Monkey Business:

Is the wildlife trade contributing to antimicrobial resistance in neotropical primates in Peru?

Background

Neotropical primates in Peru have contact with humans through involvement in the wildlife trade. In Peru, these primates do not only live in zoos, sanctuaries, and jungles. Although primate ownership is illegal in Peru, many homeowners have adopted primates as pets. The wet markets facilitate this illegal sale of primates, as well as the spread of antimicrobial resistant (AMR) bacteria. Agricultural practices also have the potential to spread antibiotic resistance through the use of antibiotics in cultivation. In order to better understand which bacterial isolates have developed AMR to different bacteria, Dr. Marieke Rosenbaum and her team collected rectal swabs from 307 Neotropical primates. The team subsequently tested those swabs for AMR and zoonotic enteric bacteria, and found that AMR was common in the 68 bacterial isolates identified. As the concept of One Health gains popularity in public health, we continue to further our understanding of the delicate balance of human health with the health of other animals and the environment. The close relationships between humans and primates bolstered by the wildlife trade in Peru pose a threat to both humans and primates through the development of AMR bacteria.

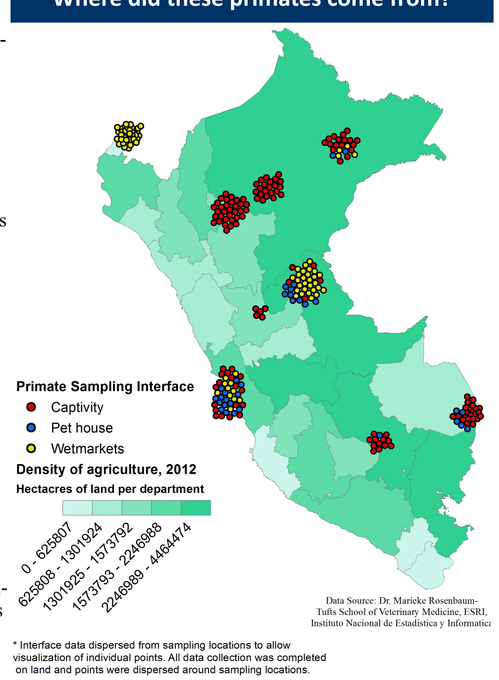
Methodology and Limitations

Data was provided by Dr. Marieke Rosenbaum of Tufts Cummings School of Veterinary Medicine. Agricultural information was obtained from Instituto Nacional de Estadistica e Informatica. **Descriptive data:** Primates were sampled from three interfaces: captivity, homes, and wet markets. One limitation of the sampling method was that, since data was collected in clusters around certain areas, several points overlap spatially. The markets were dispersed equally around each collection location, and therefore are not representative of the exact latitude and longitude of sampling. All primates were sampled on land at the center of each cluster. Descriptive maps show the sampling locations and familial distribution of sampled primates. Agricultural area by department was included to inform the potential influence of agricultural antibiotics on resistance.

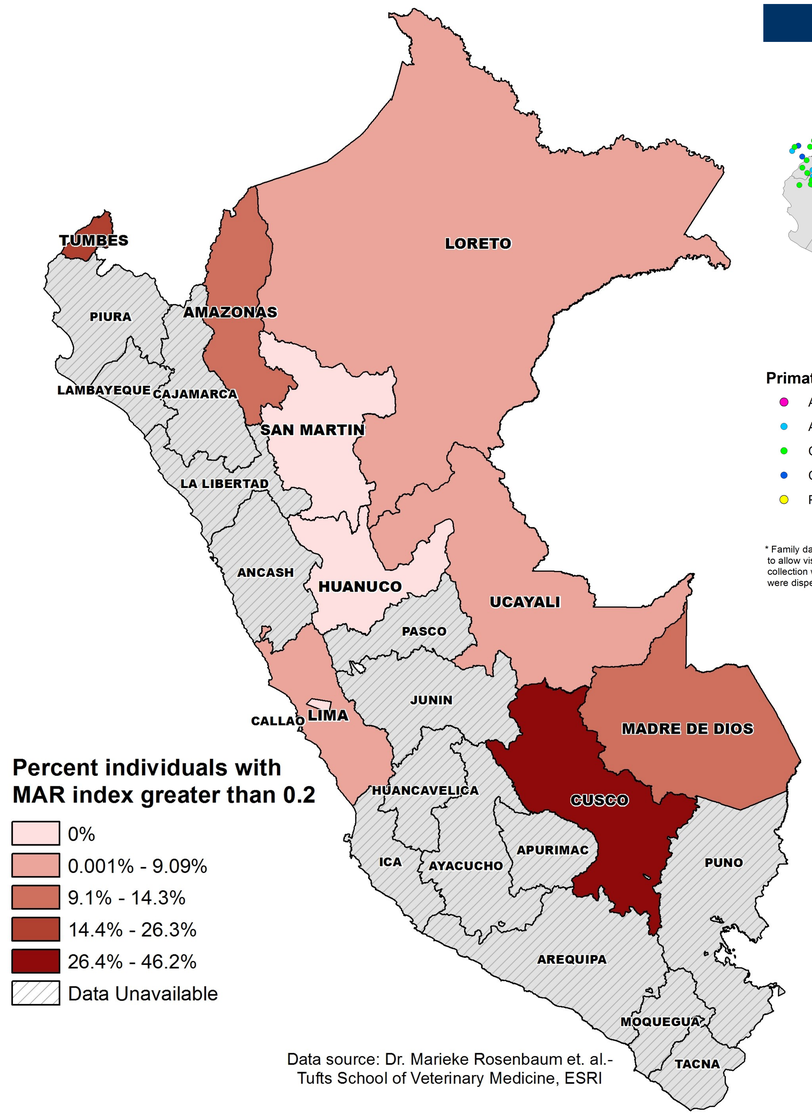
MAR Index: A multiple antibiotic resistance index was calculated for each individual. This index was dependent on the number of bacterial isolets identified from the swab and the total number of resistances of these bacteria to twelve antibiotics tested. The MAR index has not been used to assess resistance in primates before, however an index above 0.2 has been used to indicate high risk. The central map shows the percentage of primates sampled in each department that had MAR indexes above 0.2.

Resistance by bacteria: Point data shows primates who tested positive for any type of resistance. These points are also scattered equally around each collection point. Bacterial genus is specified for each positive result. [Note: Exact latitude and longitude data was missing for 19.35% of primates. These primates appear in analysis at department level, but not in point data analysis.]

Where did these primates come from?



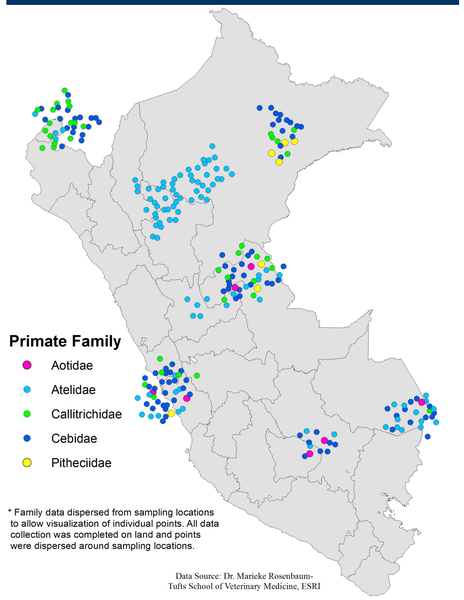
* Interface data dispersed from sampling locations to allow visualization of individual points. All data collection was completed on land and points were dispersed around sampling locations.



Results

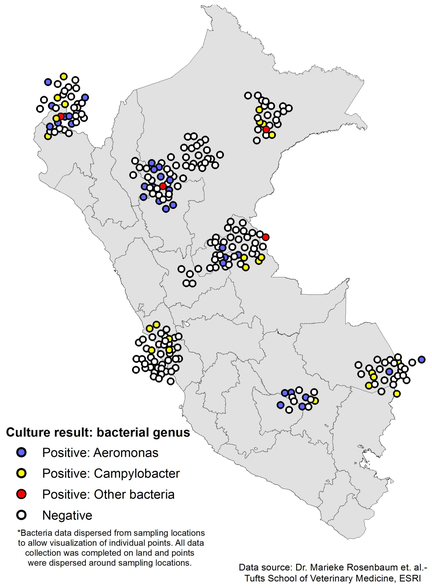
The department with the highest percentage of primates with a MAR index above 0.2 was Cusco, followed by Tumbes, Amazonas, and Madre de Dios. Primates from these departments were primarily encountered in captivity, however primates in Tumbes specifically were encountered only at wet markets. The Amazon spans the Northeast of Peru, where many primates were sampled from captivity. This Amazonian region, where the population is less dense, showed lower overall MAR indexes than the non-Amazonian regions, suggesting that human interaction and the wildlife trade may play a role in antibiotic resistance. However, more information is needed from other departments to say whether this trend continues into other densely populated spaces. High MAR index did not seem to correlate with agricultural land space. However, more specific measures for farming and antibiotic use could be used in the future to further evaluate this relationship. Resistance also did not seem to correlate with primate family, and many families spread throughout several departments. Amazonas, San Martin, and Huanuco were the only departments where a homogenous family, Atelidae, was sampled. Campylobacter bacteria was not identified in these regions, suggesting that there may be some relationship between the Atelidae family and Campylobacter bacteria. Aeromonas was identified in all departments except Lima, Callao, and Loreto. All of these departments had low percentages of primates with MAR indexes above 0.2. Further analysis should be done into whether MAR index differs based on bacteria type.

Primate Family Distribution



* Family data dispersed from sampling locations to allow visualization of individual points. All data collection was completed on land and points were dispersed around sampling locations.

Resistance by bacteria type



*Bacteria data dispersed from sampling locations to allow visualization of individual points. All data collection was completed on land and points were dispersed around sampling locations.

Aotidae | Atelidae | Callitrichidae | Cebidae | Pitheciidae

Acknowledgements: Thank you to Dr. Marieke Rosenbaum and her team at the Tufts Cummings School of Veterinary Medicine, Dr. Thomas Stopka, and Anna Kaplan.

Resources:

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PH262– GIS for Public Health

May 10, 2017

Data Source: Dr. Marieke Rosenbaum et. Al.– Tufts Cummings School of Veterinary Medicine, Instituto Nacional de Estadistica e Informatica

Images: Infogalactic

GCS/PCS: WGS_1984_UTM_Zone_18N , Projection: Transverse_Mercator

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