Functional Genomic Basis Of Olfaction In Birds

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Question

Do birds use their sense of smell, and if so to what extent?

Statistical

Approach: We looked at birds olfactory receptor genes (ORs) because they encode proteins that interact with environmental cues. The hypothesis was that ecologically carnivorous birds would have more chemoreceptors and diversity due to them eating meat (meat which itself may have eaten other meat or alternatively meat that may have eaten fruits and plants earlier in the food chain).

Methods: Genomes of 700 birds from 41 orders were taken from the NCBI system. A pipeline that included tblastn was used to identify chemoreceptor gene sequences for each bird species. Python and bash scripts were used to parse through these fasta files and annotate the genes as intact. The program R Studio, using the programming language R, helped to analyze and interpret the Bird data.

Result: In FIG. 1. the total number of receptors is shown with regards to the birds grouped by diet. Generally the more plant eating birds had more total receptors and a greater variation. The more flesh eating birds had a more comparable median value but a whole lot more outliers. When looking at birds by the order in FIG. 2. Anseriformes (geese) had a huge span of variation in the bird gamma ORs. There were many Passeriformes (songbird) outliers. Some of the more carnivorous birds in question that might fall under Accipitriformes (vultures, eagles) and Falconiformes (falcons) had a somewhat low number of these receptors.

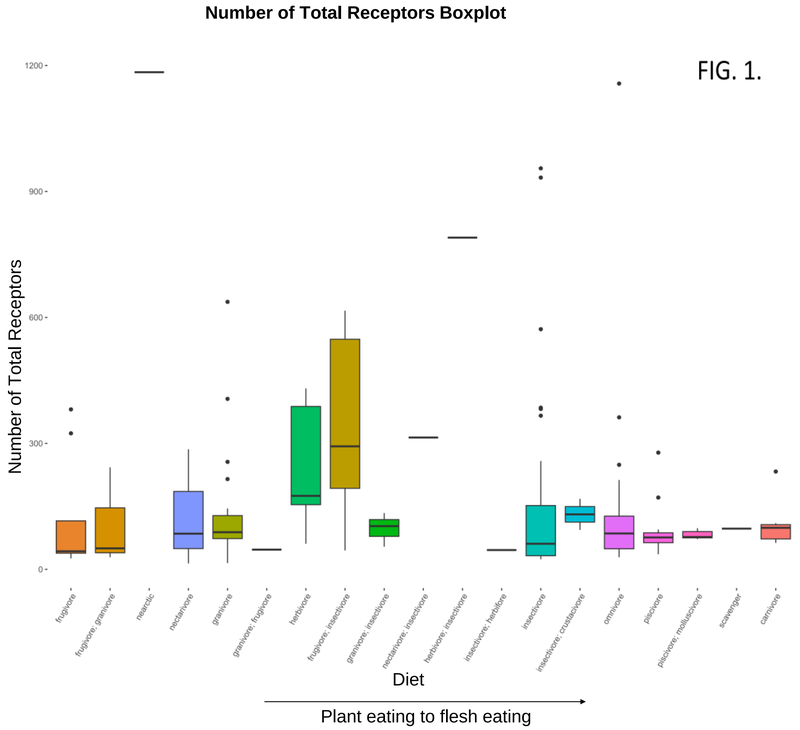


FIG. 1.

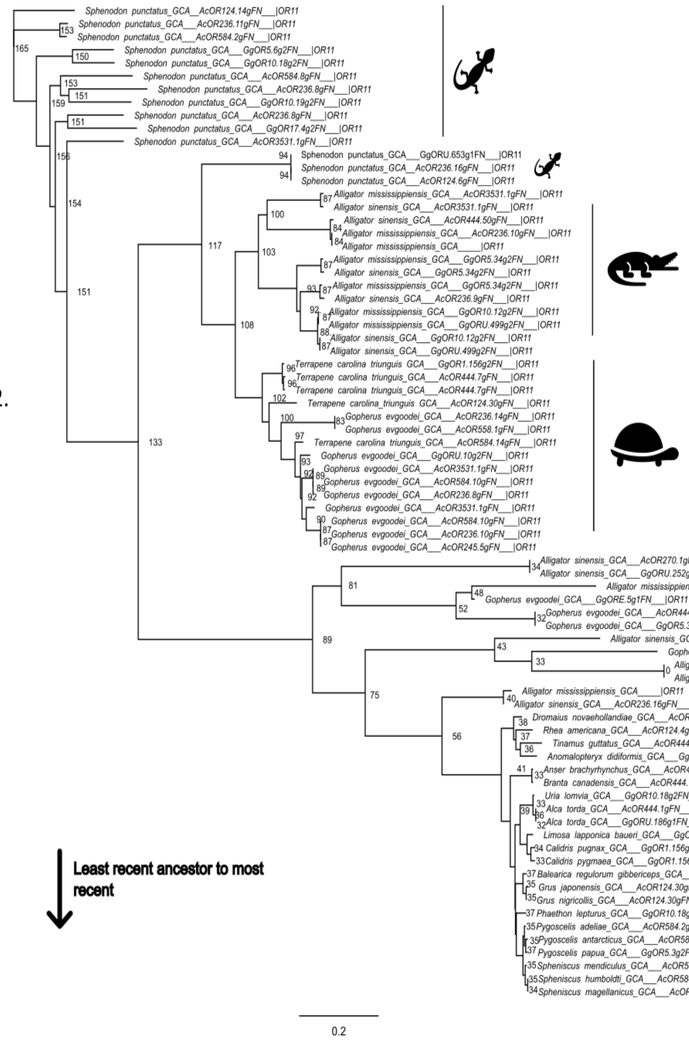
FIG. 2.

Genomic

Methods: A High Performance Cluster Computing System, the IQ Tree app, and the Geneious software app were the programs used to create a gene tree.

Result: In Fig. 3. The OR11 gene is still continuously duplicating multiple copies in turtles, lizards and crocodiles but there is only a single copy in most birds. One bird is an exception, *alca torda* (razorbill) which has this gene duplicating at least once.

FIG. 3.



Acknowledgements

Yohe LR, et al (2021), Diversity in olfactory receptor repertoires is associated with dietary specialization in a genus of frugivorous bat. Corfield JR, et al (2015), Diversity in olfactory bulb size in birds reflects allometry, ecology, and phylogeny. Sarah Powell, Kirsten Gade, Matteo Fabbri, Daniel Paredes Smith, Miccaella E Vergara, and Bhart-Anjan S Bhullar.

Conclusion

- Carnivorous birds had a lower number of receptors as compared to the more herbivorous birds.
- The OR11 gene is evolving much more slowly in birds than in alligators, turtles and lizards.
- Birds are homologically more similar to dinosaurs than alligators, turtles and other reptiles.
- In the future, running an ANOVA test may further show a representation of the ecological statistics.