Introduction

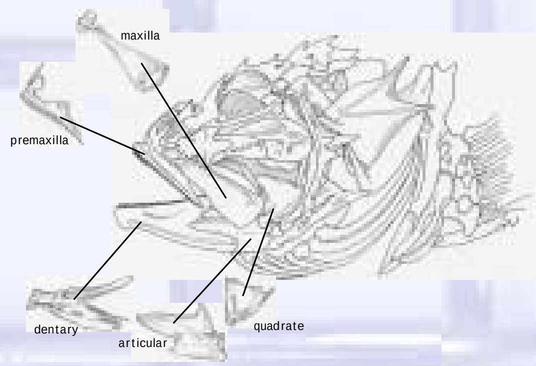
The effects of differential recovery have long been a concern in zooarchaeological analysis. Screening experiments using comparative collections have been used as one avenue for understanding recovery bias because they develop expectations about what may be recovered. In this study modern reference specimens of Pacific Island fish were screened through 1/4" and 1/8" mesh. The recovery rates are examined across taxa, body size and element type. These recovery patterns are compared to those of an archaeological fish assemblage from Moturakau rockshelter, Aitutaki, Cook Islands to evaluate how well the experimental data predicts the archaeological recovery of fish remains.

Methodology

For the screening experiment I used the osteological reference specimens from the collections at the University of Hawaii and the University of Auckland. Since identification of Pacific Island fish is typically only to family, this analysis examines the effects of screen size bias at the family level. A total of 308 specimens representing 23 families were originally used. For this analysis, I used only the 11 families that had at least 10 individuals per family for a total of 250 individual specimens. The table on the left lists the fish families used, as well as the diversity represented and the size range of the specimens.

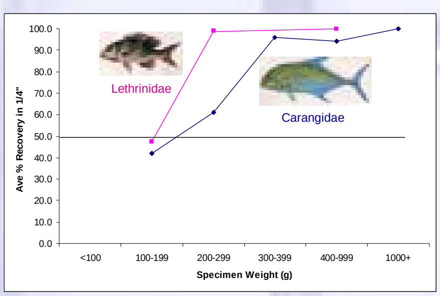
Family	N	# of Genera	# of Species	Weight Range (g)
Acanthuridae	30	4	12	92 - 1406
Balistidae	18	8	10	36 - 2124
Carangidae	27	6	9	62 - 3000
Holocentridae	24	3	8	15 - 400
Labridae	16	6	9	30 - 1411
Lethrinidae	12	3	7	100 - 4000
Lutjanidae	32	5	11	23 - 4000
Mullidae	34	3	13	24 - 782
Pomacentridae	12	2	5	31 - 283
Scaridae	17	4	8	94 - 2345
Serranidae	29	3	10	74 - 1411

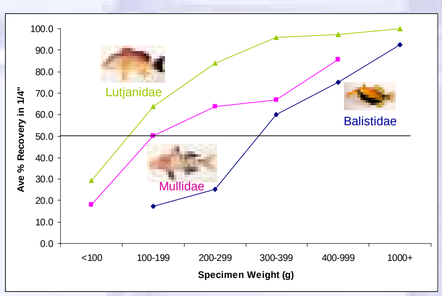
In the Pacific, identification of fish remains typically uses five skeletal elements of the mouth: premaxilla, dentary, maxilla, articular, quadrate. These five elements were screened ten times through nested 1/4" and 1/8" mesh for each reference specimen. The frequency with which the elements were retained in each screen was calculated.

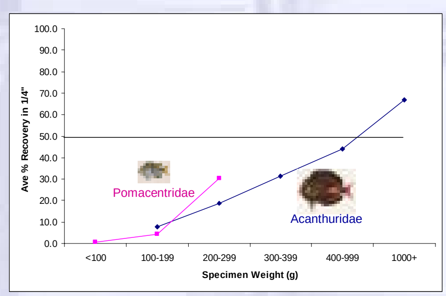


Differential Recovery Across Taxa

For each fish family, the 1/4" mesh recovery rates for taxa within a particular weight range were averaged. The variability in recovery rates across taxa is due to body size as well as element size. The 50% line marks where half of the elements are recovered in the 1/4" mesh, while the other half would be lost through the 1/4" mesh.







- An average of 50 % of lethrinid and carangid elements were recovered for specimens weighing 100-199 grams. As weight increases, the recovery rate quickly increases to near 100%.
- Thus, these taxa are more likely to be recovered using 1/4" mesh.
- The high recovery rate is due to the large size of the taxa and their relatively large and robust mouth elements.

- Balistids, lutjanids, and mullids cover a wide range in size.
- Their mouth elements are 'average' in size and shape.
- Their recovery depends mainly on the size of the fish. The larger the fish, the greater the recovery rate in the 1/4" mesh.

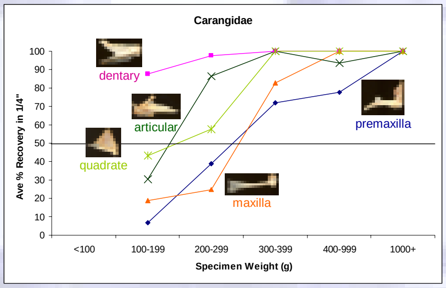
- Acanthurids and pomacentrids have the lowest recovery rates of the 11 families.
- For Pomacentrids, the poor recovery is due to the small size of the taxon. Only 30% of the elements from the largest individuals were recovered.
- Acanthurids have greater size range, but their mouth parts are small, thus 1/4" recovery of even large individuals is relatively poor.

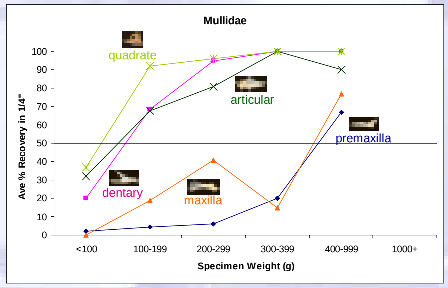
Differential Recovery of Pacific Island Fish

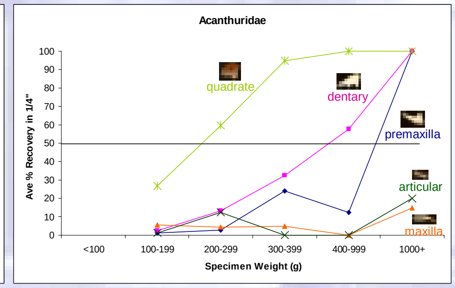
Lisa Nagaoka, University of North Texas

Differential Recovery Across Elements

Within taxa, there is also variability in the recovery rates across elements. This variability is due to the size and the shape of the individual elements. In general, premaxillae and maxillae have the lowest 1/4" recovery rates. The linear or L-shape of these elements makes it easier for them to pass through mesh than the triangular shaped quadrate, dentary and articular.







- While there is variability across elements for carangids, the recovery rate for most elements is generally above 50% regardless of size.
- For mullids, quadrates, articulars and dentaries are more likely to be recovered than premaxillae or maxillae.
- The lower recovery rate for premaxillae and maxillae are due to their size and shape.
- The recovery of acanthurids is poor even for larger individuals. Only quadrates were consistently recovered.

Comparing the Predicted to the Archaeological

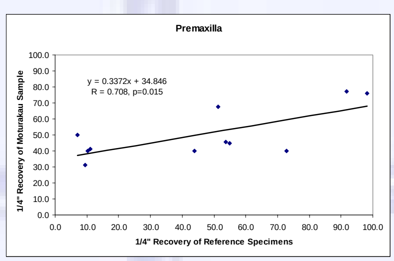
The screening experiment provides a prediction of the recovery rates that should be expected archaeologically. To test the accuracy of these predictions, the recovery rates for the experimental data are compared to the actual recovery of archaeological fish remains from the Moturakau site in Aitutaki, Cook Islands.

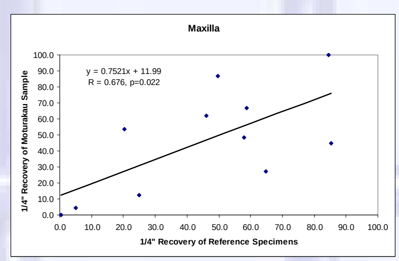
The Moturakau fish assemblage constitutes one of the largest samples from the Pacific Islands with over 11,000 identified specimens. My research on recovery bias in the assemblage found similar results to the screening experiments:

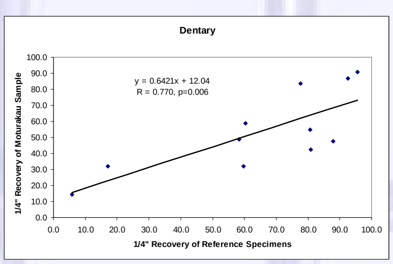
- The rank order abundance of fish taxa in the 1/4" and 1/8" samples were statistically different for sample sizes under 200 NISP.
- The 1/8" sample increased the number of taxa represented significantly.
- This increase in taxa is due to recovery of small-bodied taxa or taxa with small diagnostic elements.

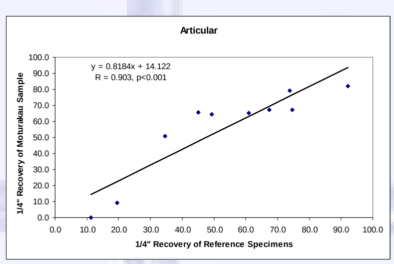
To examine the relationship between the recovery rates of the experimental and archaeological samples, regression analyses were performed for the five mouth elements.

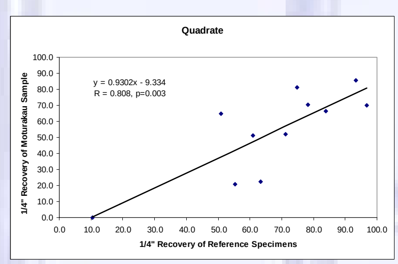
The relationship between the two datasets is statistically significant across all five elements, indicating that the recovery rates of the Aitutaki fish assemblage could be predicted from the screening experiment data.



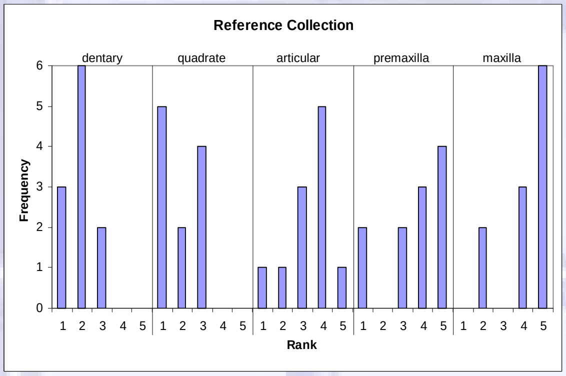


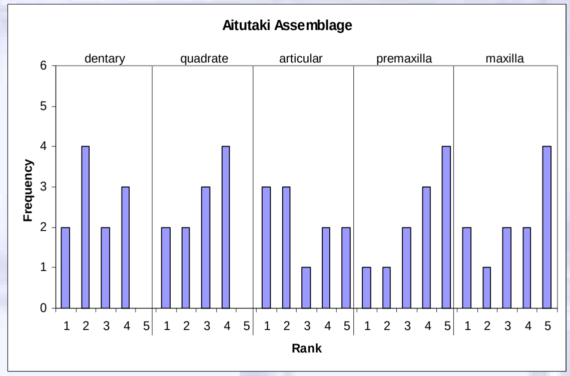






The next question is, are some elements more likely to be recovered than others? To address this question, I ranked the recovery rate of the elements for each taxon. So for acanthurids, the element with the highest recovery rate is the quadrate, followed by the dentary, etc. The number of times that an element was ranked 1st, 2nd, 3rd, etc. was tallied. The histograms below show the frequency of times that the element was placed in the different ranks. The more times an element had ranks of 1 or 2, the more likely it would be or was recovered in the 1/4" mesh.





- The screening experiment data predicts that the maxilla and premaxilla are more likely to be lost through 1/4" mesh.
- The dentary and quadrate are more likely to be recovered in the 1/4".

- For the archaeological data, maxilla and premaxilla were recovered more frequently in the 1/8" screen.
- The pattern for dentary and quadrates
- The differences between the experimental and archaeological datasets are likely due to other factors that affect recovery such as fragmentation rates, differential identifiability, and differential preservation.

Summary of Findings

- Experimental data shows that certain taxa such as lethrinids and carangids are more likely to be recovered in 1/4" screens because they are large sized taxa and/or their elements are relatively large and robust.

- Recovery will vary across skeletal elements due to the shape and size of the elements. In general, premaxilla and maxilla are likely to be underrepresented when large mesh screens are used. They tend to be the smaller of the five mouth elements and their small size and shape allow them to pass more easily through the screens.

- The predictive ability of the experimental data is strongest for assemblages such as the Moturakau dataset with relatively good preservation and where the bones are not highly fragmented.

Implications

This analysis shows that differential recovery affects the types of taxa and skeletal elements recovered. The biases in datasets caused by differential recovery can affect the ability of these datasets to inform us on a variety of important questions.

- <u>Changes in fish abundances</u>

- <u>Changes in fishing methods or habitats exploited</u>

- <u>Declines in fish size due to predation pressure</u>

With the use of larger mesh screens, a representative sample of the range of fish exploited may not be achieved. More importantly, premaxilla are one of the common elements used to derive size measurements however, it is often the least recovered of the mouth elements.