

Urine Protein Composition of Common Bottlenose Dolphins (*Tursiops truncatus*) from the Gulf of Mexico, USA

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Background

Kidney Diseases: More Common Than You Think

- ~3.7% of dog population = 1 in 10 dogs¹
- Affect 1 in 10 humans around the world²
- **Rarely** identified in bottlenose dolphins (*Tursiops truncatus*)

Can Urinary Proteins Reflect Kidney Health?

- **Proteinuria**: the presence of an abnormally high level of protein in urine³
 - Resulting from glomerular dysfunction & tubular impairments
- **Tamm-Horsfall protein (THP)**: abundant in human & California sea lion (*Zalophus californianus*) urine proteomes
 - ↓ excretion of THP leads to...
 - Urinary tract infections in humans⁴
 - Tubular injury in sea lions⁵
- **Lysozyme & Resistin**: abundant in sea lions
 - Not common in dogs or humans
 - Defense against infections in marine mammals?

- Urine protein is **not** always examined in bottlenose dolphins

This study will be the first to investigate & characterize variability across the urine proteome of bottlenose dolphins.

Hypotheses & Aims

H₁: Urinary protein composition will remain consistent across populations despite geographical distinctions.

H₂: Antimicrobial proteins will be amongst the most abundant proteins, like California sea lions.

Aim 1: Examine correlations among urinary protein profiles and serum chemistry values, urine osmolality, age, & health status

Aim 2: Describe variation in protein composition in bottlenose dolphins across two Gulf of Mexico populations (Sarasota Bay, FL & Barataria Bay, LA)

Methods

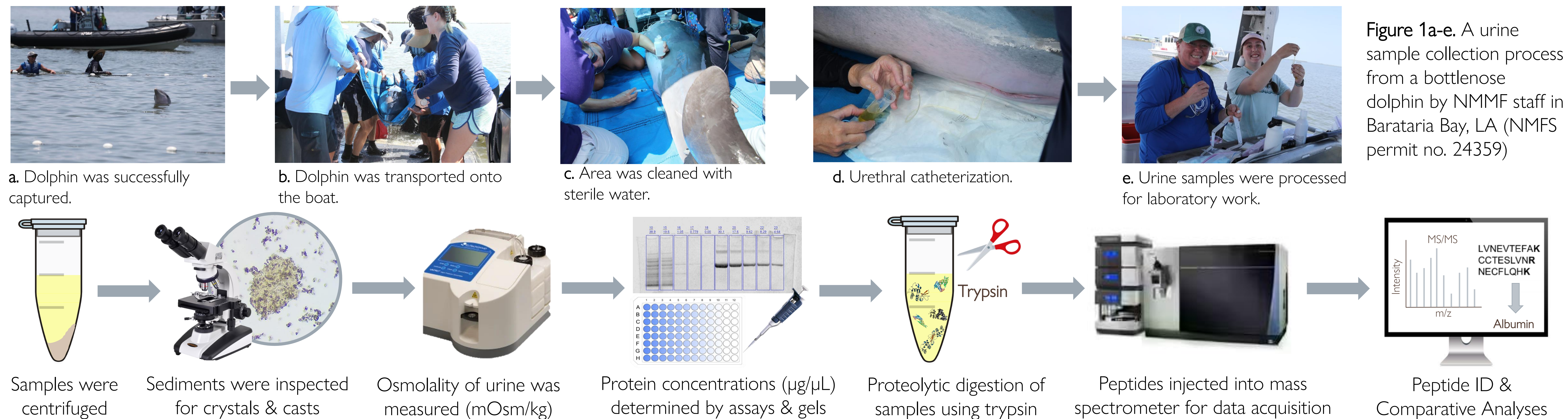


Figure 1a-e. A urine sample collection process from a bottlenose dolphin by NMFS staff in Barataria Bay, LA (NMFS permit no. 24359)

Results

Table 1. Dolphin population characteristics and urine osmolality, protein, and water salinity values.

| | Barataria Bay (N=11) | Sarasota Bay (N=4) | p-value |
|-----------------------------------|----------------------|--------------------|---------|
| Sex | | | |
| Female | 5 | 3 | 0.5692 |
| Male | 6 | 1 | |
| Age | | | |
| Juveniles (<10 years) | 3 | 2 | 0.5604 |
| Adults (≥10 years) | 8 | 2 | |
| Urine Osmolality (mOsm/kg) | | | |
| Mean ± SD | 1438 ± 224 | 1103 ± 179 | 0.0223 |
| Range | 1037 - 1834 | 943 - 1332 | |
| Urine Protein (mg/dL) | | | |
| Mean ± SD | 67.3 ± 104.4 | 10.3 ± 9.3 | 0.0581 |
| Range | 10 - 356 | 4 - 24 | |
| Proteinuria | | | |
| > 30 mg/dL | 4 | 0 | |
| Water Salinity (ppt) | | | |
| Median | 31.8 | 34 | |
| Range | 30.3 - 33.2 | 33.7 - 34 | |

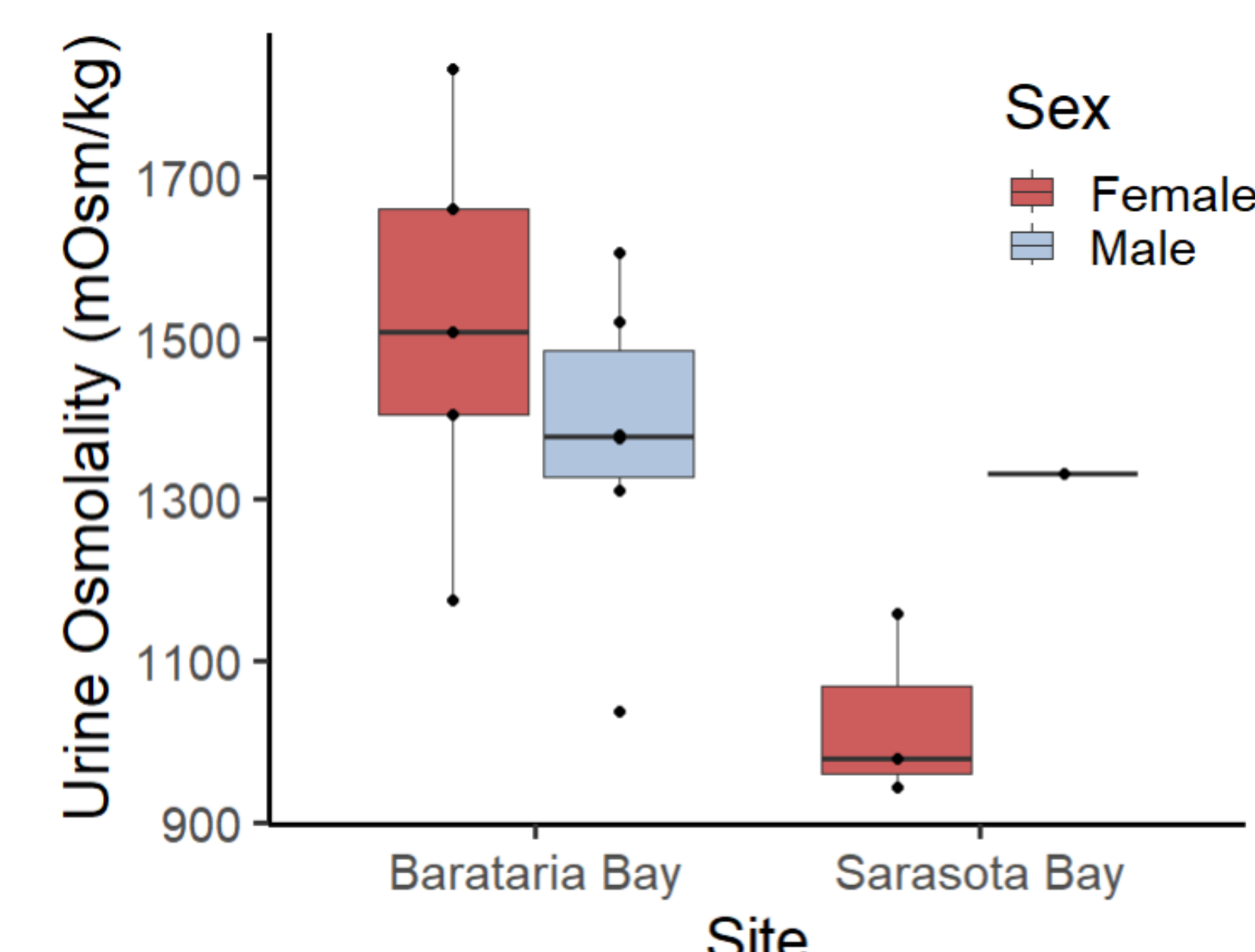


Figure 2. Boxplot of urine osmolality (mOsm/kg) & sex of dolphins in each site. The box represents the interquartile range (IQR), with the median marked by the horizontal line inside the box. Whiskers extend to the minimum and maximum values within 1.5 times the IQR, and the dots represent the datapoints. Female dolphins varied significantly between sites ($U = 15, p = 0.0357$).

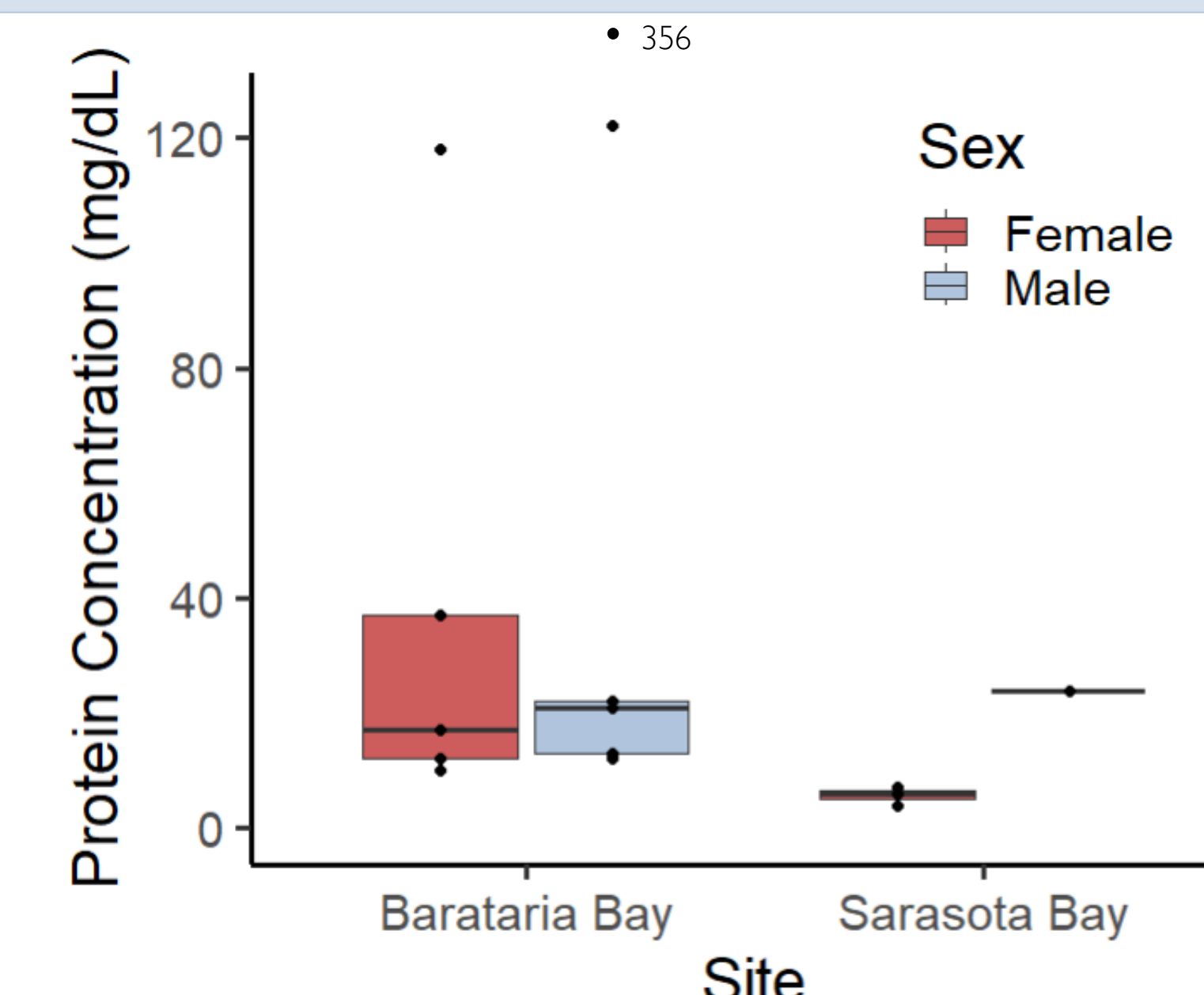


Figure 3. Boxplot of urine protein concentration (mg/dL) & sex of dolphins in each site. The box represents the IQR, with the median marked by the horizontal line inside the box. Whiskers extend to the minimum and maximum values within 1.5 times the IQR, and the dots represent the datapoints. Female dolphins differed significantly between sites ($U = 15, p = 0.0357$).

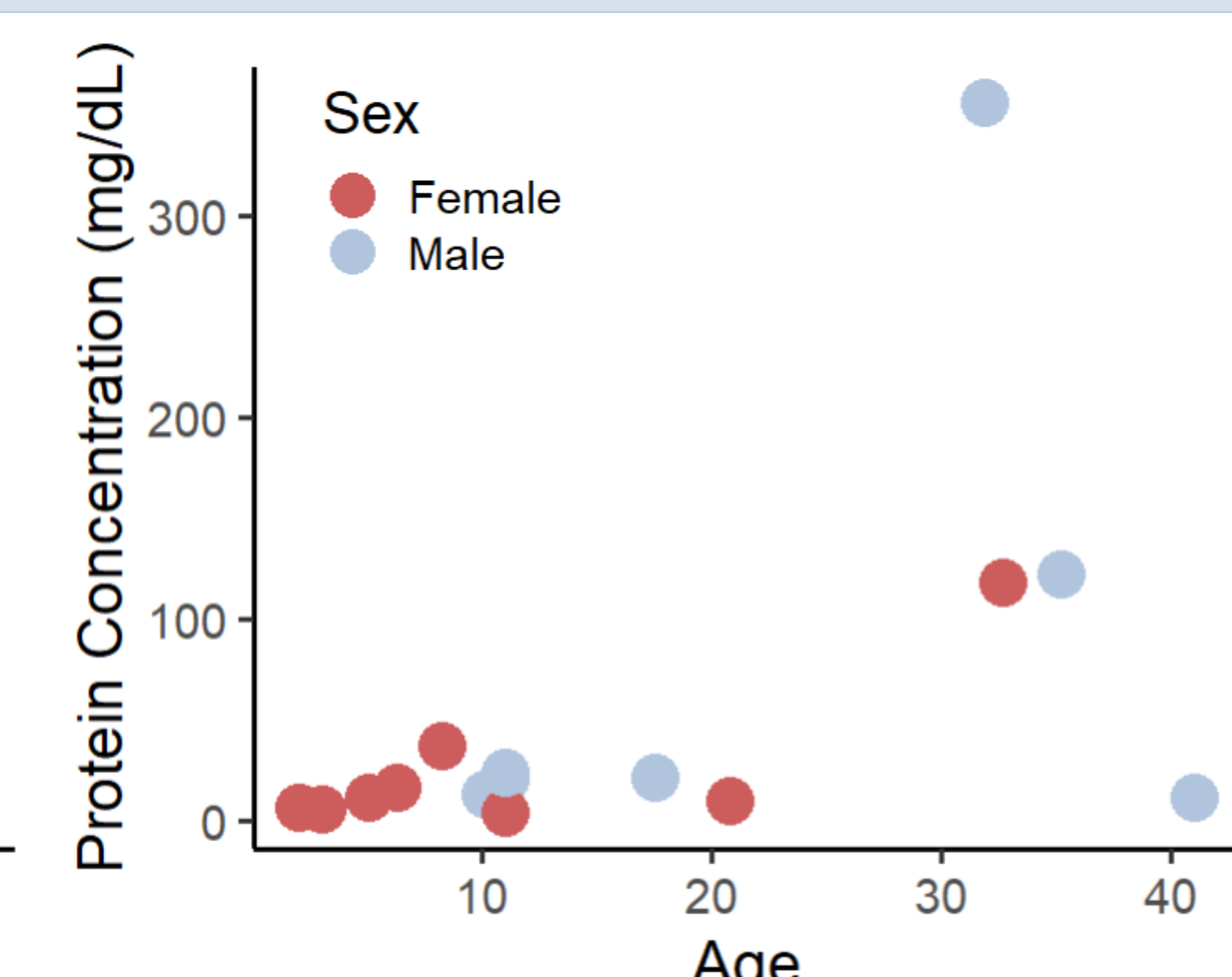


Figure 4. Scatterplot of urine protein concentration (mg/dL) versus age of dolphins throughout the Gulf of Mexico. There is no correlation between the protein concentration (mg/dL) and age of dolphins ($\rho = 0.49, p = 0.0628$).

Conclusions

Urine Osmolality

- Barataria Bay > Sarasota Bay
- Shrimp: 3rd most abundant prey item in Barataria Bay dolphins (48.6%)⁶
- Sarasota Bay dolphin diet solely consists of fish⁷
 - Invertebrates = osmoconformers
 - Fishes = osmoregulators
- Saltier diet? → ↑ Urine Osmolality?

Urine Protein

- Urine protein concentrations differ in females
 - Contributed by health status or age?
- Age ↑ Protein Concentration ↑
- Renal function ↓ as age ↑?

Future Work

- Characterize the urine proteome of dolphins
- Compare with urine proteome of sea lions & Artiodactyl species

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