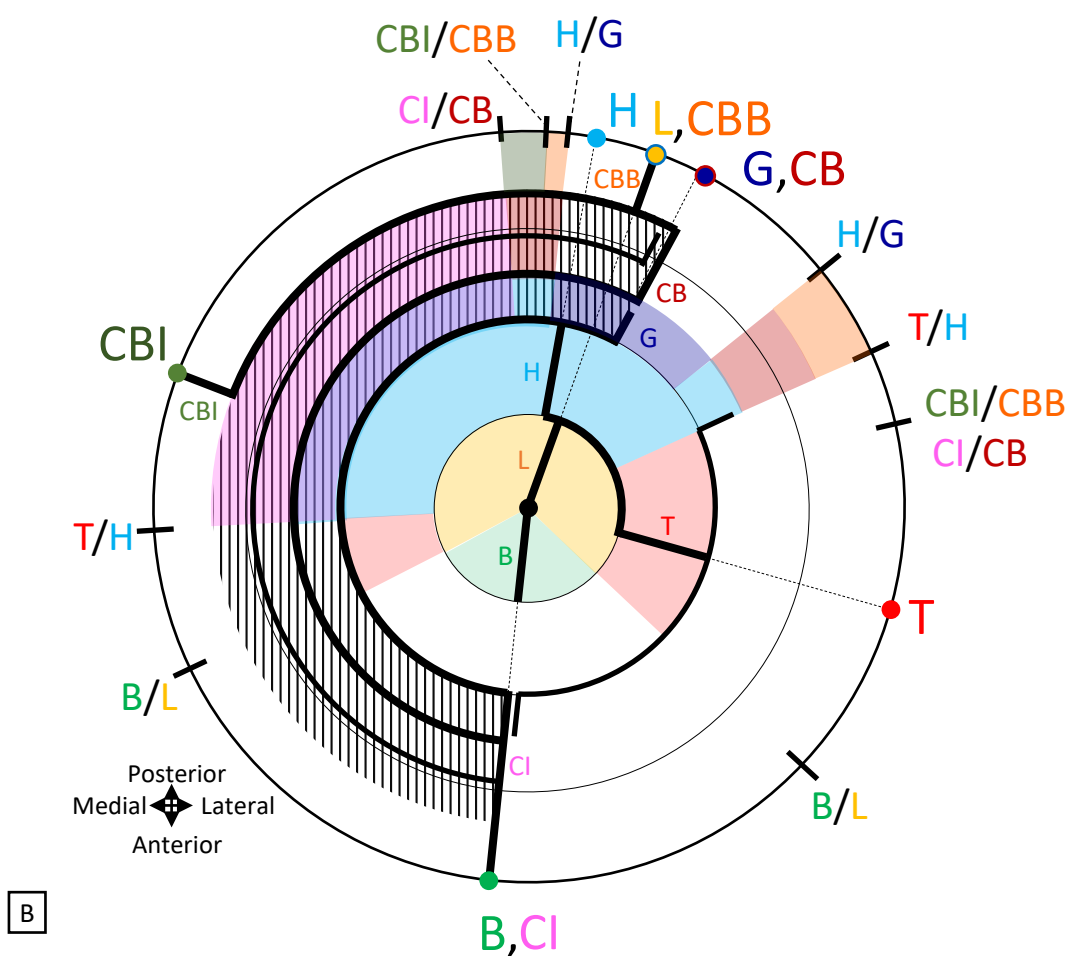
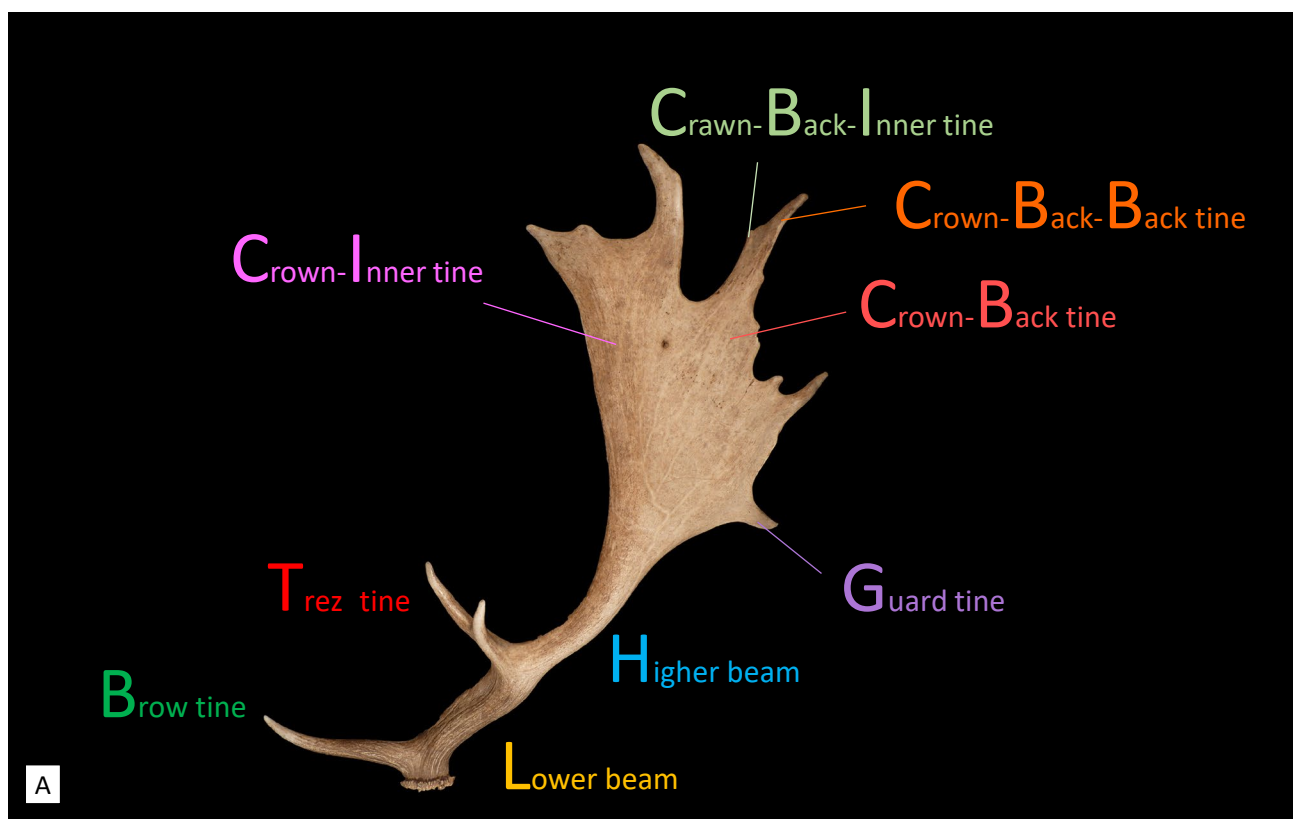




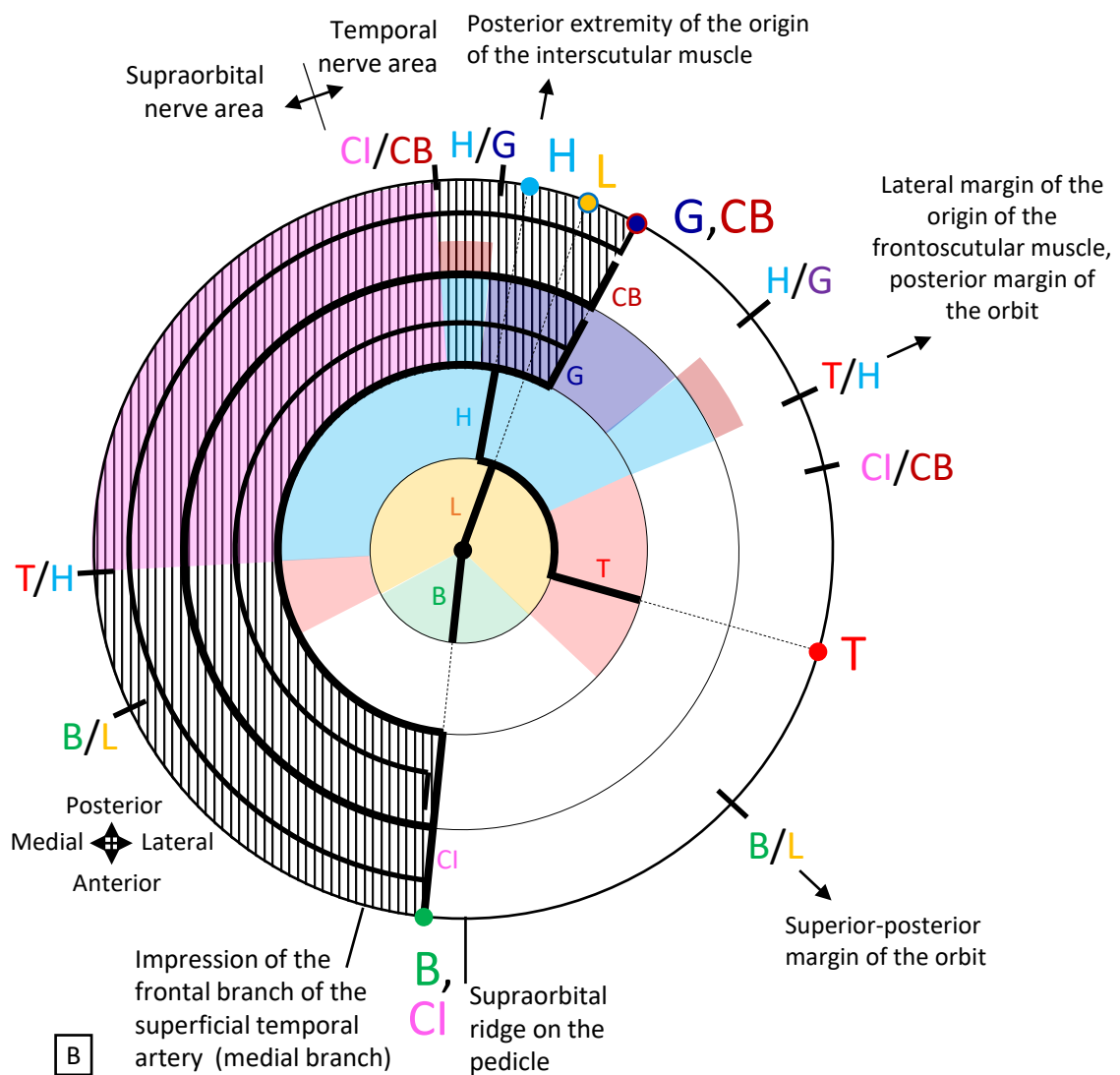
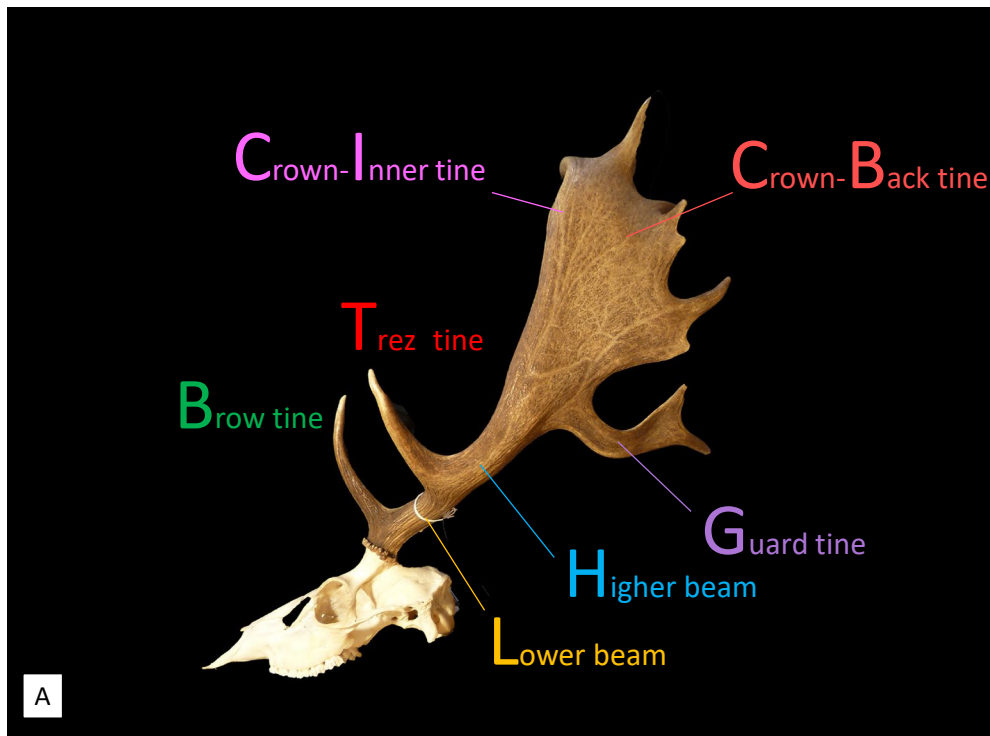
**Figure 20.** Juvenile antler of *Dama dama* (KUGM-RM204) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the left antler (horizontally flipped) .



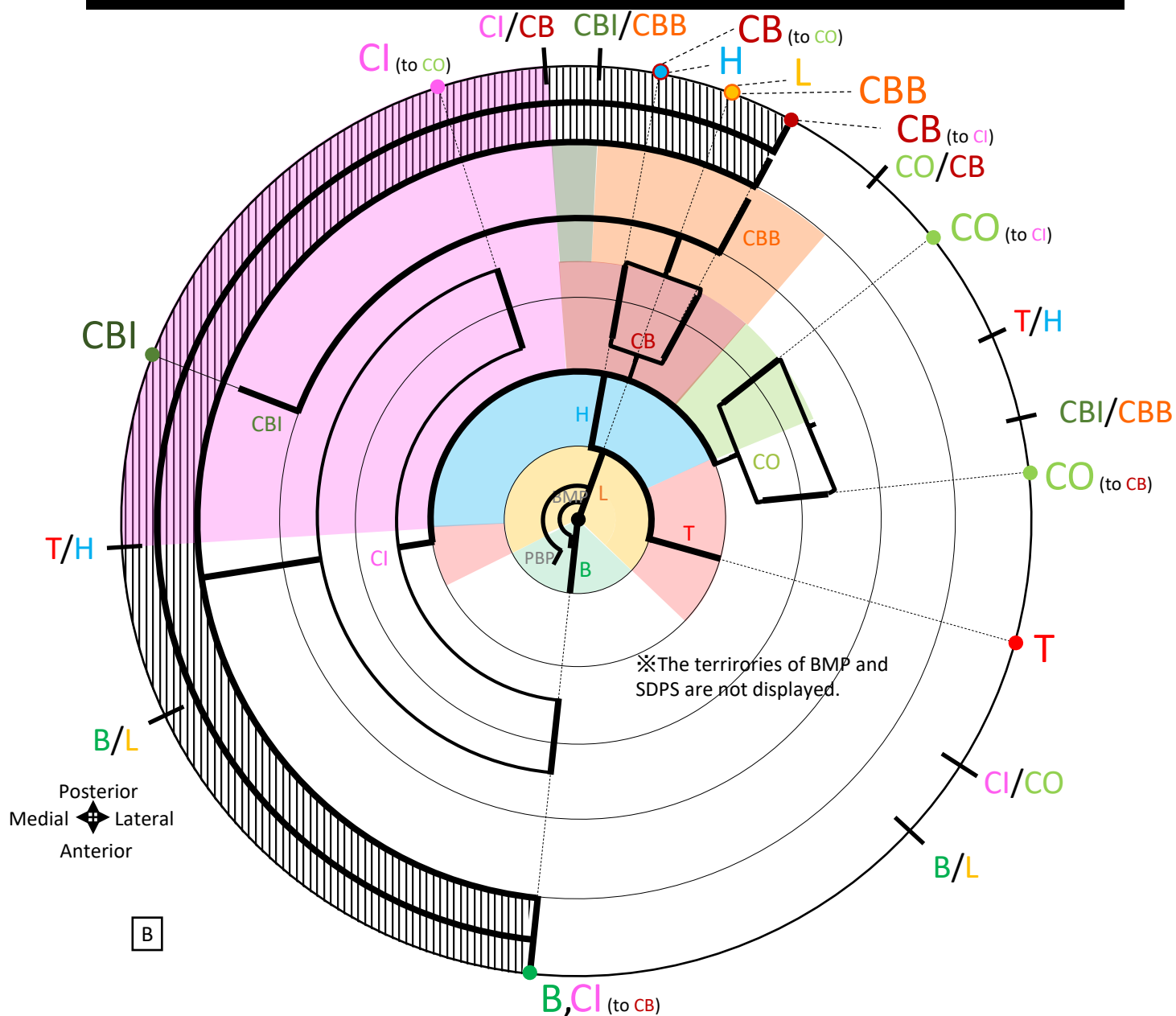
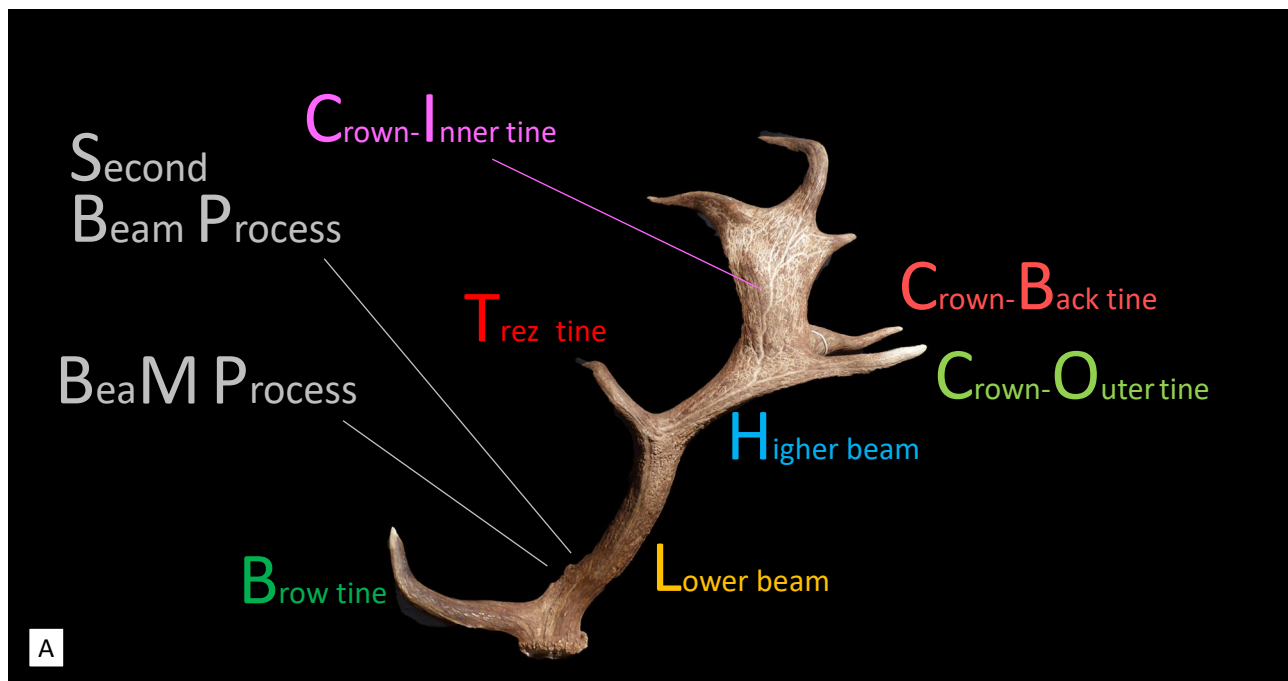
**Figure 21.** *Dama dama* (KUGM-RM107) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) . Small tines in the palmate portion are omitted.



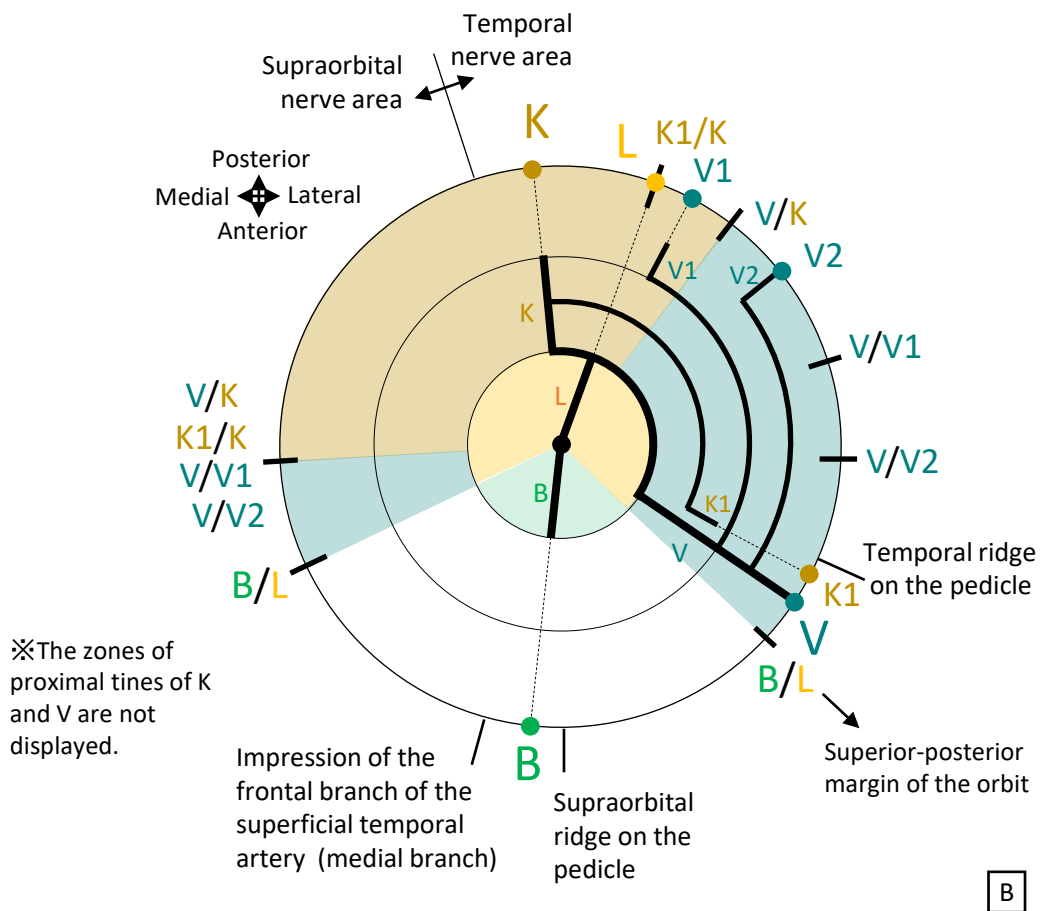
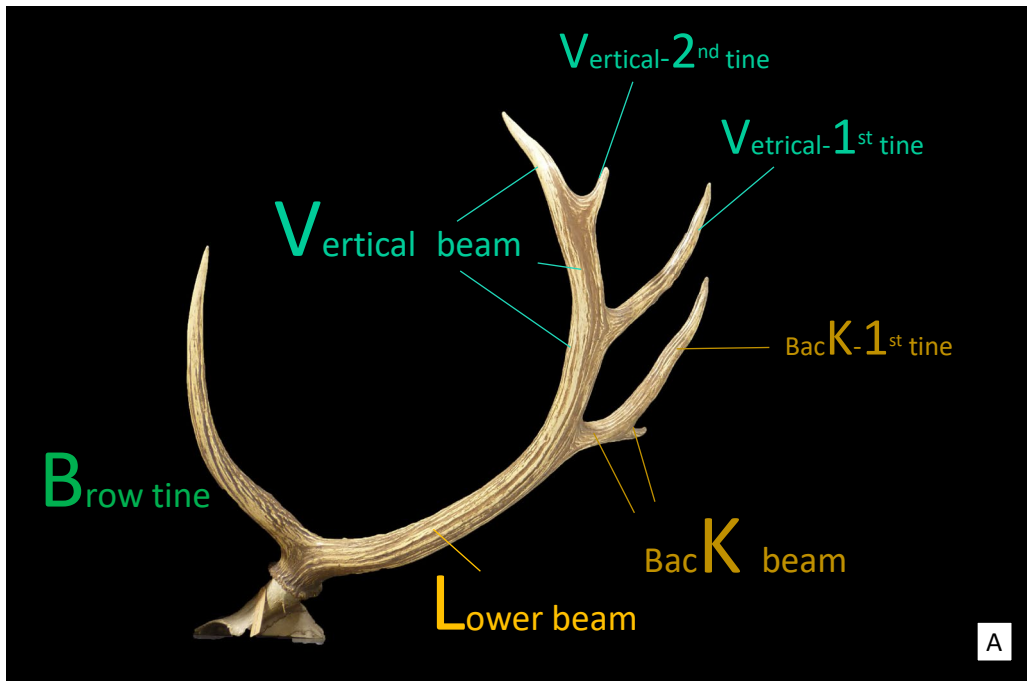
**Figure 22.** *Dama dama* (KUGM-RM144) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) . Small tines in the palmate portion are omitted.



**Figure 23.** *Dama dama* (LBM-1900000787) A) Left antler, lateral view. B) The diagram of the left antler. Small tines in the palmate portion are omitted.

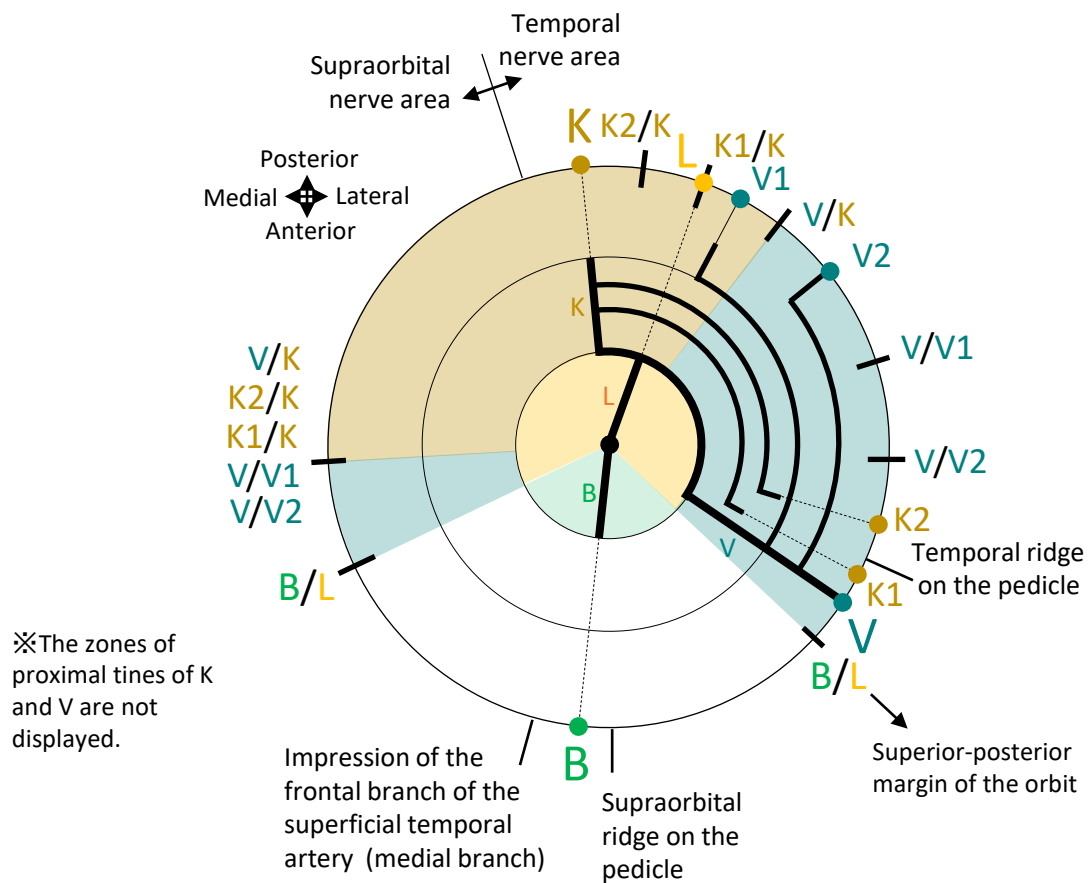
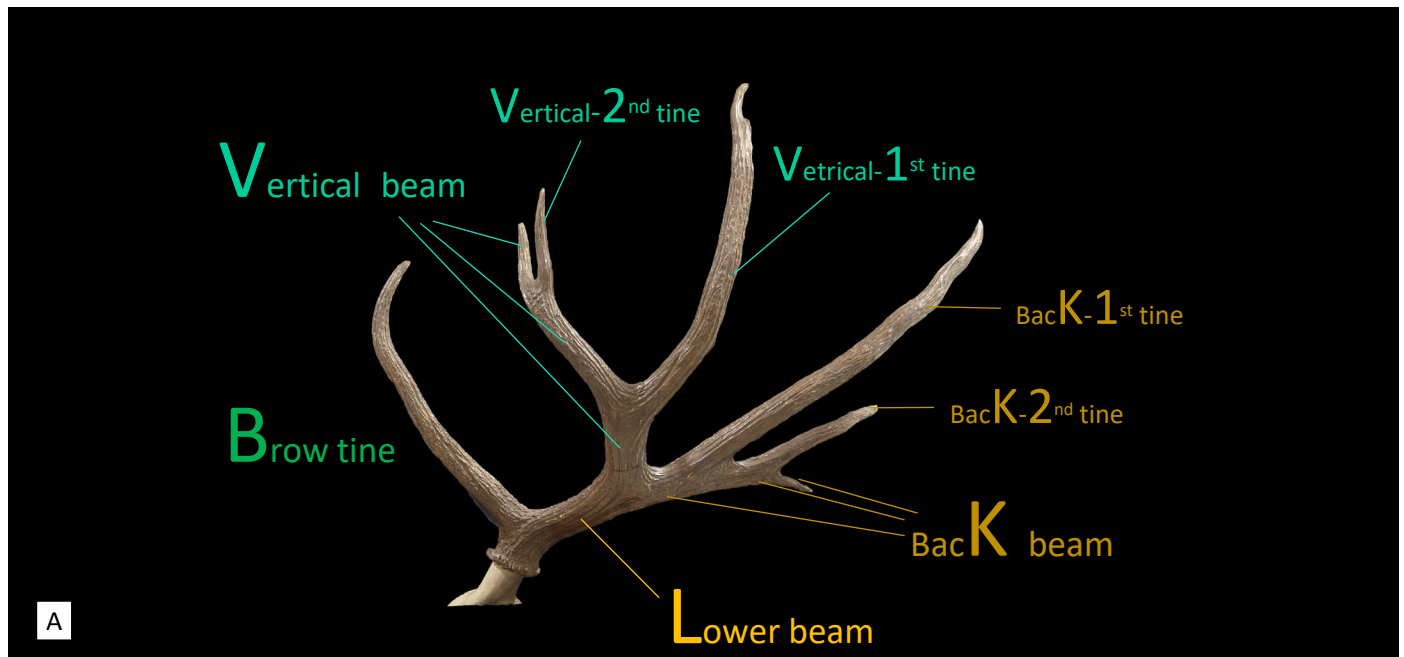


**Figure 24.** Non-typical antler of *Dama dama* (KUGM-RM107) A) Left antler, lateral view. B) The diagram of the left antler. Small tines in the palmate portion are omitted.

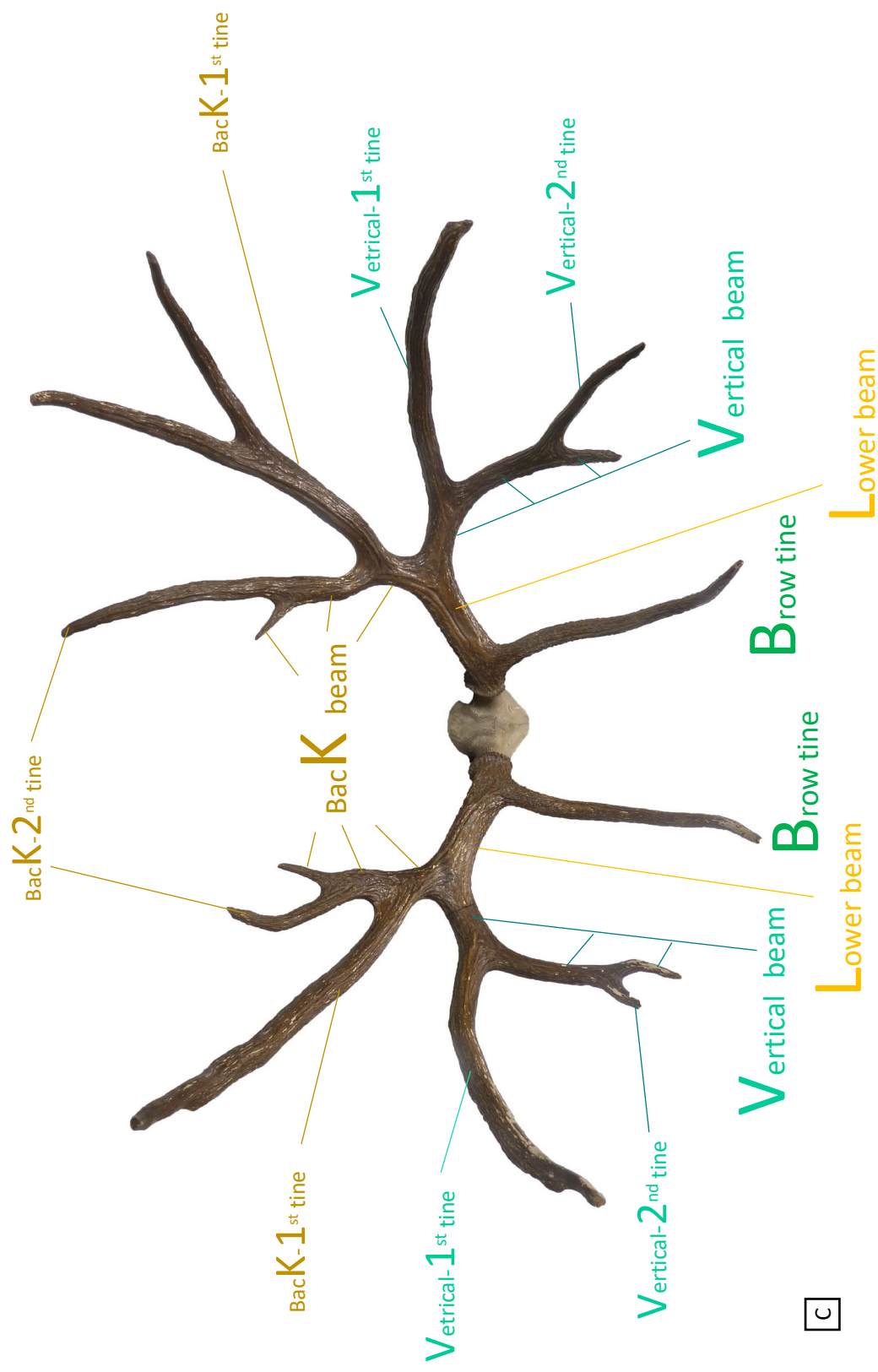


**Figure 25.** *Rucervus duvaucelii* (NSMT-M01152) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the left antler (horizontally flipped) .

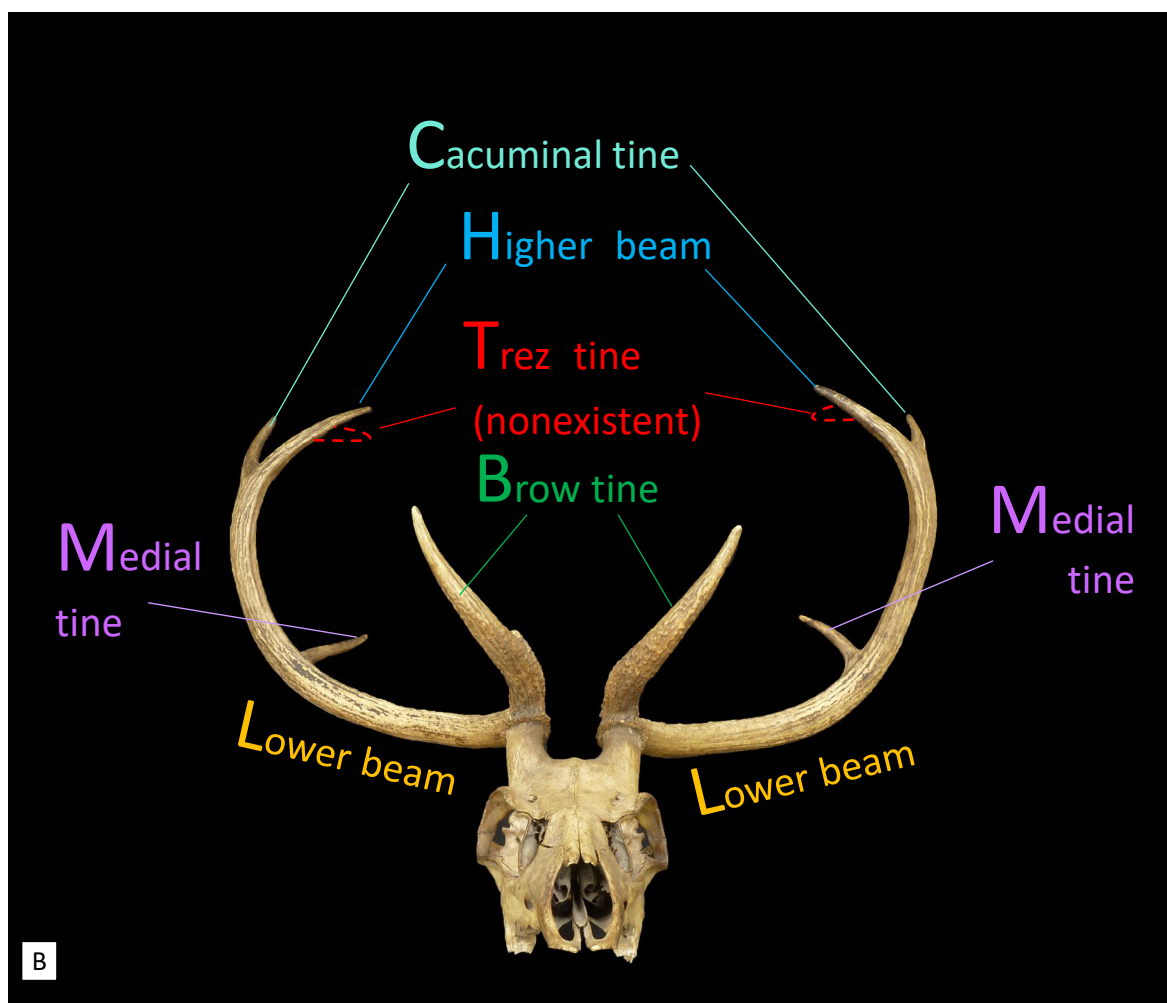
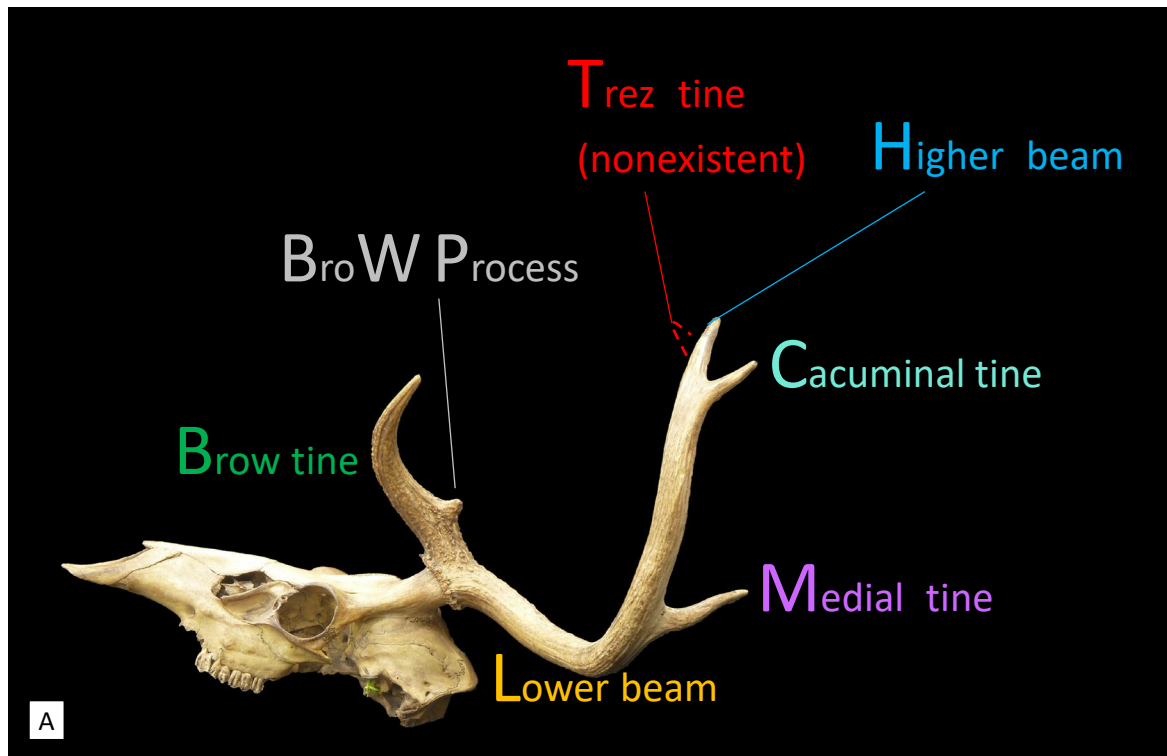




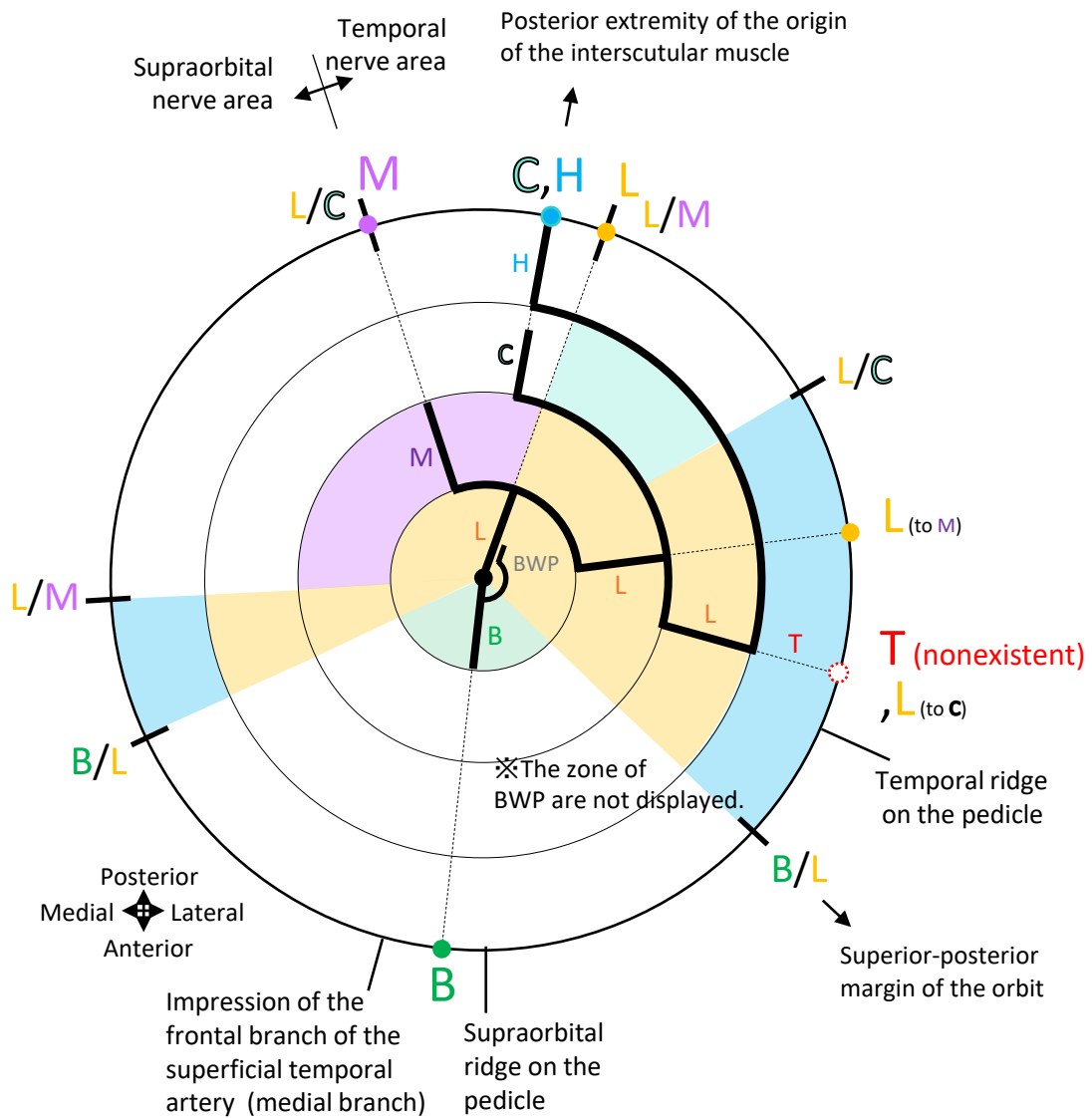
**Figure 26.** *Rucervus schomburgki* (NSMT-M01151) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .



**Figure 26.** *Rucervus schomburgki* (NSMT-M01151) C) Dorsal view.

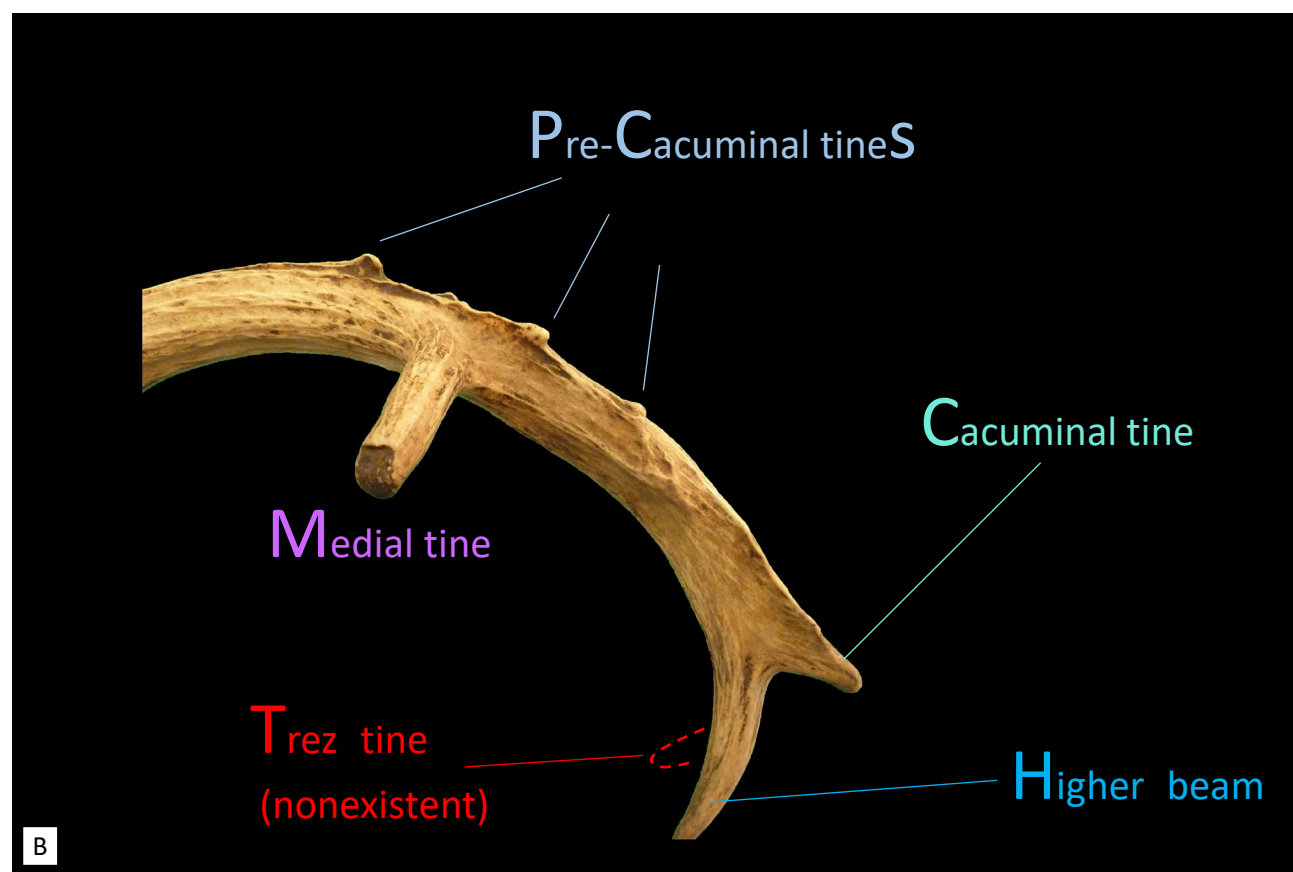
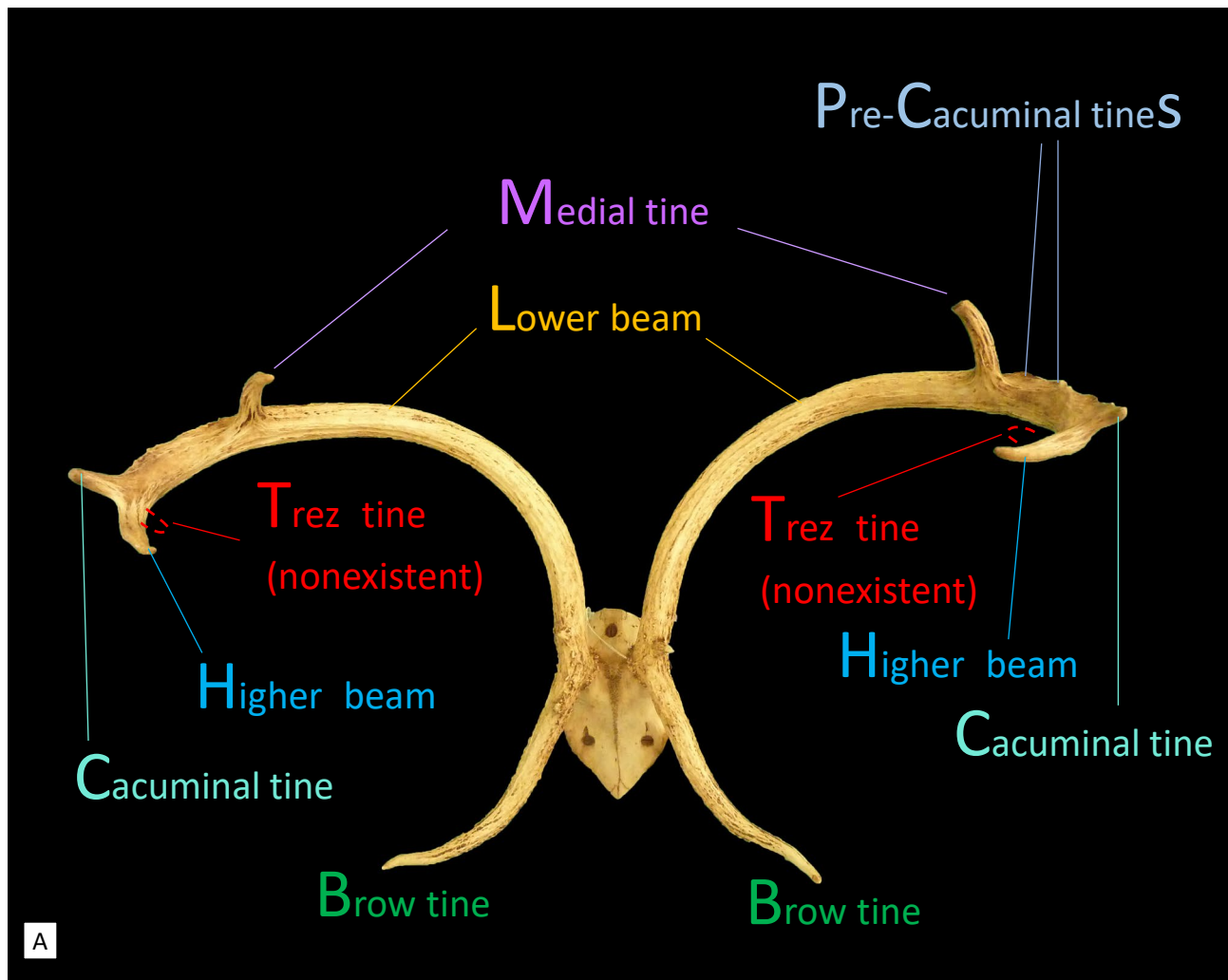


**Figure 27.** *Panolia eldii* (OMNH-M2034) A) Left antler, lateral view. B) Anterior view.



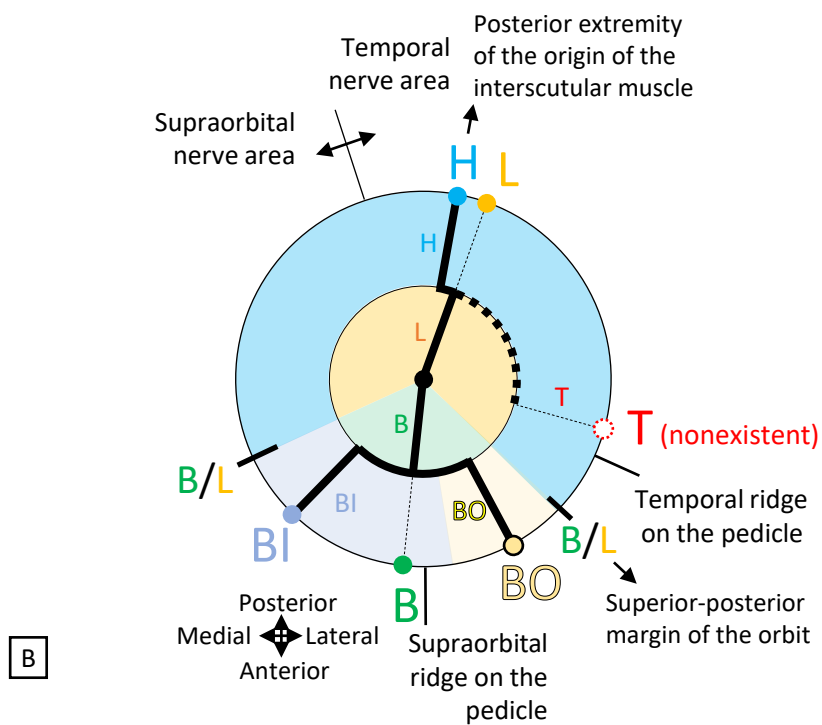
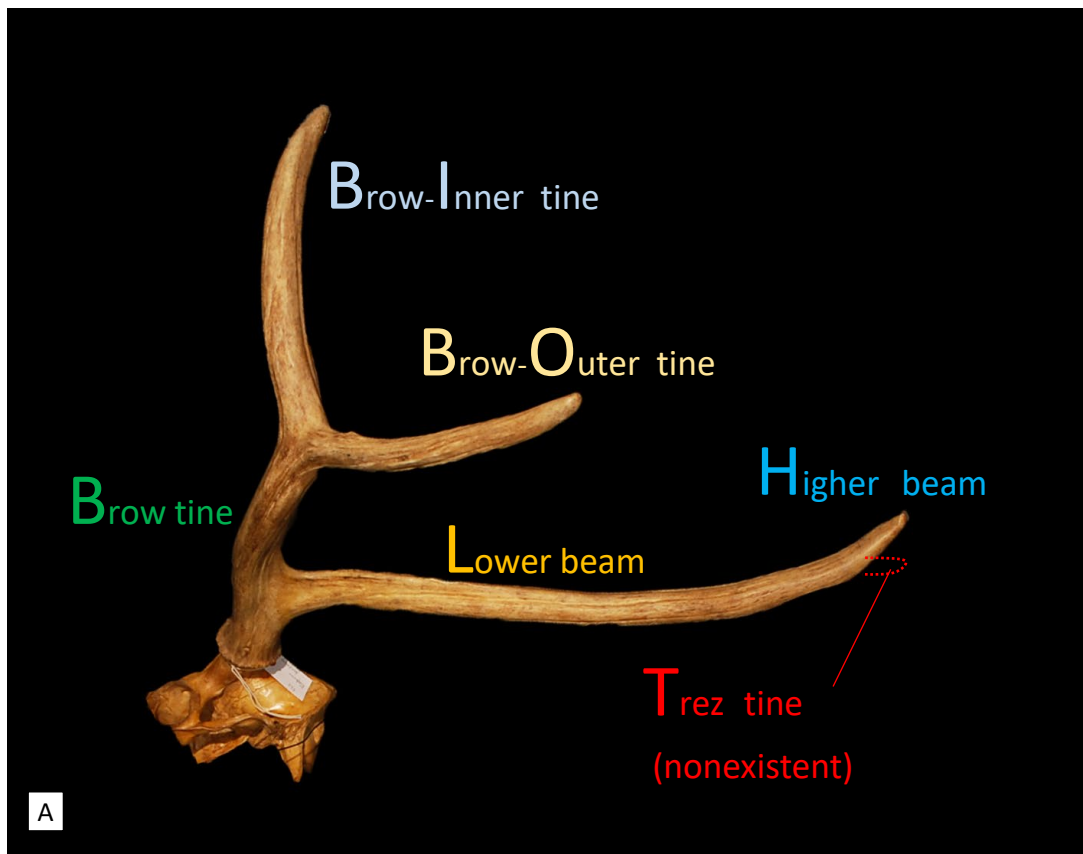
C

**Figure 27.** *Panolia eldii* (OMNH-M2034) C) Diagram of the left antler.

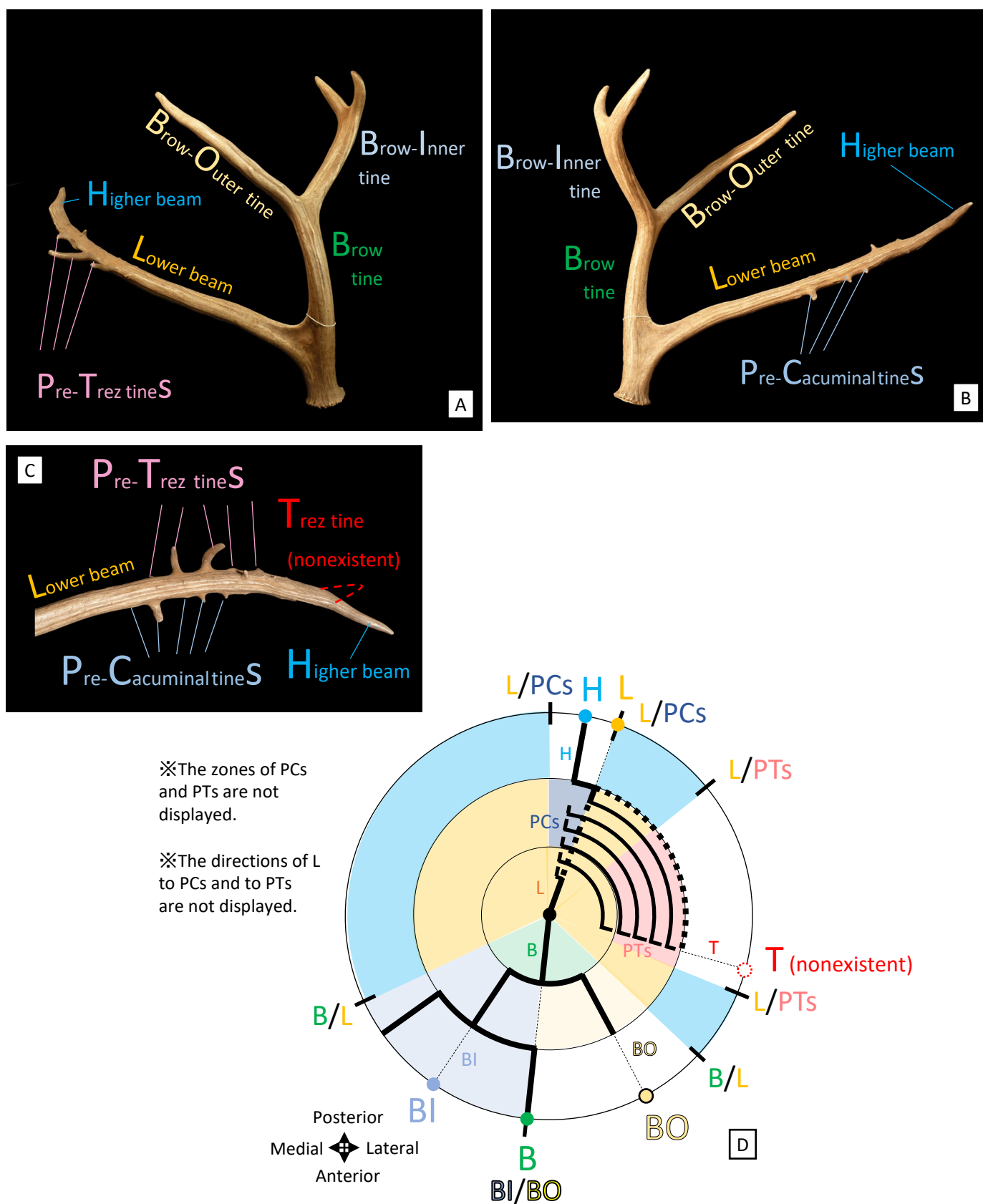


**Figure 28.** *Panolia eldii* (HUBG-10286) A) Dorsal view. B) Magnification of the distal part of the left antler.



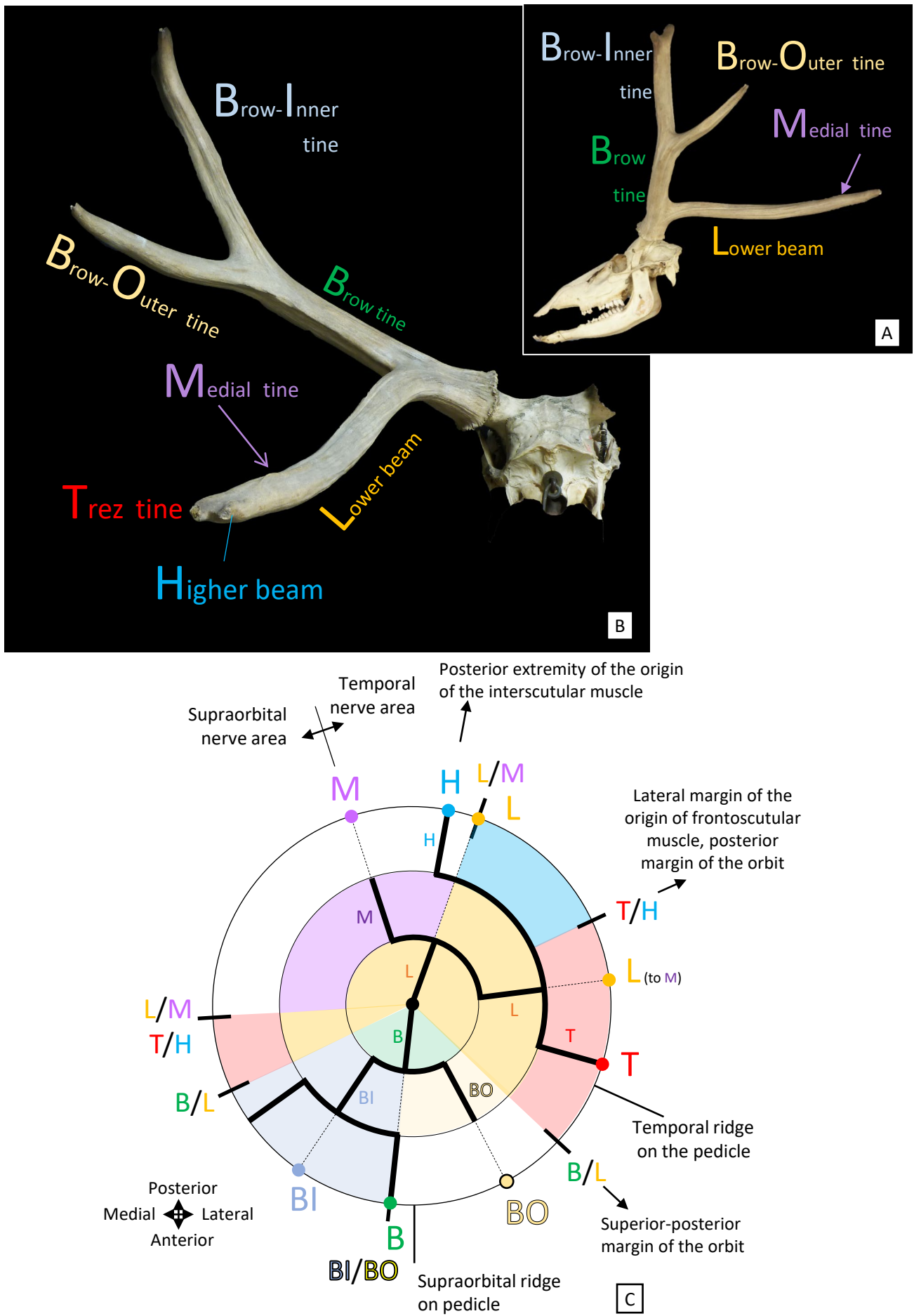


**Figure 29.** *Elaphurus davidianus* (KUGM-RM022) A) Left antler, lateral view. B) Diagram of the left antler.

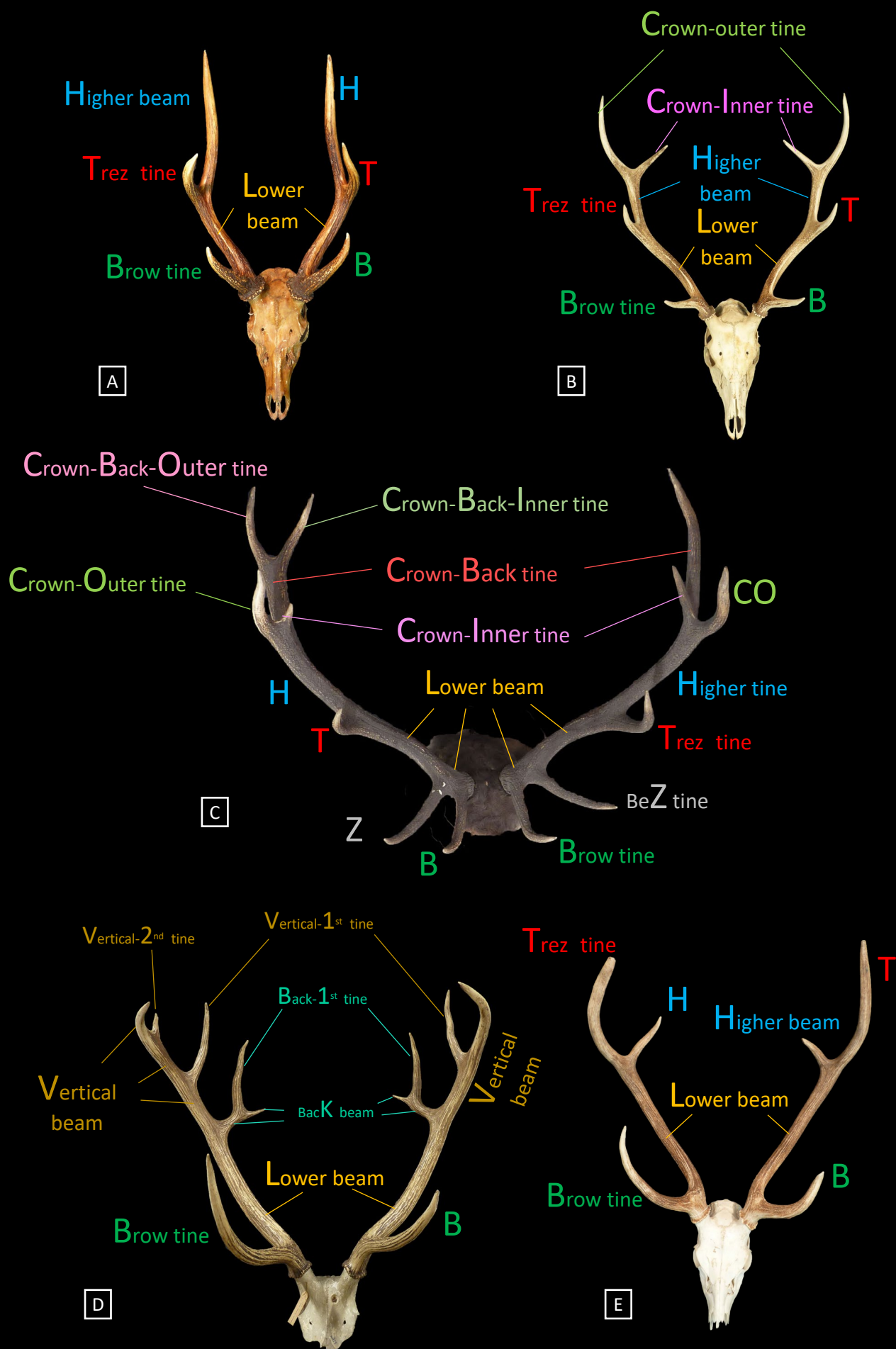


**Figure 30.** *Elaphurus davidianus* (KUGM-RM044) A) Right antler, lateral view. B) Right antler, medial view. C) Distal portion of the right antler, dorsal view. D) Diagram of the right antler (horizontally flipped) .

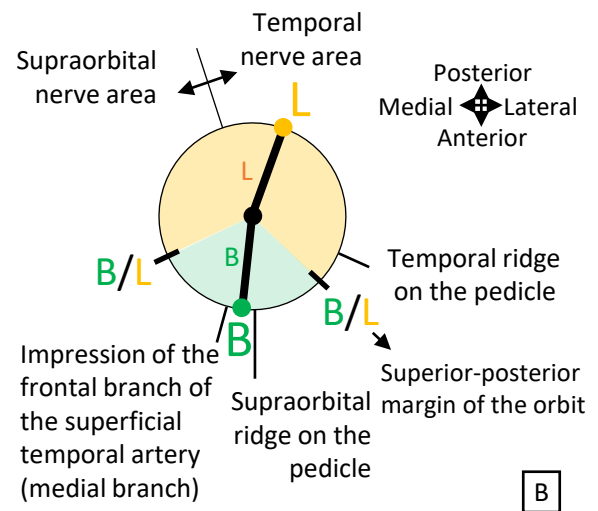
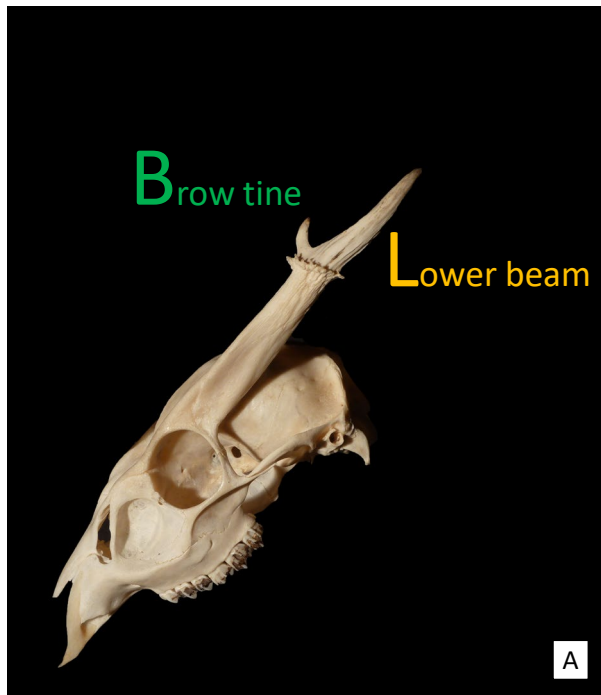




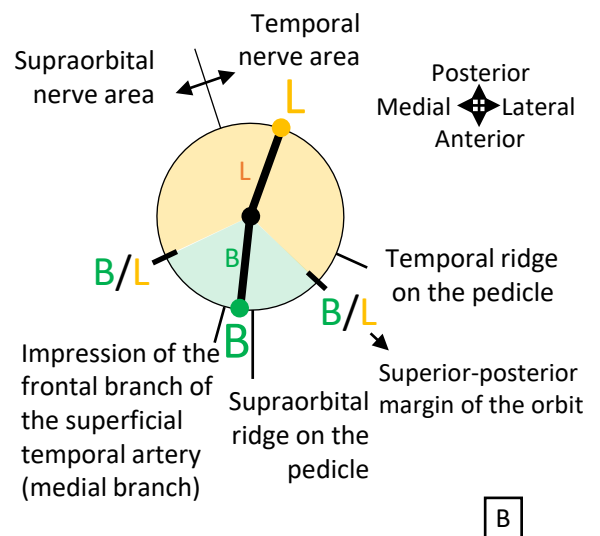
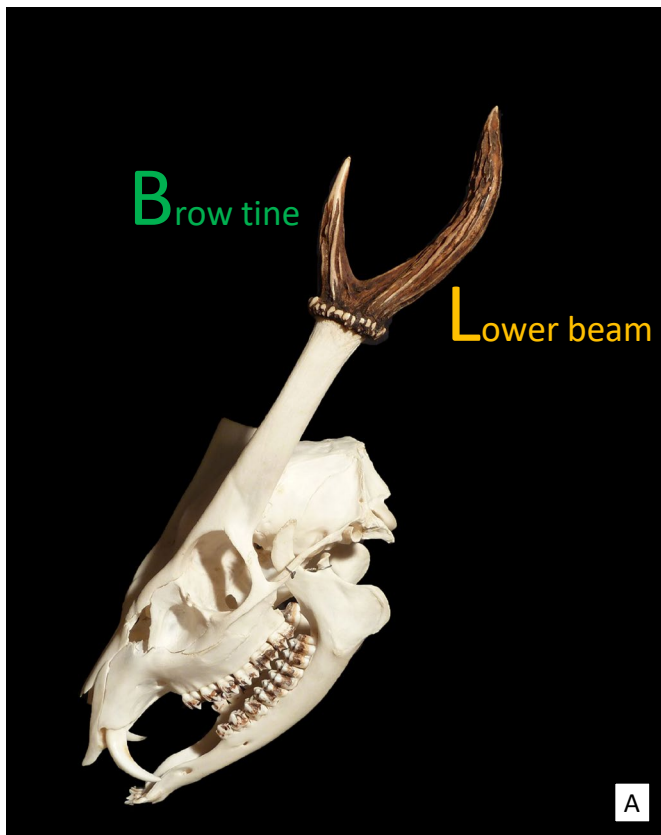
**Figure 31.** *Elaphurus davidianus* (NSMT-M00464) A) Left antler, lateral view. B) Left antler, posterior view. C) Diagram of the left antler.



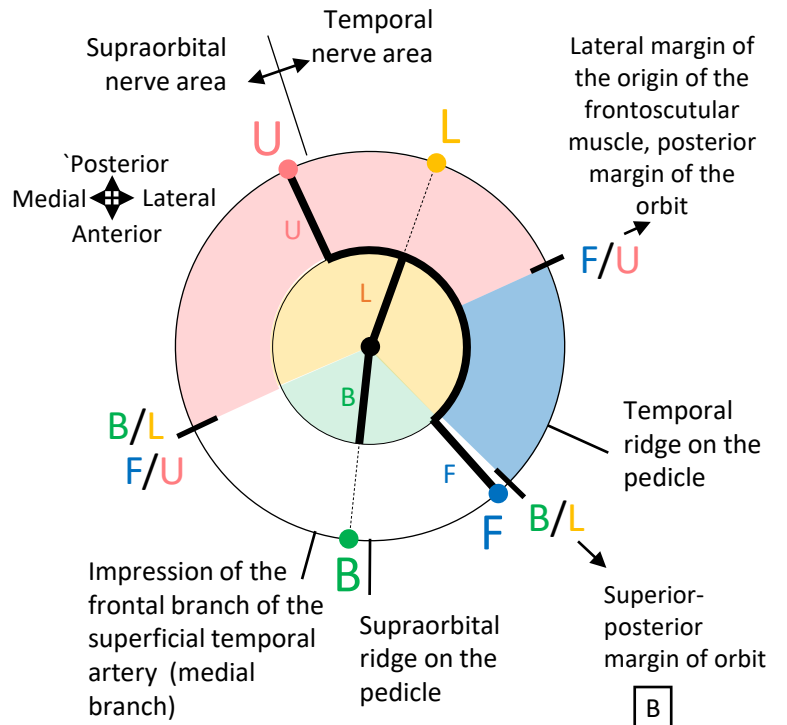
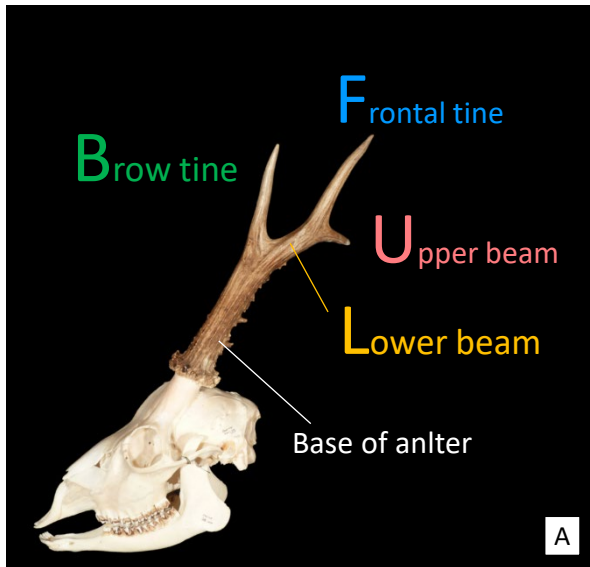
**Figure 32.** Comparison of A) *Rusa timorensis* (KUGM-RM021) , B) *Cervus nippon* (KUGM-RM003) , C) *Cervus elaphus* (NSMT-No number) , D) *Rucervus duvaucelii* (NSMT-M01152) and E) *Axis axis* (KUGM-RM014) in the dorsal view.



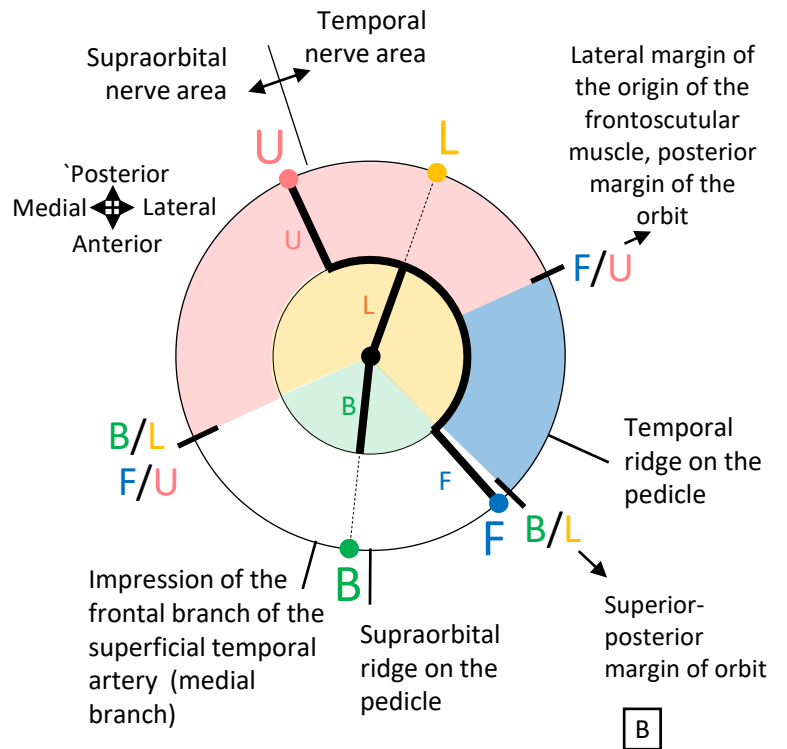
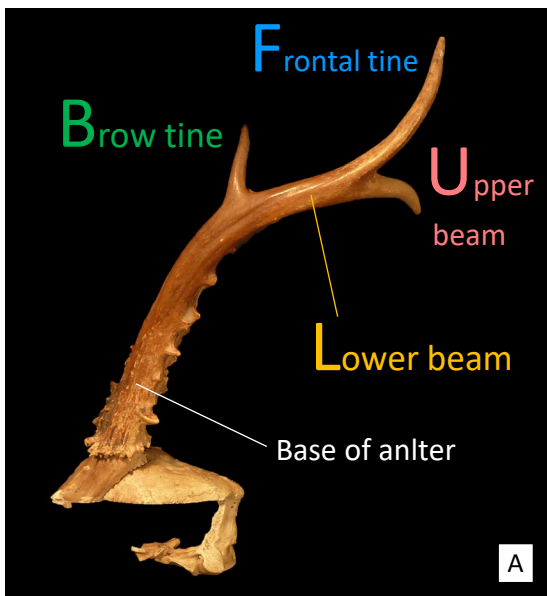
**Figure 33.** *Muntiacus reevesi* (KUGM-RM026) A) Left antler, lateral view. B) Diagram of the left antler.



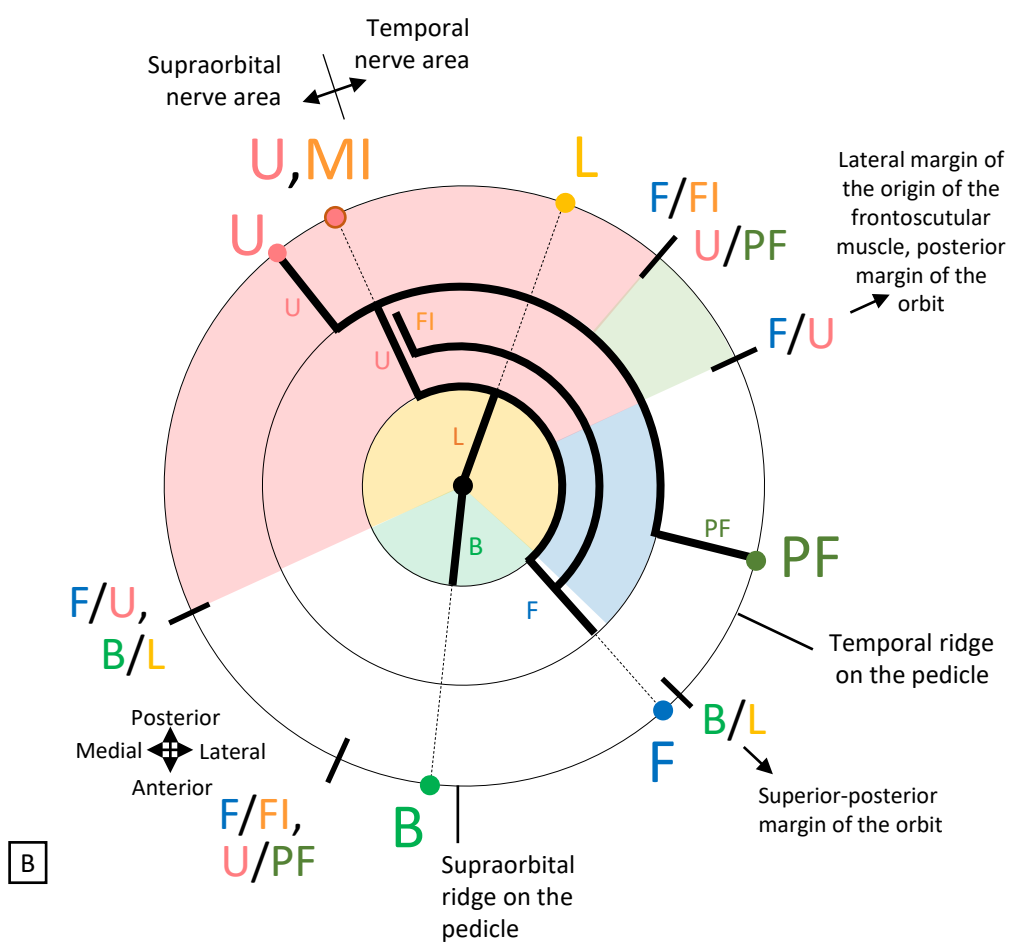
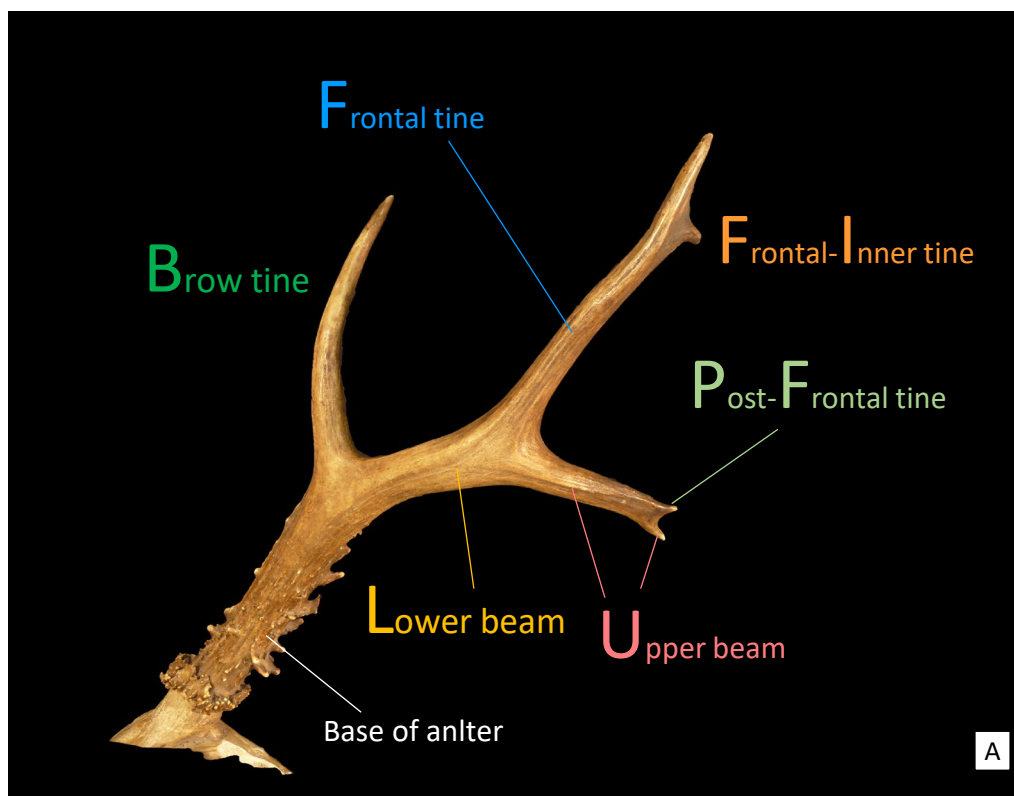
**Figure 34.** *Muntiacus muntjak* (KUGM-RM023) A) Left antler, lateral view. B) Diagram of the left antler.



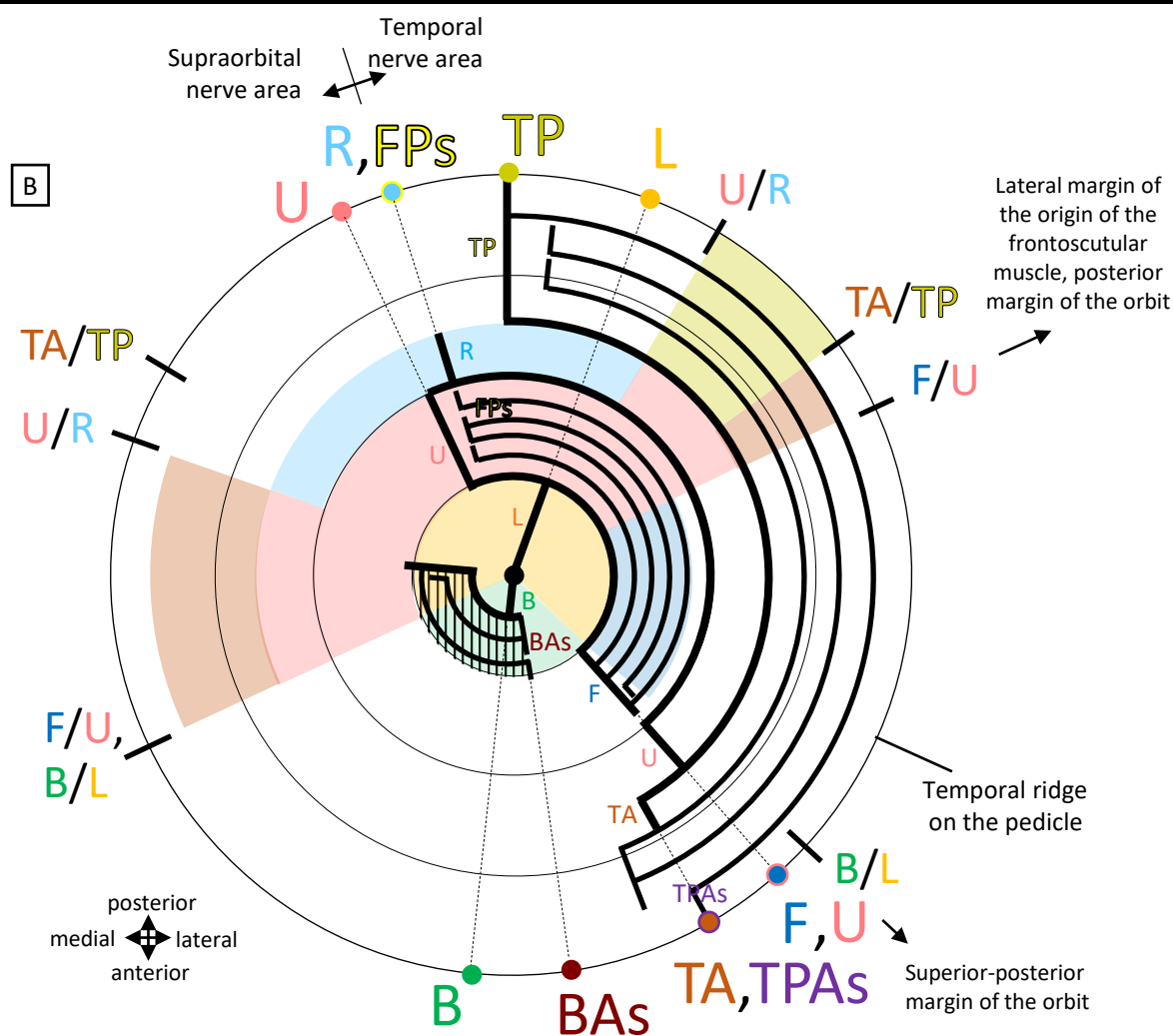
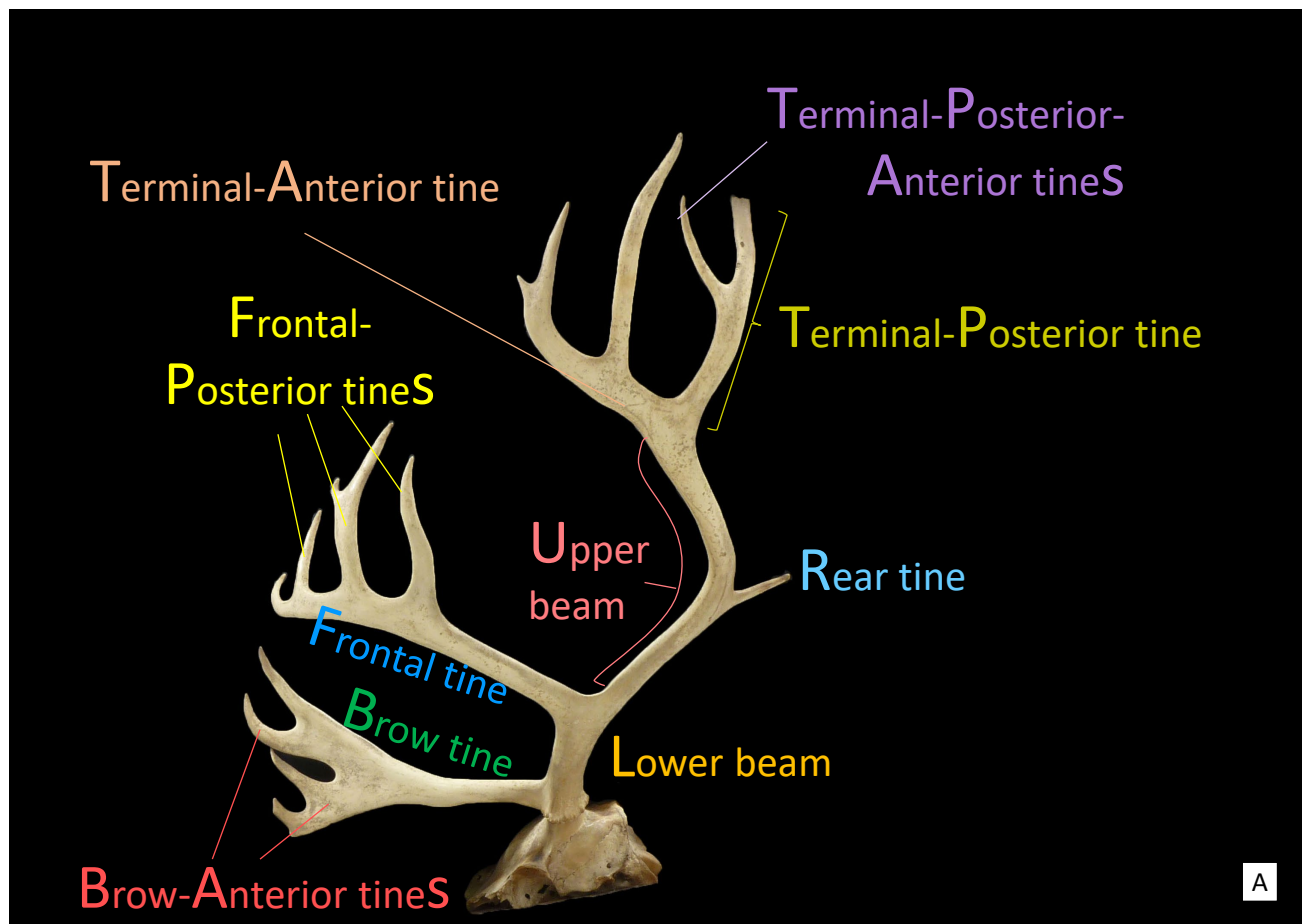
**Figure 35.** *Capreolus capreolus* (KUGM-RM027) A) Left antler, lateral view. B) Diagram of the left antler.



**Figure 36.** *Capreolus pygargus* (KUGM-RM081) A) Left antler, lateral view. B) Diagram of the left antler.

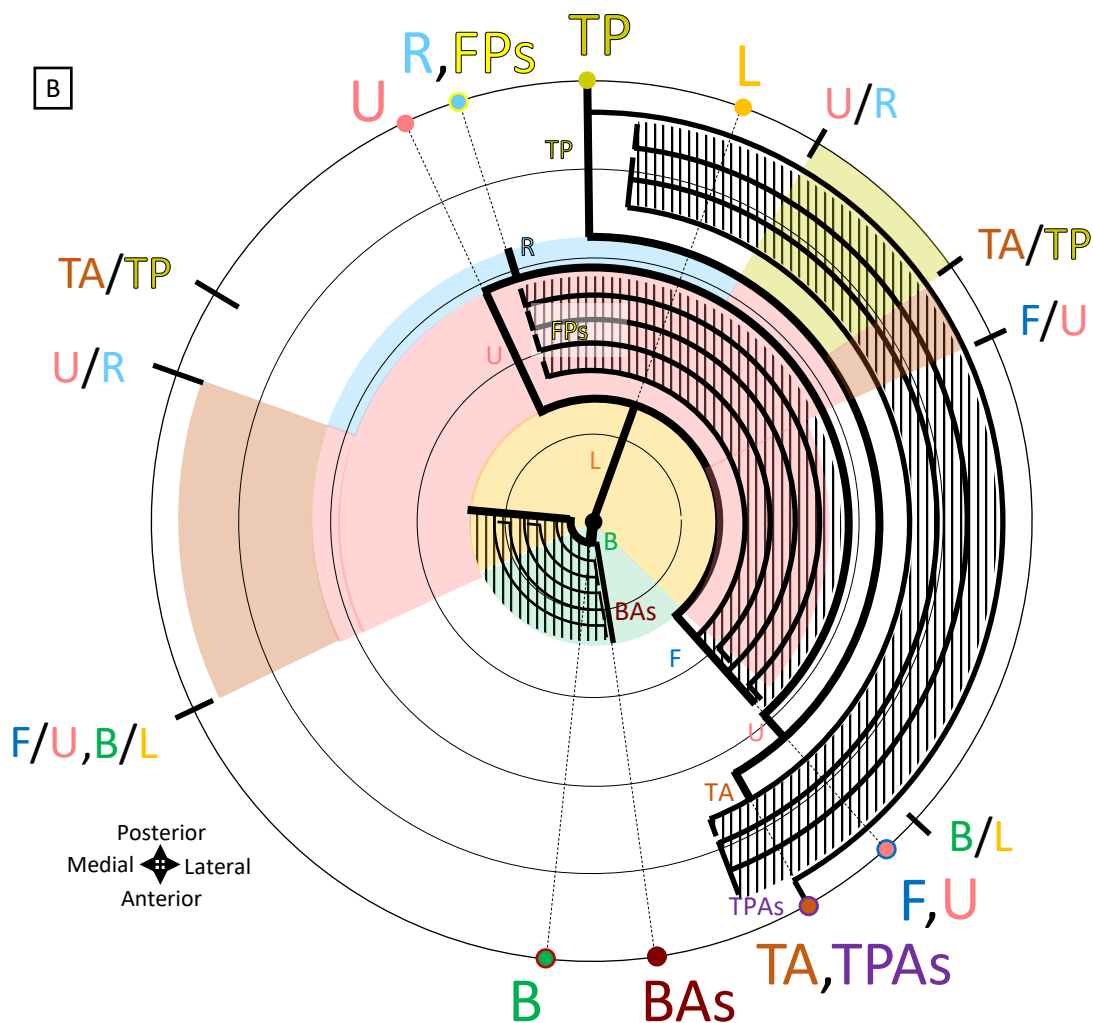
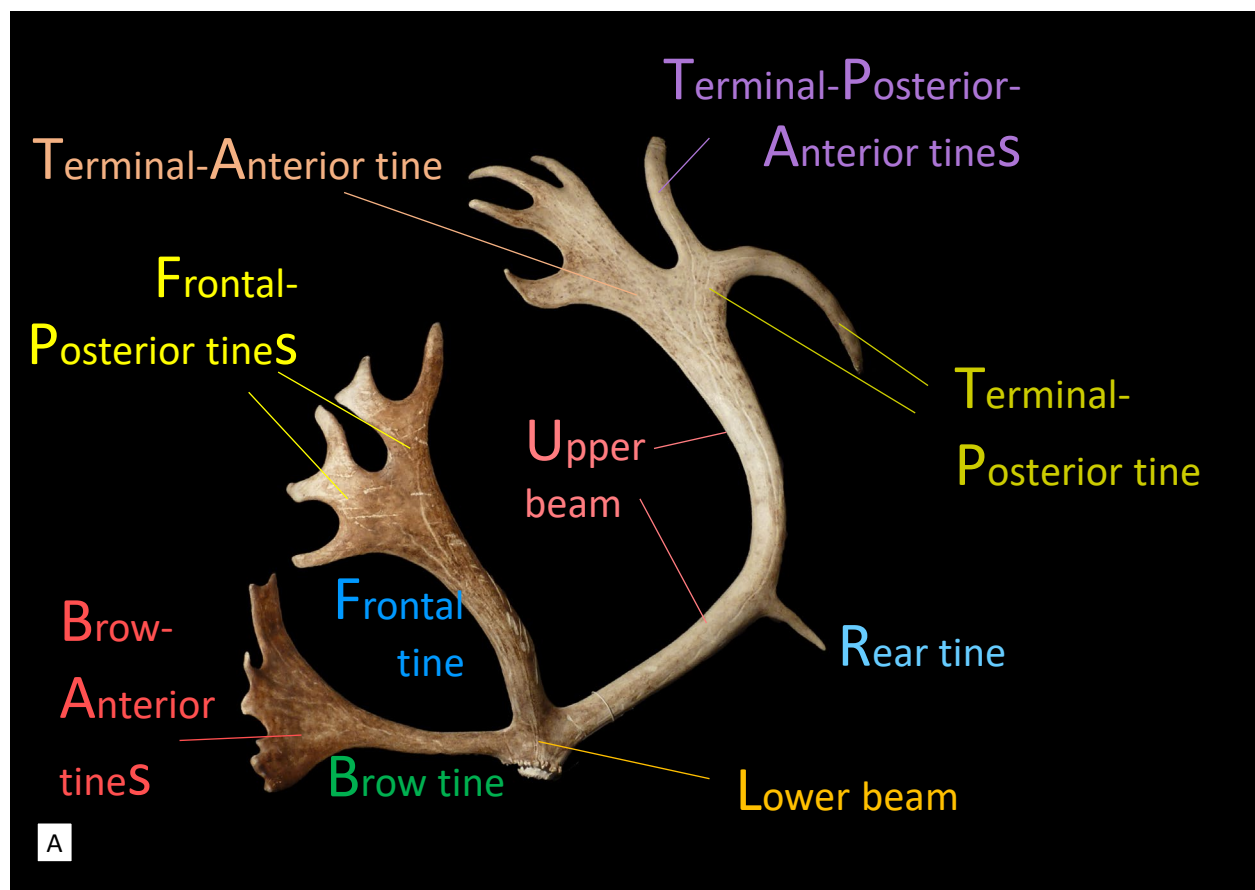


**Figure 37.** *Capreolus pygargus* (KUGM-RM131) A) Left antler, lateral view. B) Diagram of the left antler.

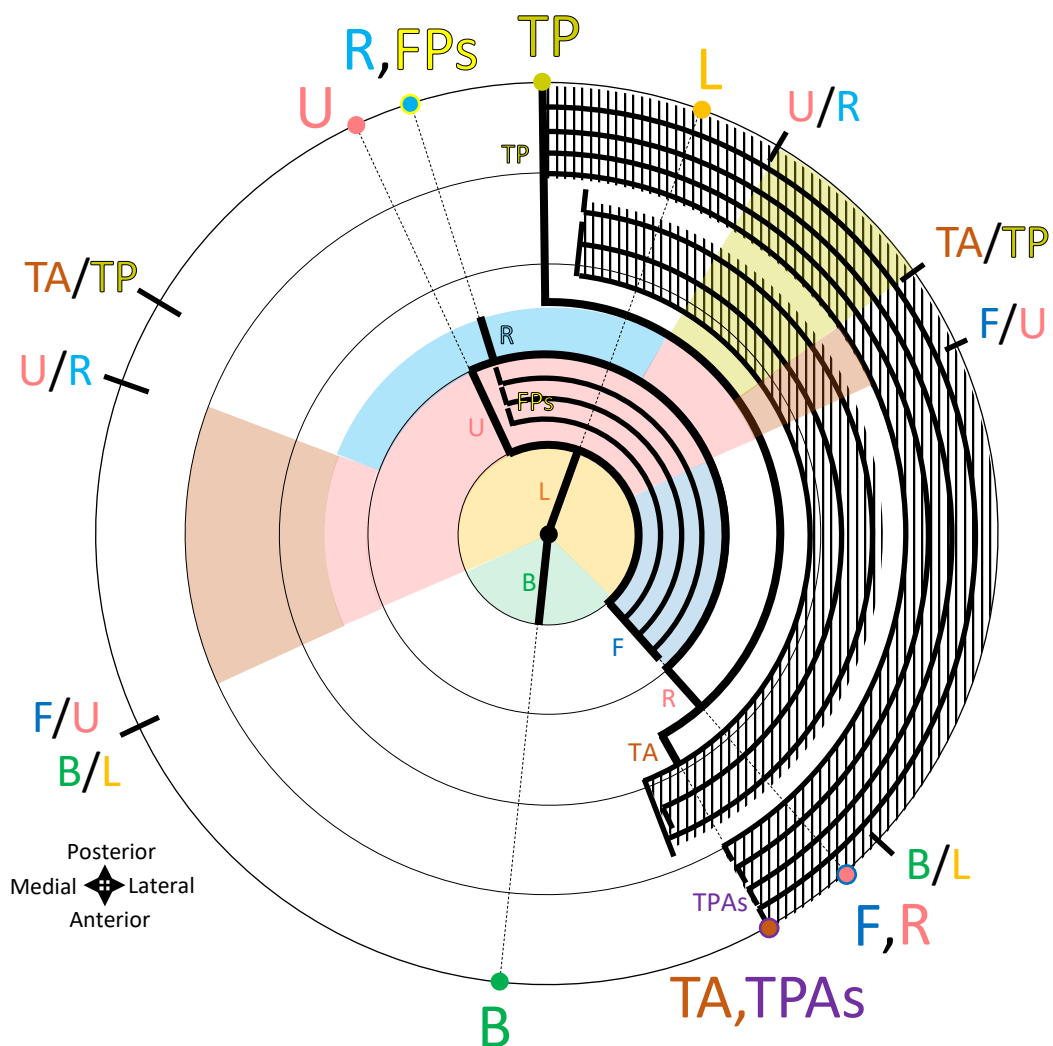
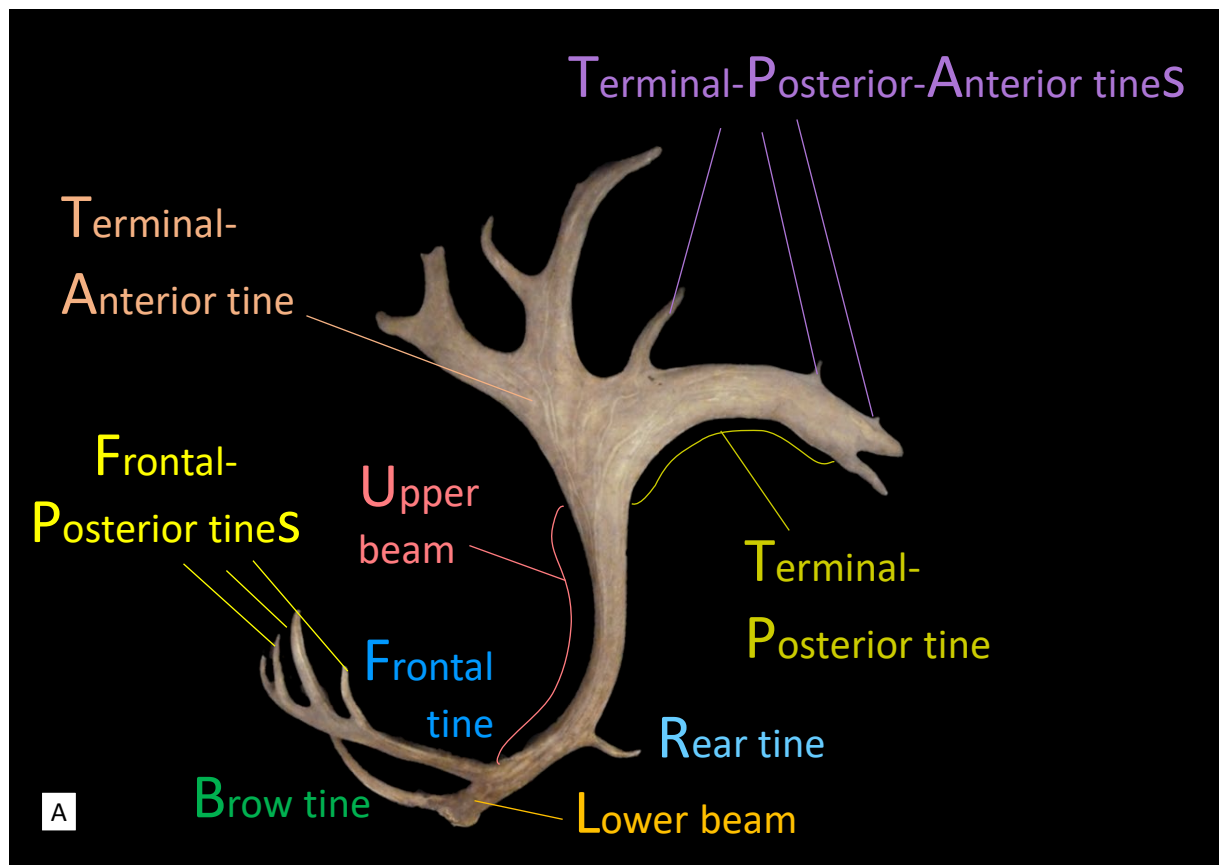


**Figure 38.** *Rangifer tarandus* (NSMT-M56438) A) Left antler, lateral view. B) Diagram of the left antler.





**Figure 39.** *Rangifer tarandus* (KUGM-RM052) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .

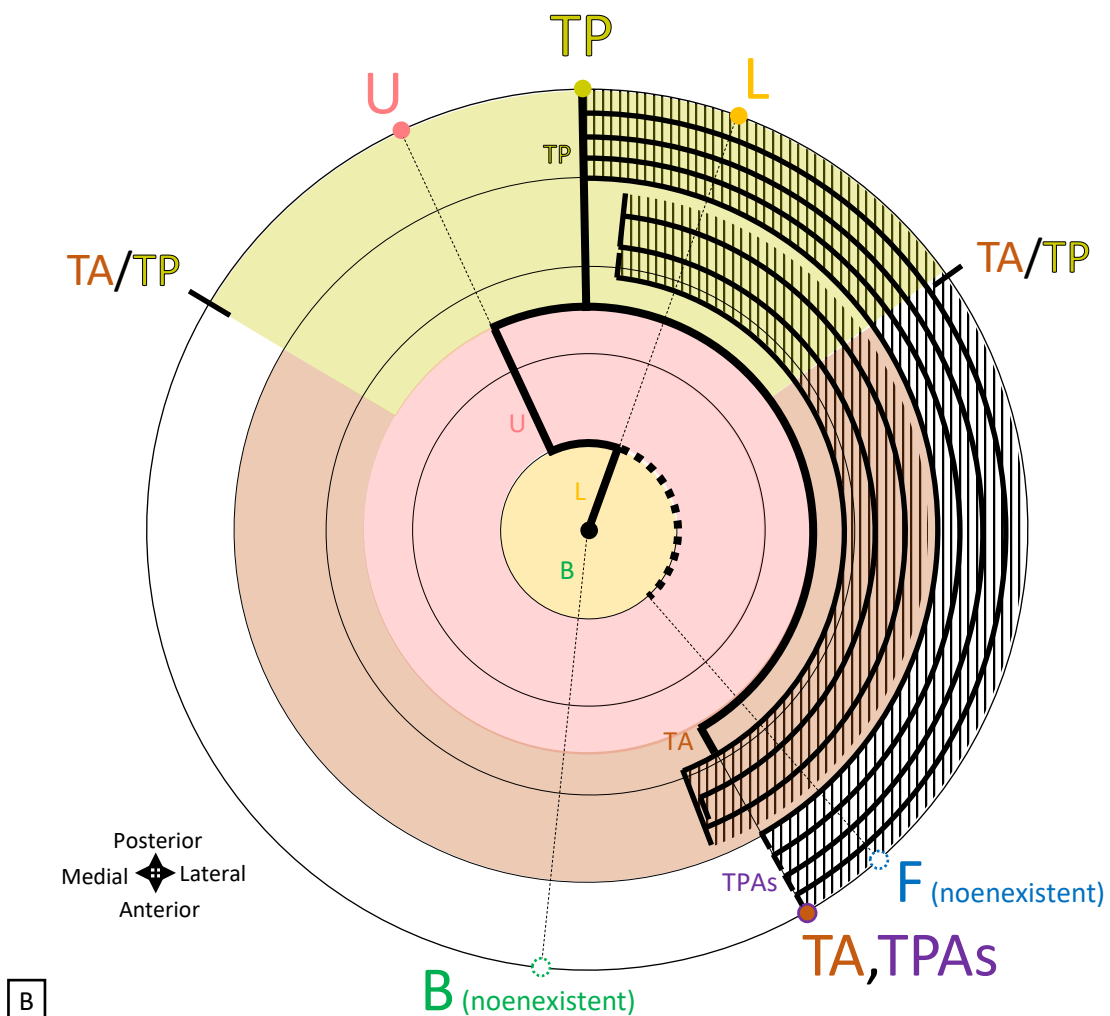
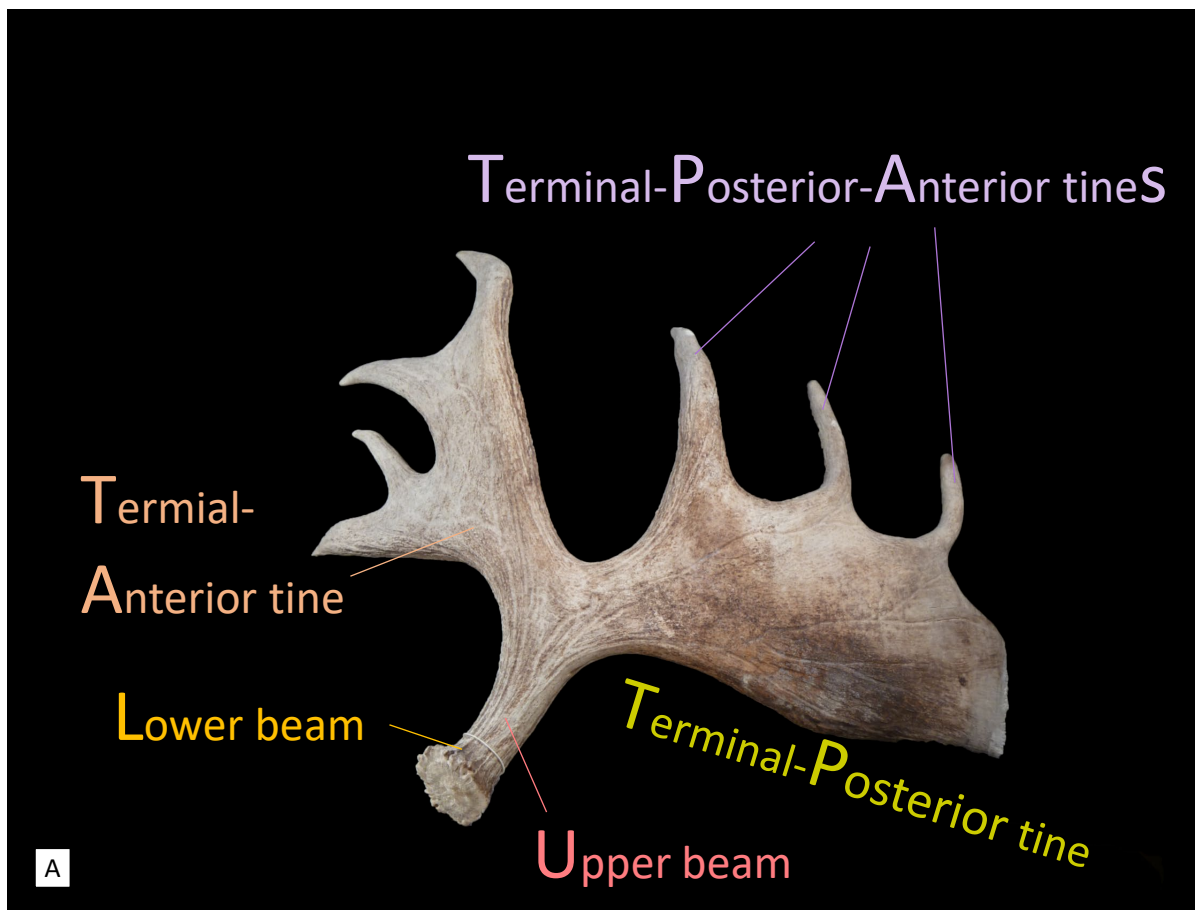


**Figure 40.** *Rangifer tarandus* (NSMT-M43364) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .

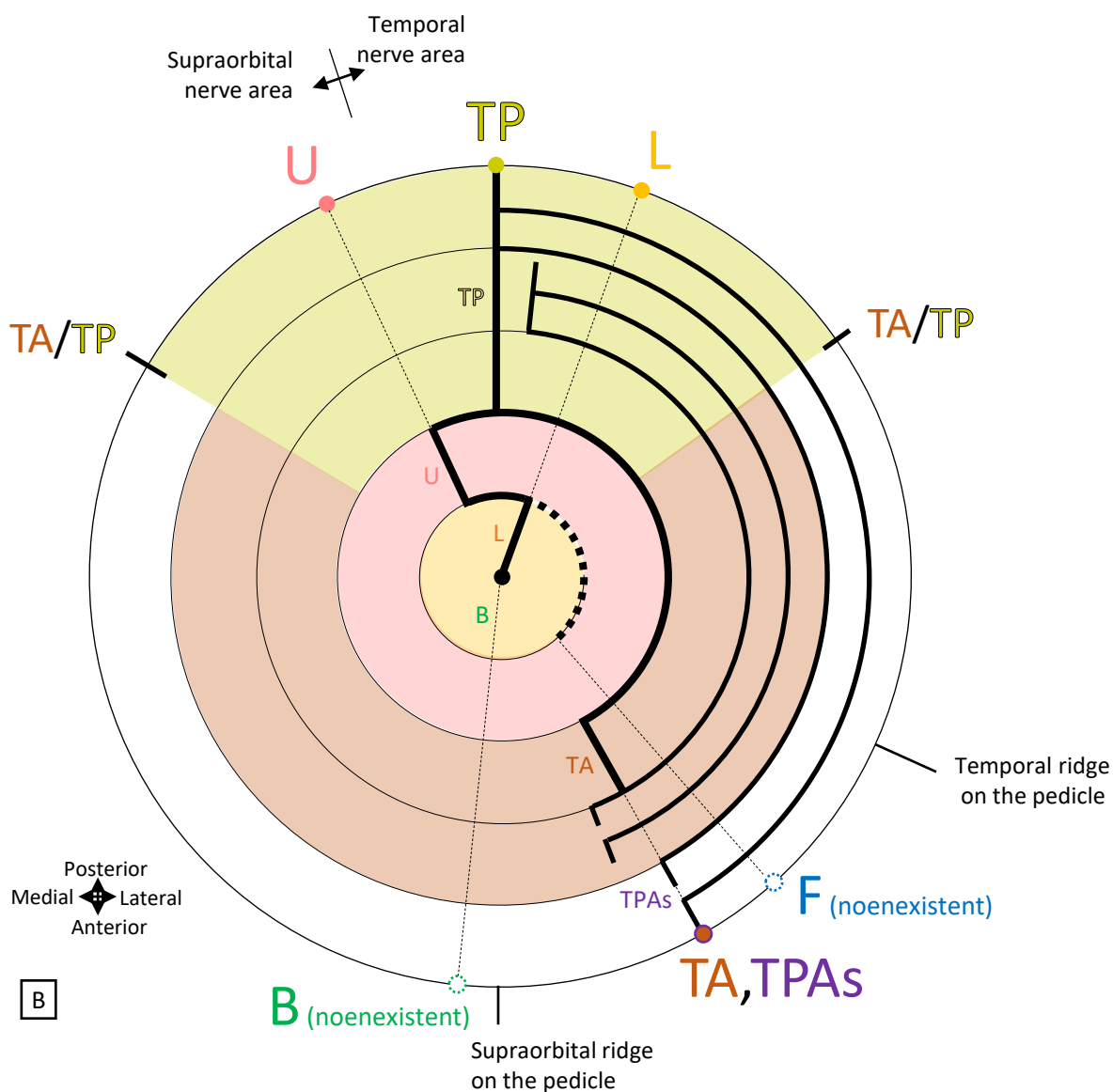
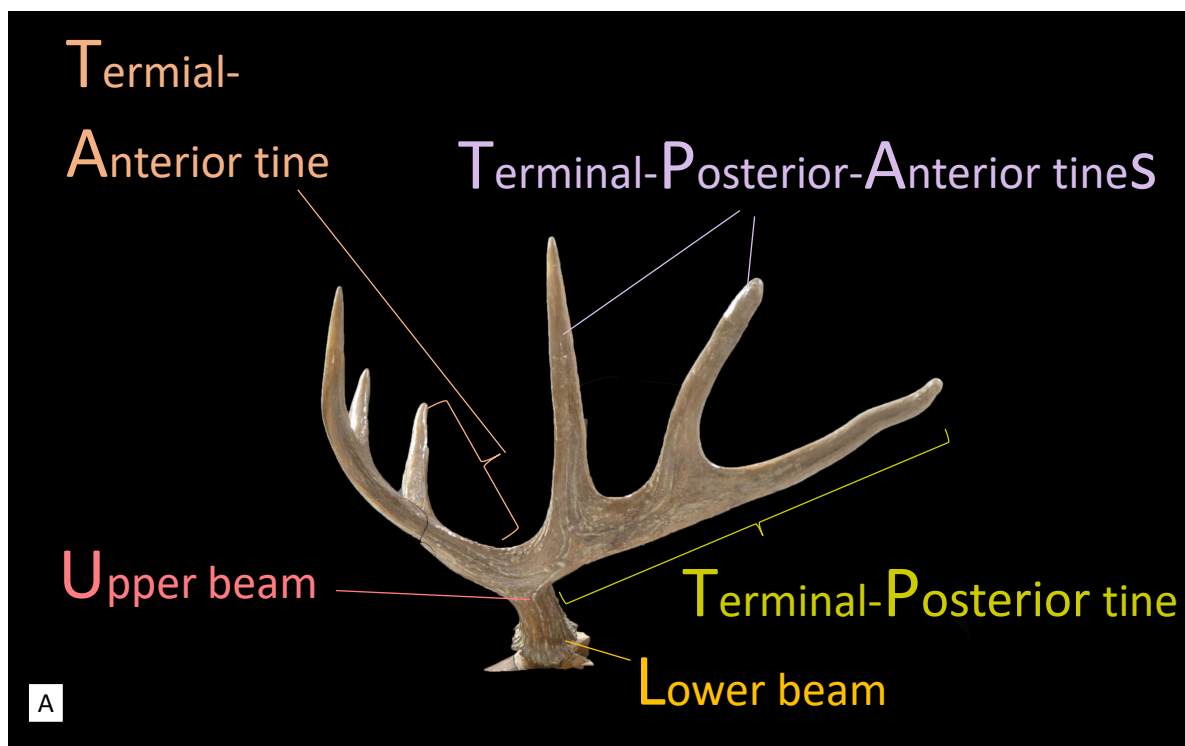




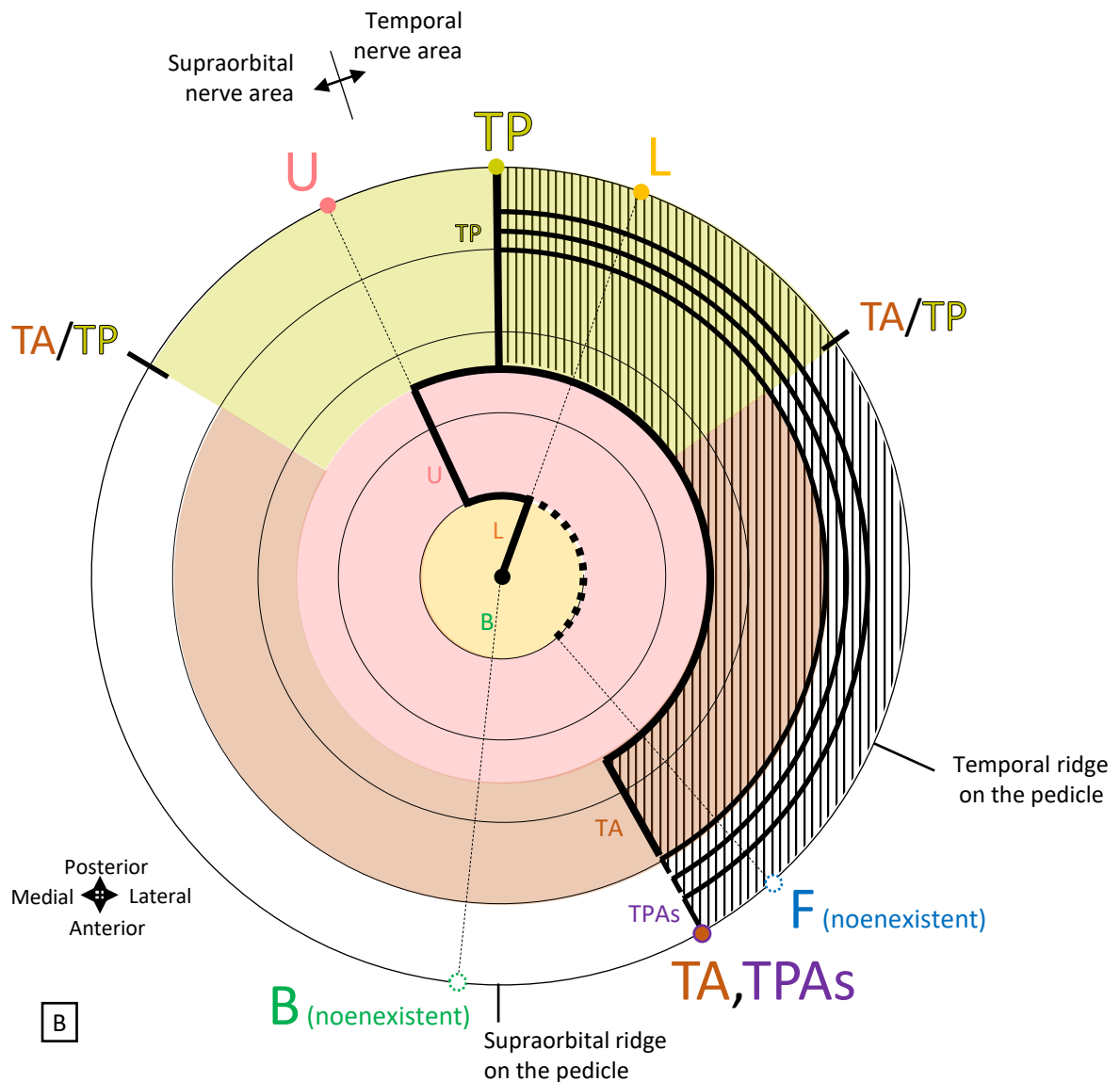
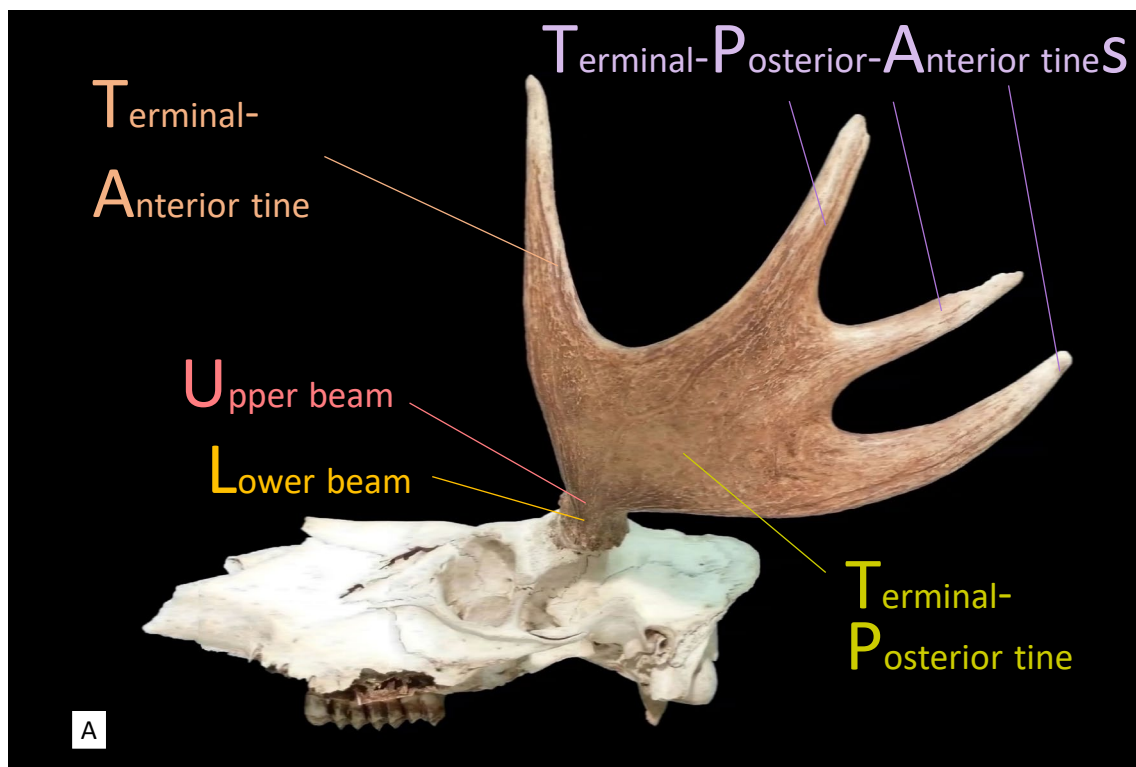
**Figure 41.** Comparison of A) *Rangifer tarandus* (NSMT-M43364) (horizontally flipped) and B) *Alces alces* (KUGM-RM049) . The palmate part of *R.tarandus* surrounded by the red square is resembles *A.alces*.



**Figure 42.** Typical antler of *Alces alces* (KUGM-RM049) . A) Left antler, ventral-lateral view . B) Diagram of the left antler.



**Figure 43.** Non-palming antler of *Alces alces* (NSMT-M43310) . A) Left antler, lateral view . B) Diagram of the left antler.

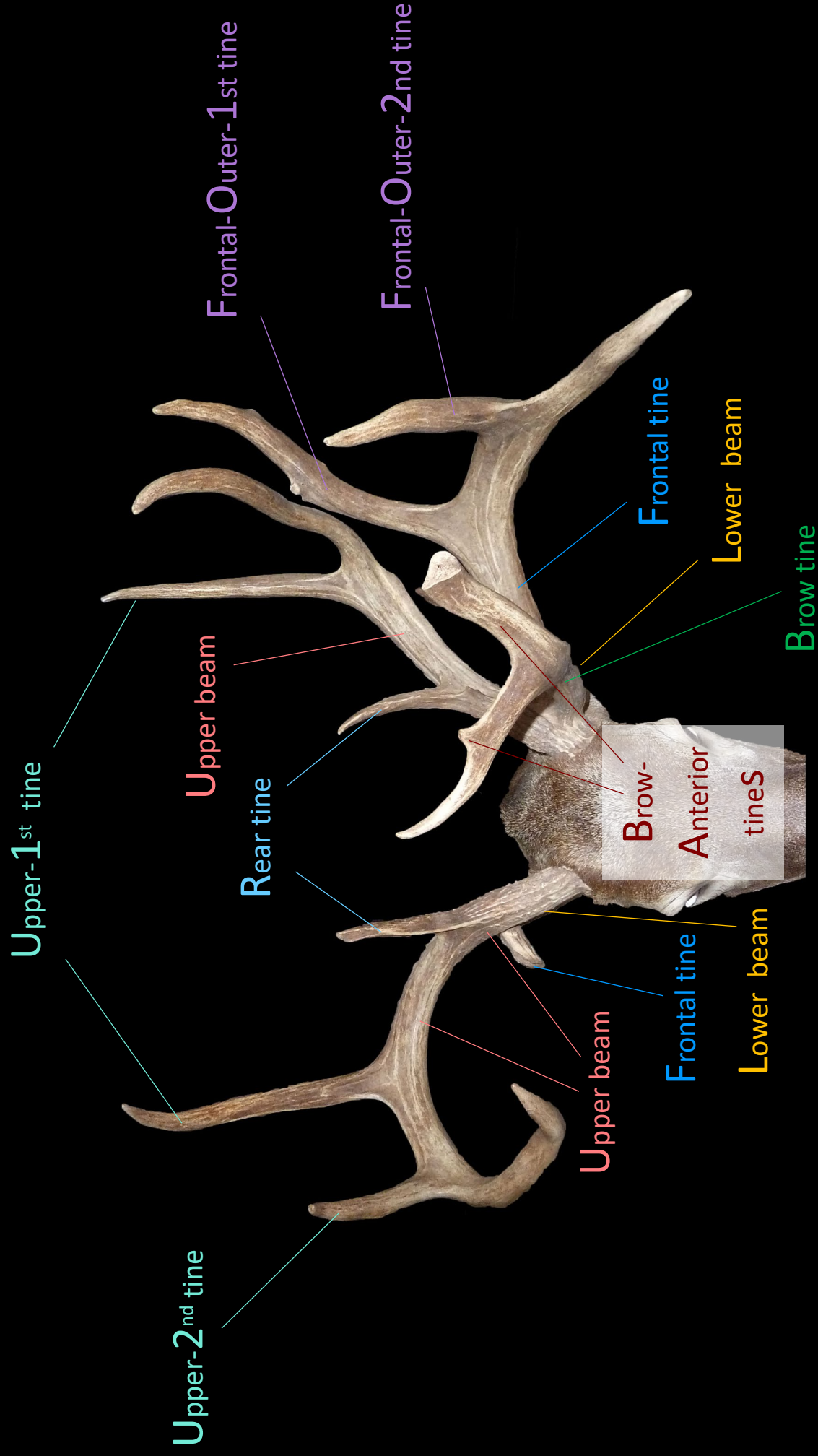


**Figure 44.** *Alces alces* (KUGM-RM029) . A) Left antler, lateral view . B) Diagram of the left antler.



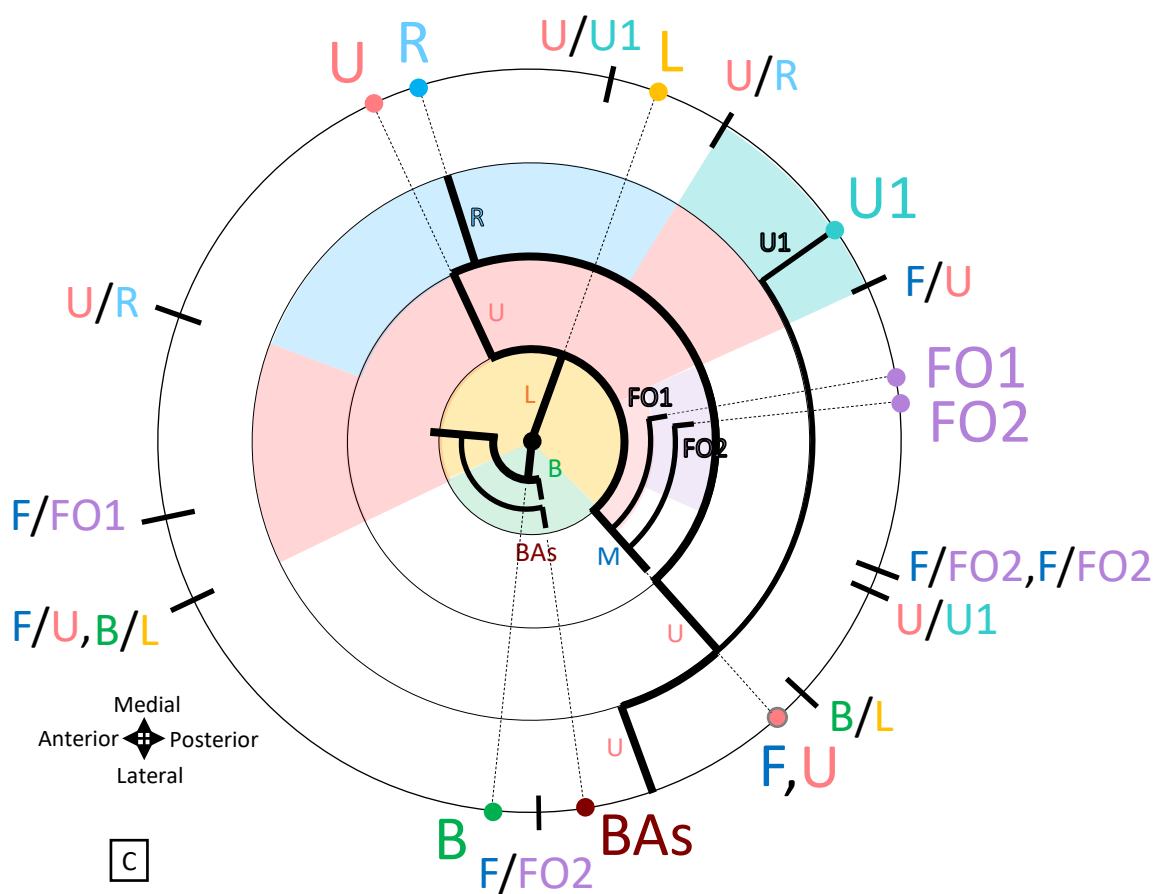
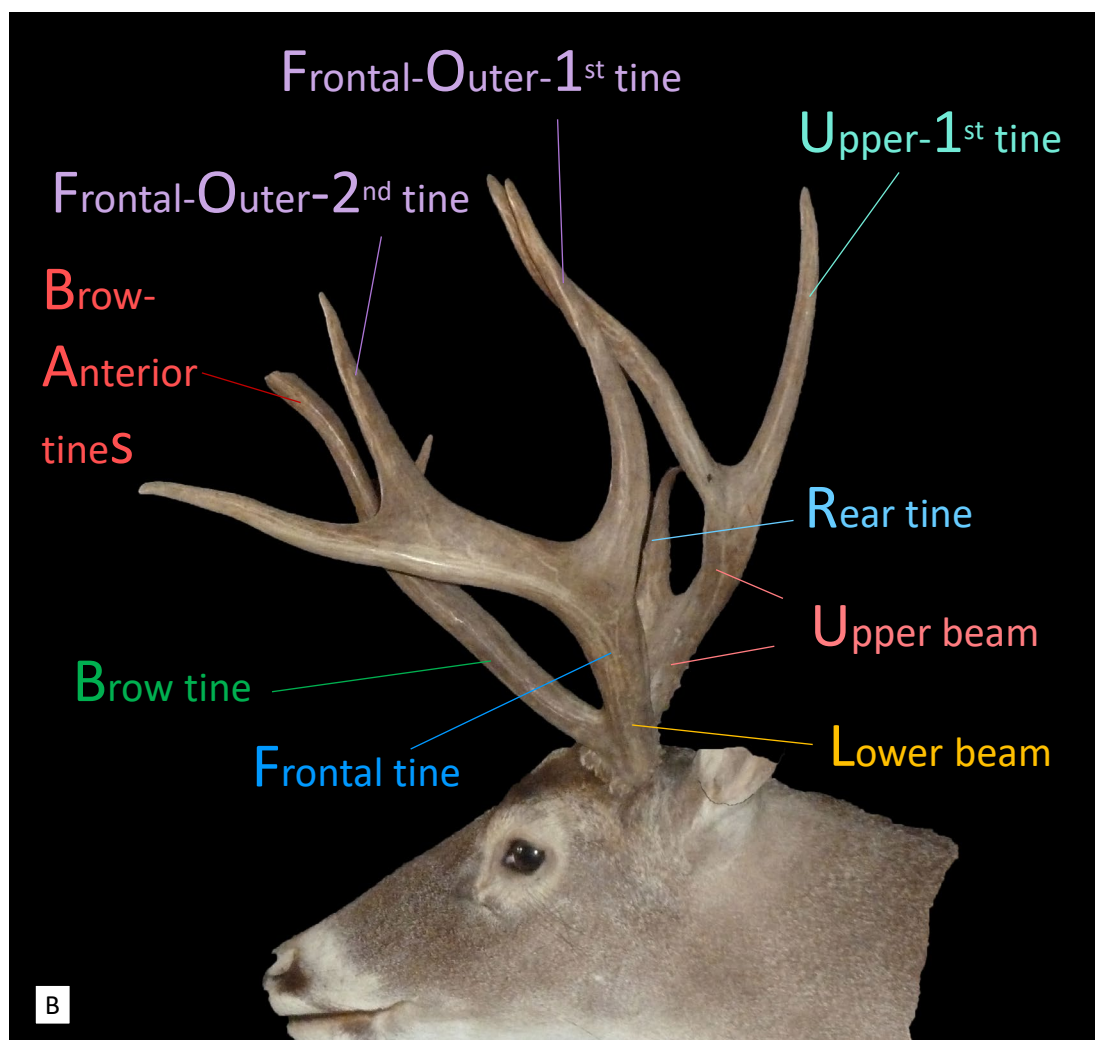
**Figure 45.** *Odocoileus virginianus* with abnormal antlers. (NSMT-M32362) A) Dorsal-anterior view. B) Lateral view. C) Dorsal view. D) Medial-dorsal view.



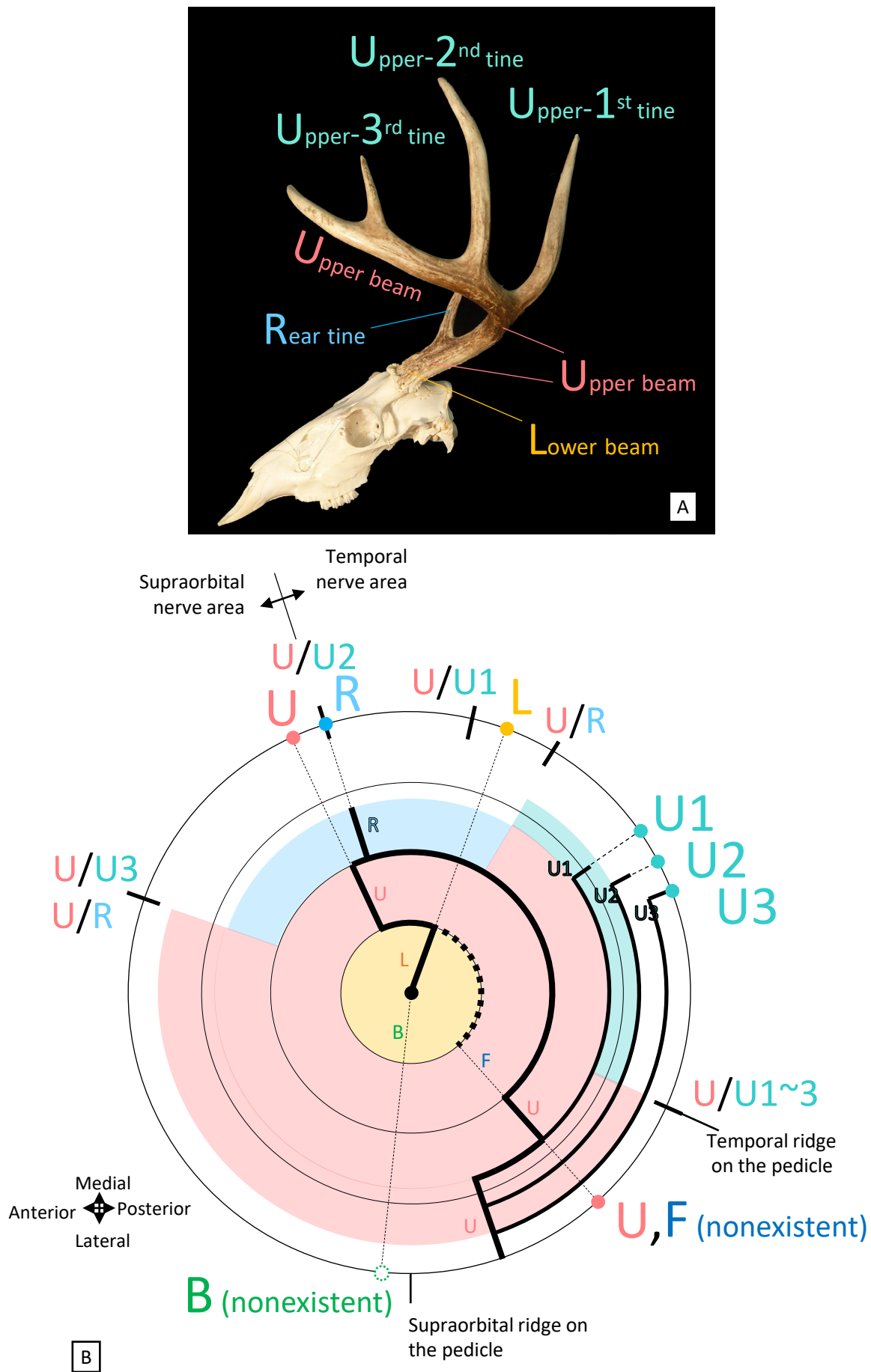


A

**Figure 46.** *Odocoileus virginianus* (NSMT-M32362) A) Dorsal-anterior view, with terminology of the tines.

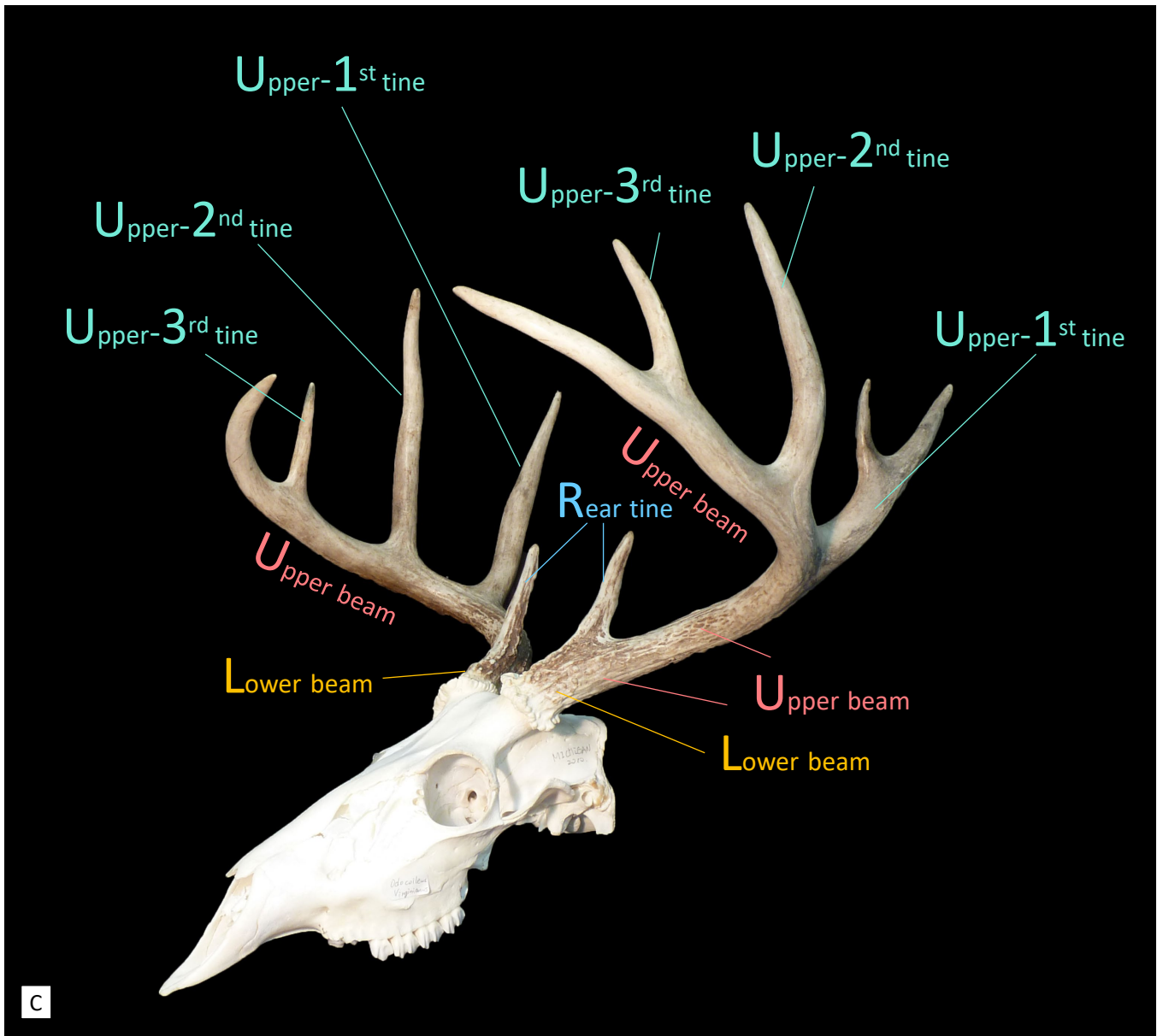


**Figure 47.** Abnormal antler of *Odocoileus virginianus* (NSMT-M32362) A) Left antler, lateral view. B) Diagram of the left antler.

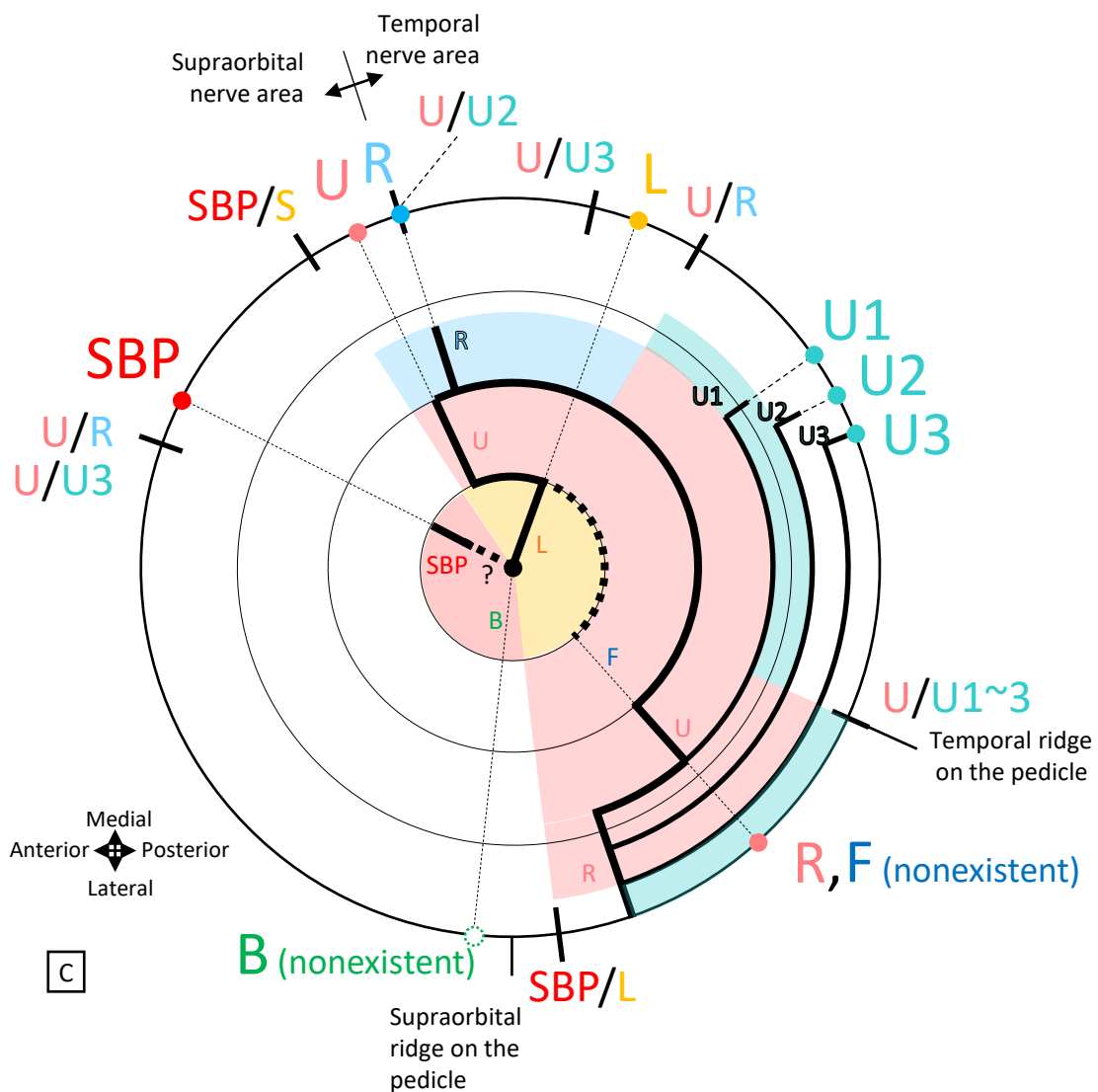
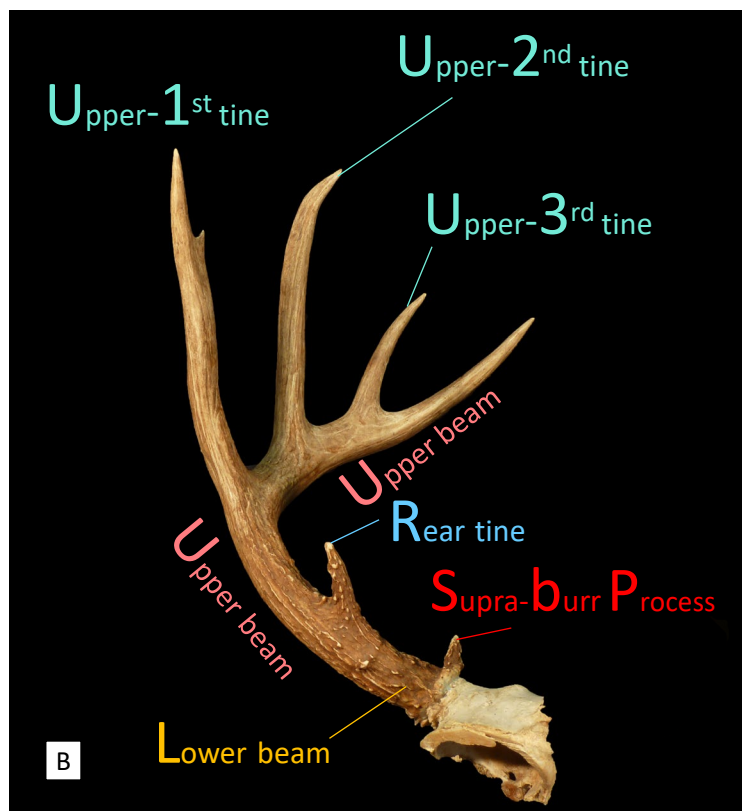
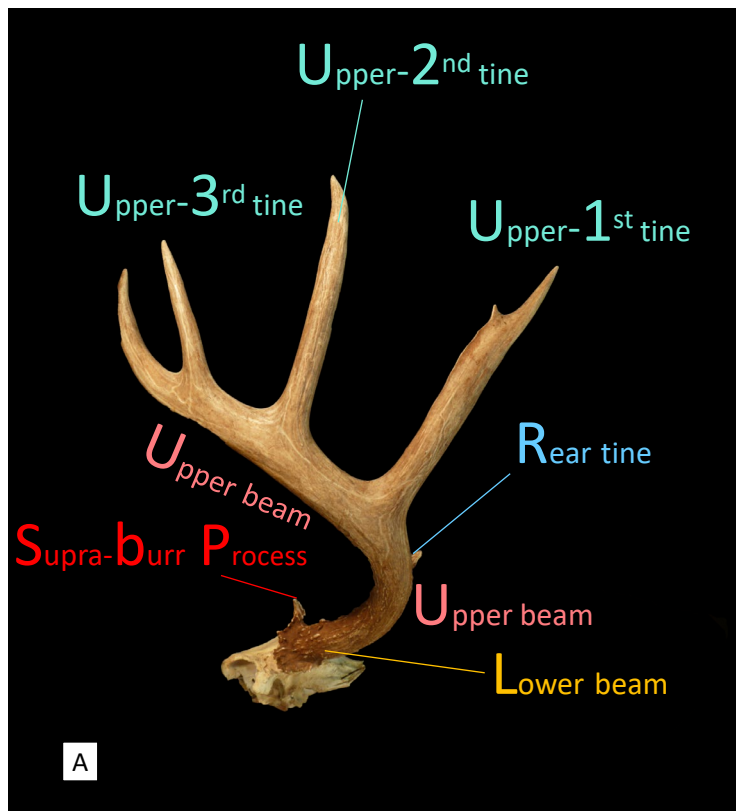


**Figure 48.** Typical antler of *Odocoileus virginianus*, with normal antlers. (KUGM-RM033)  
 A) Right antler, lateral view. (horizontally flipped) , B) Diagram of the right antler.  
 (horizontally flipped)

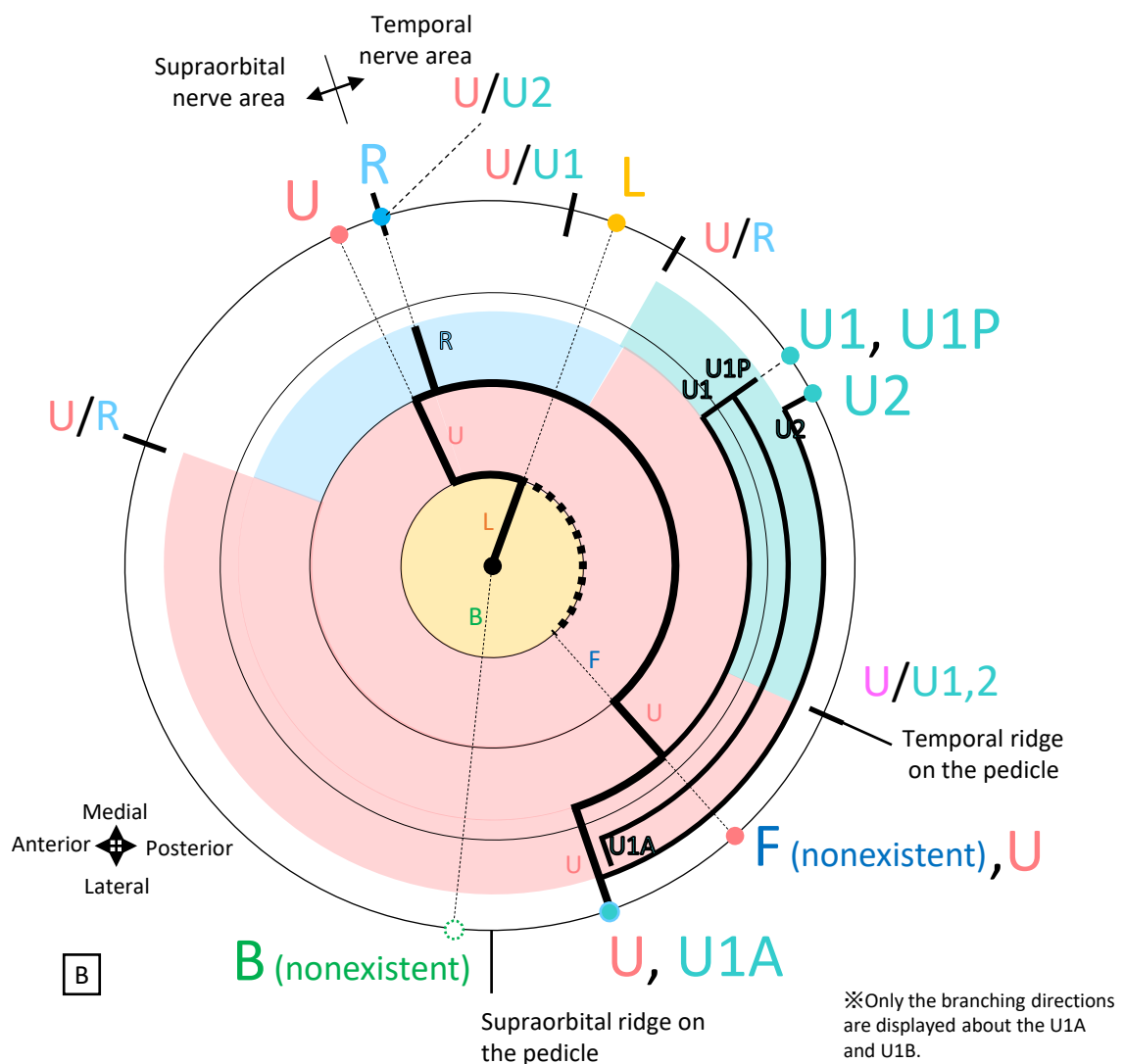
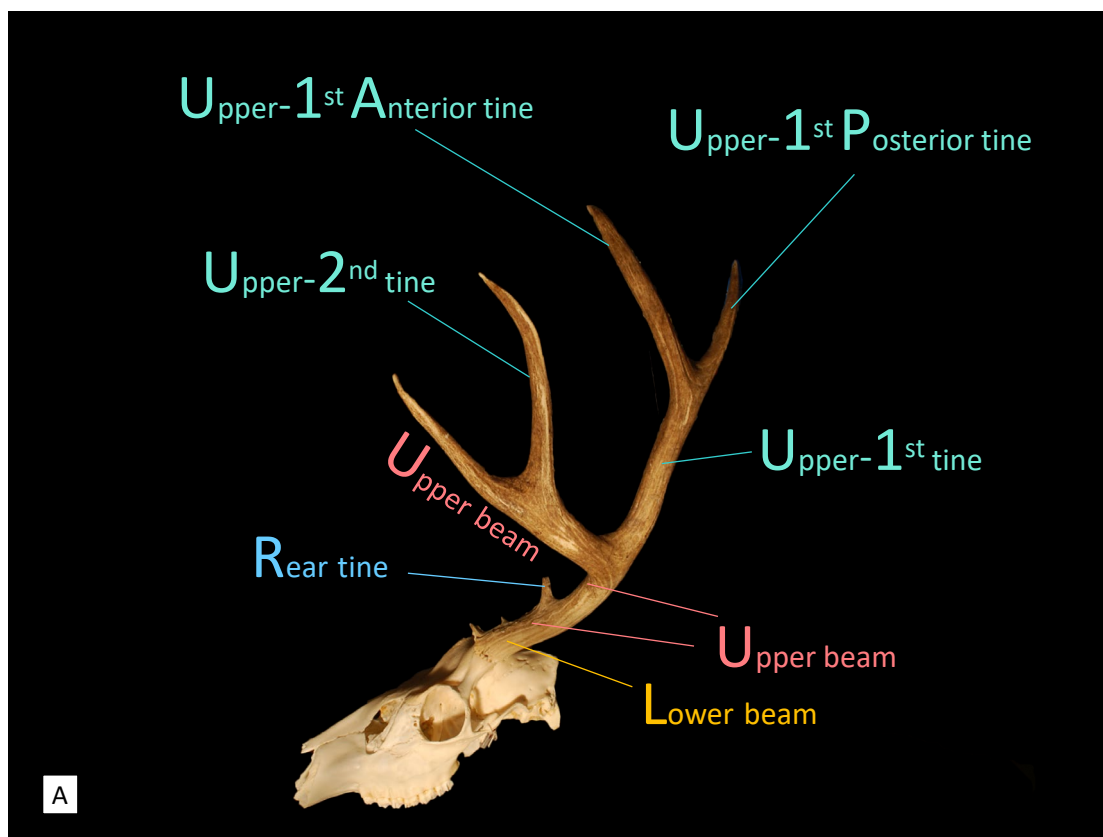




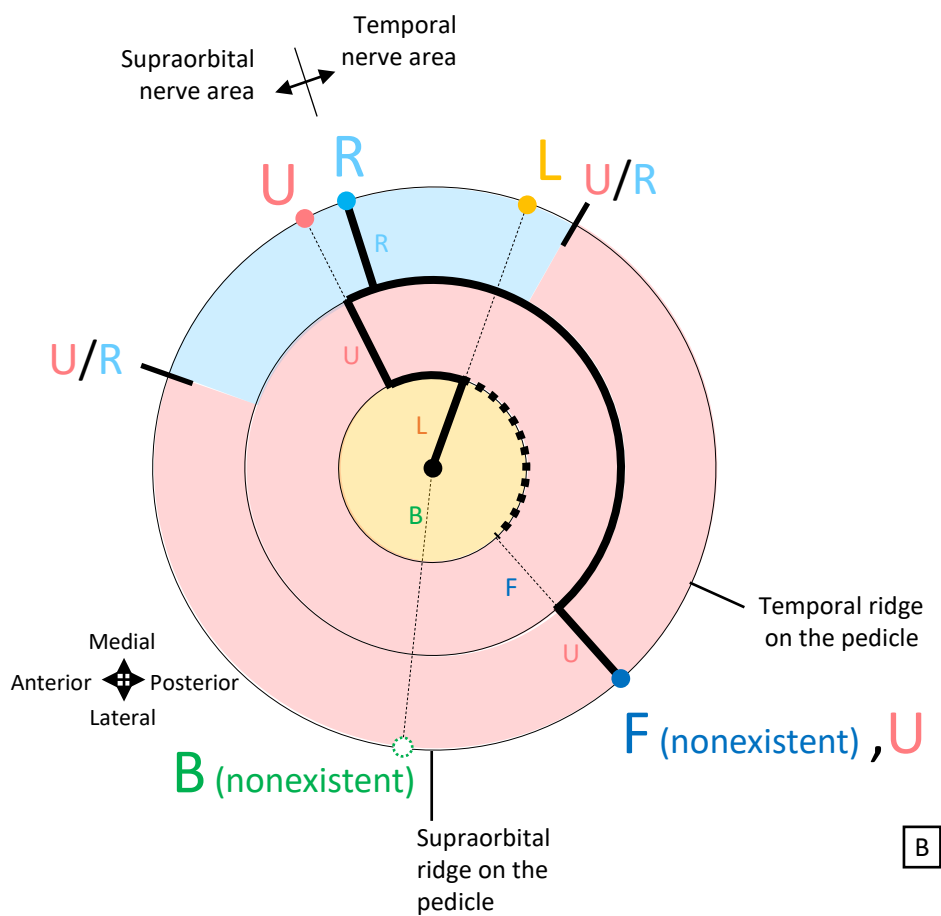
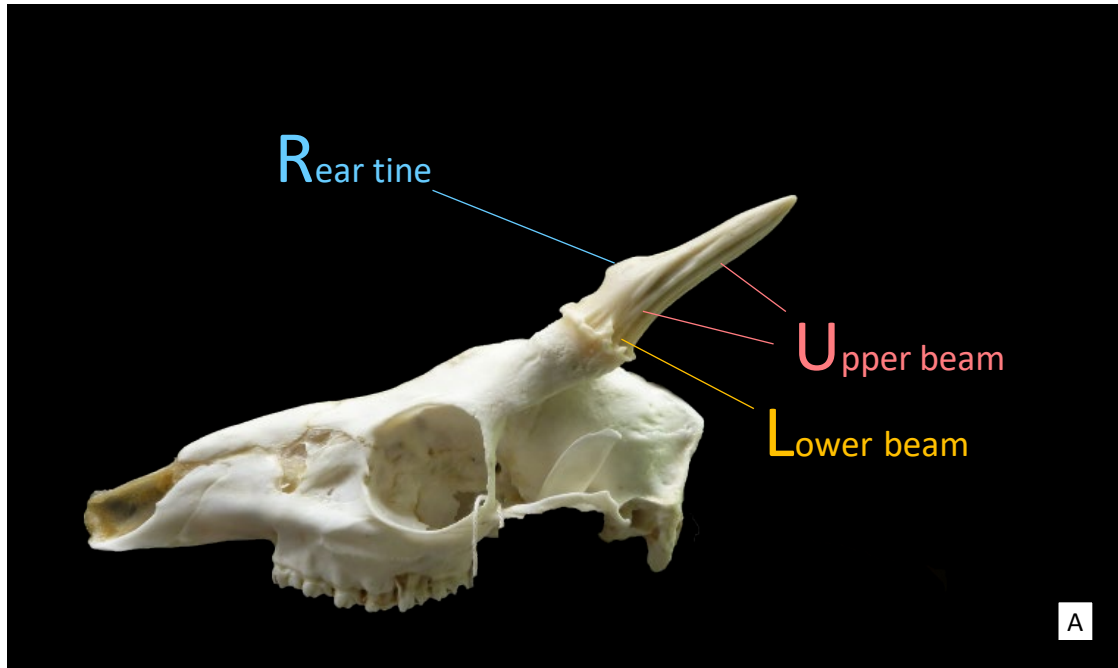
**Figure 49.** *Odocoileus virginianus*, with normal antlers. (KUGM-RM033) C) Lateral-anterior view.



**Figure 50.** *Odocoileus virginianus*. (KUGM-RM208) A) Left antler, lateral view. B) Left antler, posterior-medial view. C) Diagram of the left antler.



**Figure 51.** *Odocoileus hemionus*. (KUGM-RM032) A) Left antler, lateral view. B) Diagram of the left antler.



**Figure 52.** *Mazama americana*. (KUGM-RM035) A) Right antler, lateral view (horizontally flipped) . B) Diagram of the right antler (horizontally flipped) .

