Taphonomic Analysis of Fish Remains Recovered from the Mink Island Site (XMK-030), Amalik Bay, Katmai National Park and Preserve

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Archaeologically Deposited Fishbone Databases

- Culture change proxy
  - Changes in taxa composition and abundance over time
- Environmental change proxy
  - Cold-water-adapted vs. warm-water-adapted taxa
  - Stable isotopes (bone collagen)
- Causes and consequences of long-term variability in fish assemblages when combined with:
  - Modern fisheries
  - Paleo-oceanographic datasets
- Millennial-scale vs. decadal-scale

Factors Influencing Bone Survival

Inter-Taxa and Inter-Elemental Differences

- Bone volume density
- Size
- Shape
- Protein content
- Lipid content

Biostratinomic Agents

- Cooking/burning
- Cutmarks/breakage

Diagenic Agents

- Biological (microorganisms, fungi, other animals, etc.)
- Physical (attrition, compaction, etc.)
- Chemical (temperature, pH, etc.)

Bone Diagenesis and Contamination in a Shell Midden Context

Without Mitigating for Preservation and Contamination Biases

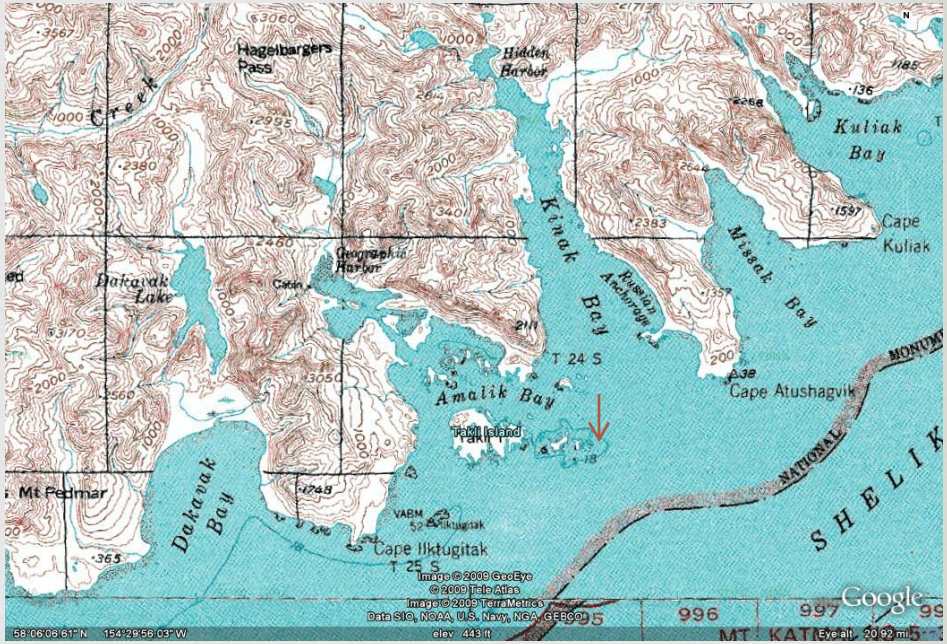
Zooarchaeological Abundance Measures

- Skewed in favor of bones that best survive biostratinomic and diagenic destruction

Stable Isotope ($\delta^{13}C$, $\delta^{15}N$) Values

- Reflect differences in preservation and contamination rather than variability in ecosystem structure and function

Mink Island (XMK-030)



Dynamic Environment

Culture History

Lower Midden
7500-4100 B.P.

- **Paleoarctic Tradition**
  - Fish bones absent
- **Ocean Bay Tradition**
  - **Ocean Bay I**
    - (7500-4500 B.P.)
  - **Ocean Bay II**
    - (4500-3500 B.P.)

Upper Midden
2000-535 B.P.

- **Norton Sub-Tradition**
  - **Takli Cottonwood Phase**
    - (1800-1500 B.P.)
  - **Kukak Beach Phase**
    - (1500-1000 B.P.)
- **Thule Tradition**
  - **Kukak Mound Phase**
    - (1000-500 B.P.)

Fish Bone Preservation Assessment Using Zooarchaeological Methods: BVD and NISP

Taphonomic

Pacific Cod

-Most dense bones are most numerous (R^2=0.7457)

Taphonomic

Pacific Halibut

-Most dense bones are most numerous (R^2=0.5313)

Cultural

Pacific Salmon Spp.

-Most dense bones are not most numerous (R^2=0.0537)

All photos from www.fishbase.org

Average Completeness Percentage by BVD

Lower Midden

Upper Midden

The most dense bones <u>are not</u> the most complete

(R^2=0.4546)

- 96% of bones = BVD rank 1-6

(R^2=0.2441)

- 77% of bones =BVD rank 1-6

Fish Bone Preservation Assessment Using Stable Isotopic Methods

Bulk Bone Percent Nitrogen

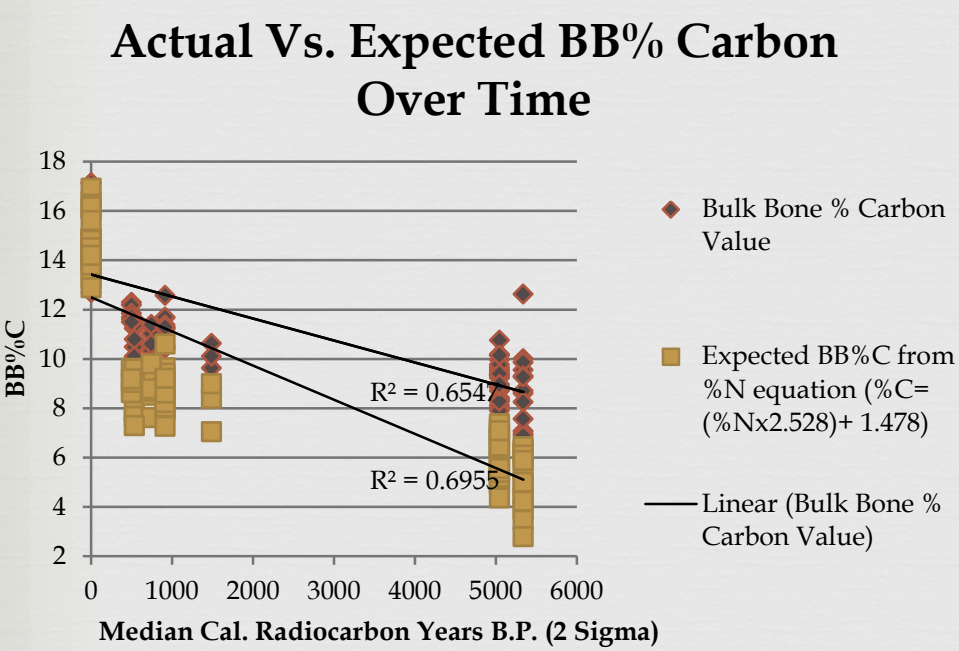
- Preservation Assessment
  - BVD and Protein
    - Significant negative (R^2=0.6349)
  - Breakage Class and Protein
    - Significant (R^2=0.9257)
  - Radiocarbon Years BP and Protein
    - Significant (R^2=0.9598)

Bulk Bone Percent Carbon

- Preservation Assessment
  - BVD and Carbon
    - Not significant (R^2=0.0768)
  - Breakage Class and Carbon
    - Significant (R^2=0.8425)
  - Radiocarbon Years BP and Carbon
    - Significant (R^2=0.8680)

Fish Bone Contamination Assessment Using Stable Isotopic Methods

Contamination



Contamination by Carbon-Rich Sources

- BVD and Contaminant Carbon
  - Significant negative (R^2=0.9163)
- Breakage Class and Contaminant Carbon
  - Significant (R^2=0.9100)
- Radiocarbon Years BP and Contaminant Carbon
  - Significant (R^2=0.6554)

Mink Island Fish Taxa

(all photos from www.fishbase.com)

Pacific cod (*Gadus macrocephalus)*

Walleye Pollock (*Theragra chalcogramma*)

Sockeye Salmon (*Oncorhynchus nerka*)

Pacific Herring (*Clupea pallasii)*

Red Irish Lord (*Hemilepidotus hemilepidotus)*

Great Sculpin (*Myoxocephalus polycantocephalus)*

Atka Mackerel (*Pleurogrammus monopterygius*)

Lingcod(*Ophiodon elongatus*)

Pacific Ocean Perch (*Sebastes alutus)*

Rock Greenling (*Hexagrammos lagocephalus)*

Flathead Sole (*Hippoglossoides elassodon)*

Yellowfin Sole (*Limanda aspera)*

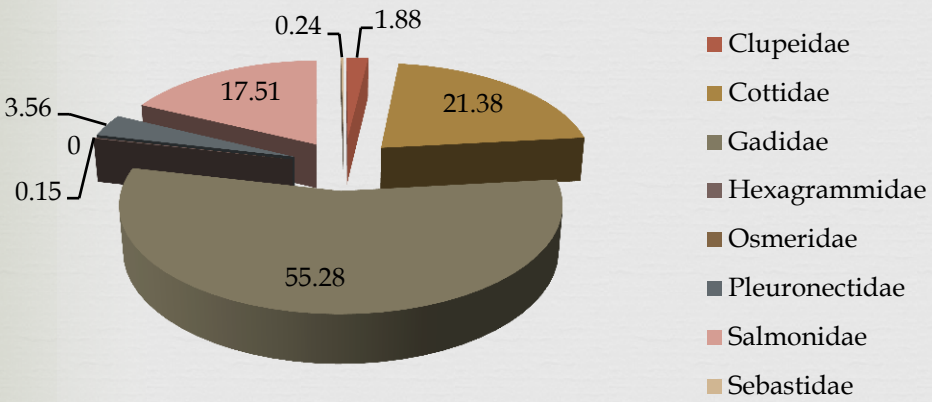
Northern Rock Sole (*Lepidopsetta polyxystra)*

Pacific Halibut (*Hippoglossus stenolepis)*

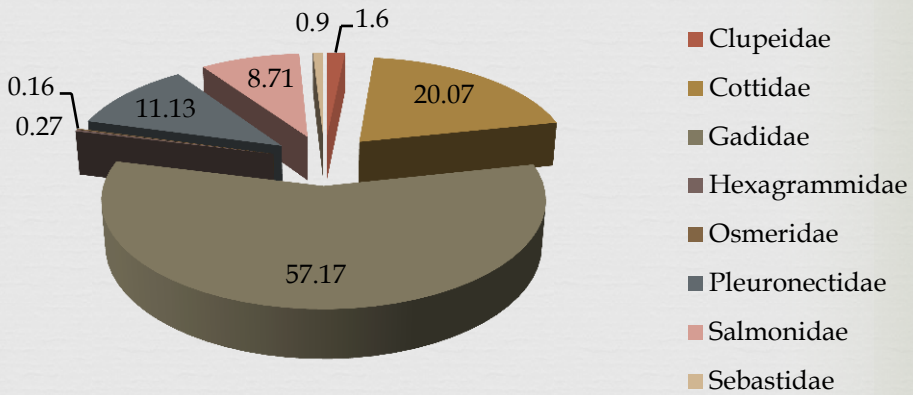
Butter Sole (*Isopsetta isolepis*)

Family-Level %NISP

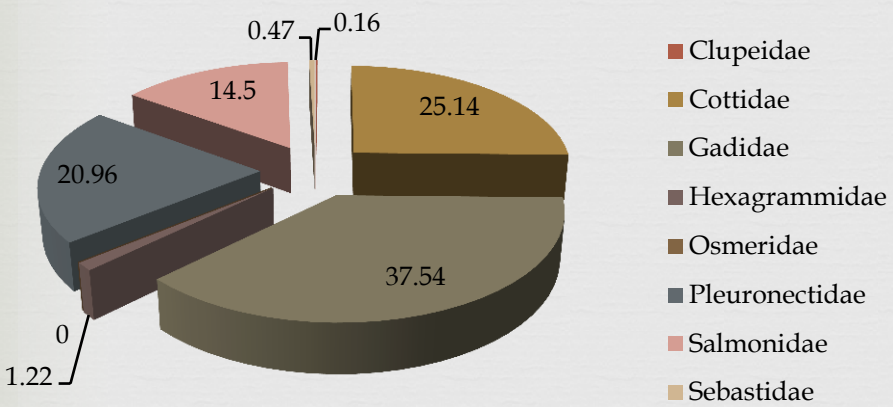
Thule Tradition % NISP



Norton Sub-Tradition % NISP



Ocean Bay Tradition % NISP

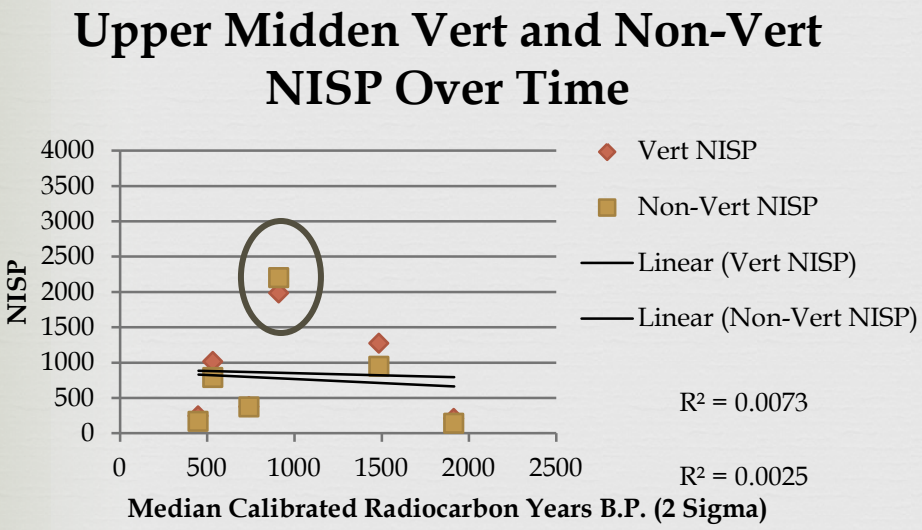


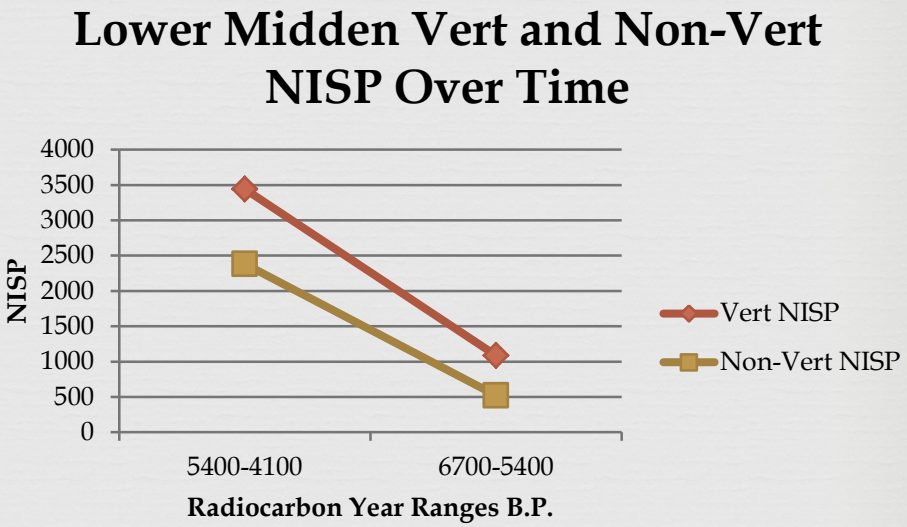
Thule Tradition:
NISP=7184
73.72% of Upper Midden

Norton Sub-Tradition:
NISP=2561
26.28% of Upper Midden

Ocean Bay Tradition:
NISP=7446
100% of Lower Midden

NISP Over Time

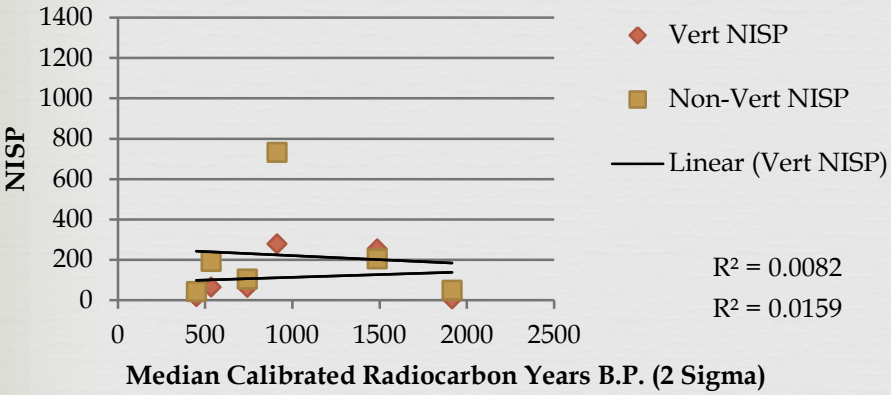




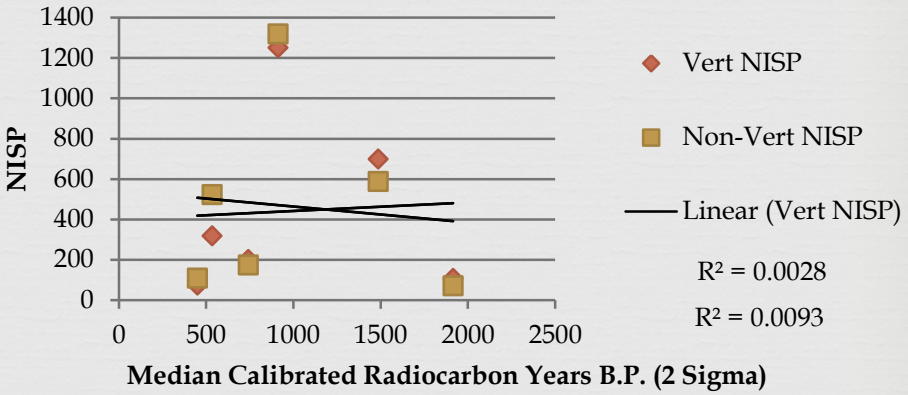
Radiocarbon Dates Provided by Jeanne Schaaf, Personal Communication, 2011

Upper Midden Taxa NISP Over Time

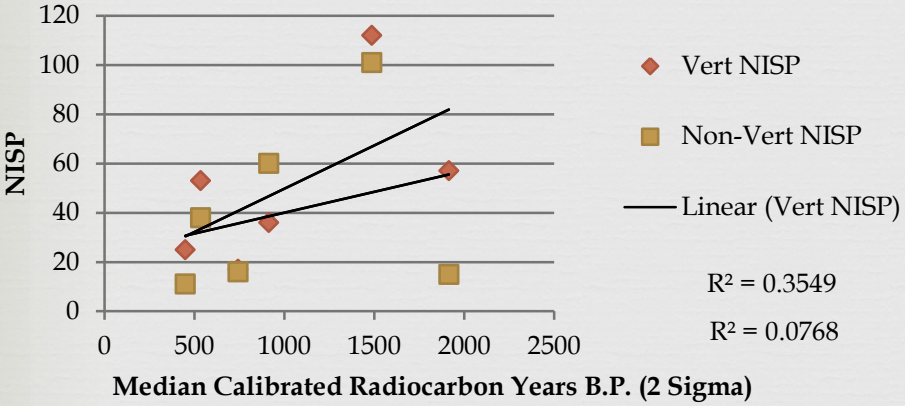
Upper Midden Cottidae (Sculpins)



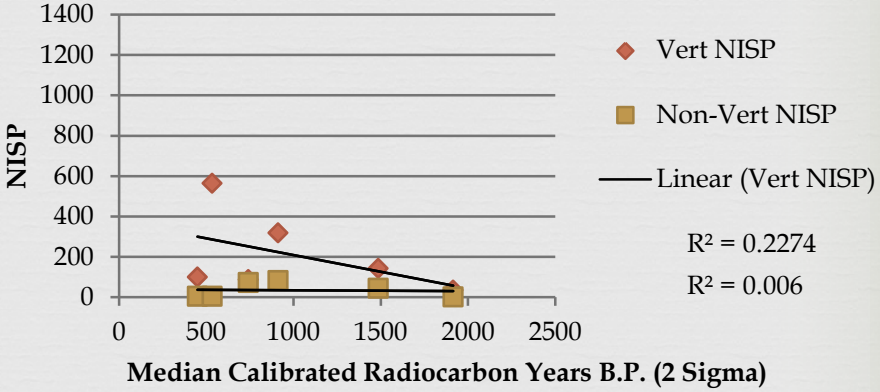
Upper Midden Gadidae (Cods and Haddocks)



Upper Midden Pleuronectidae (Righteye Flounders)

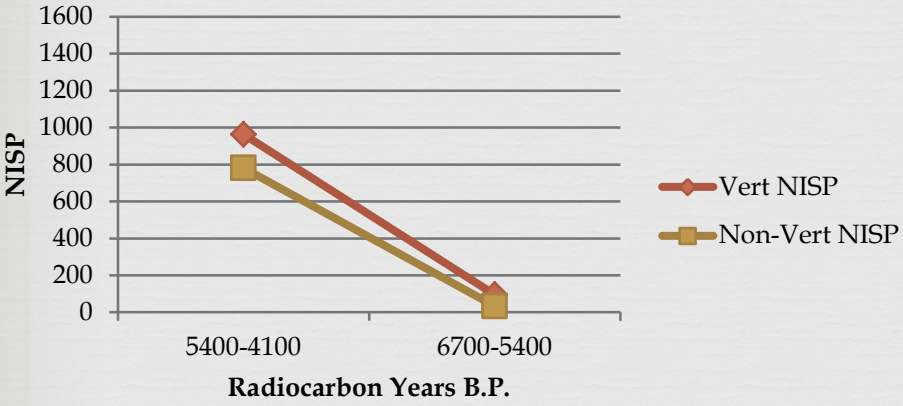


Upper Midden Salmonidae (Salmonids)

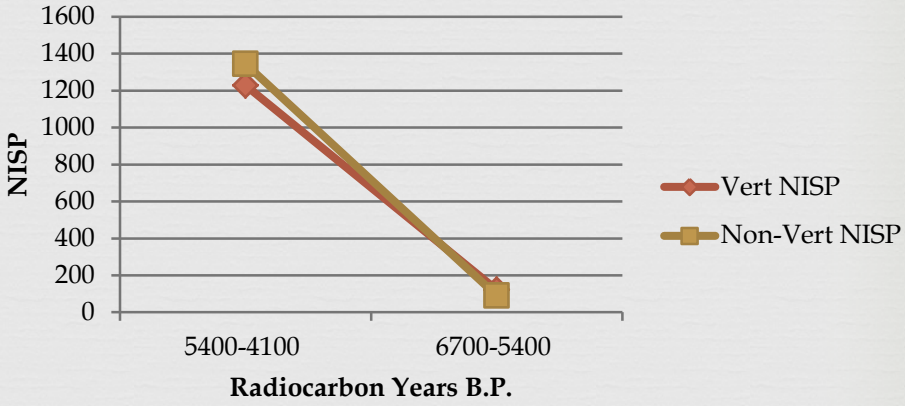


Lower Midden Taxa NISP Over Time

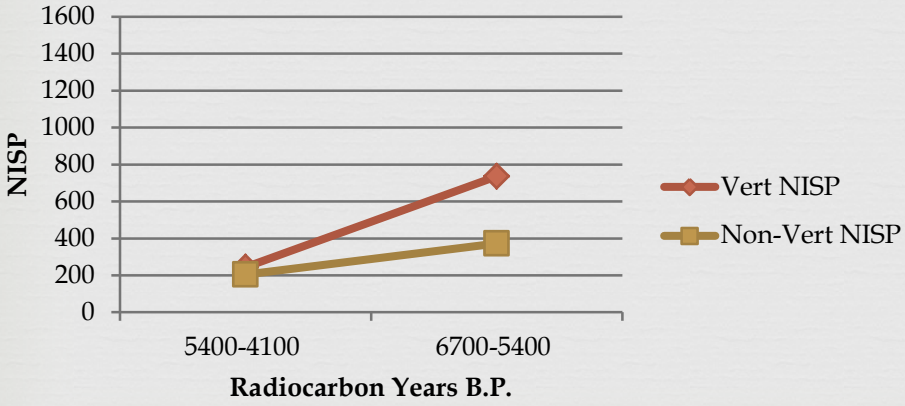
Lower Midden Cottidae Vert and Non-Vert NISP Over Time



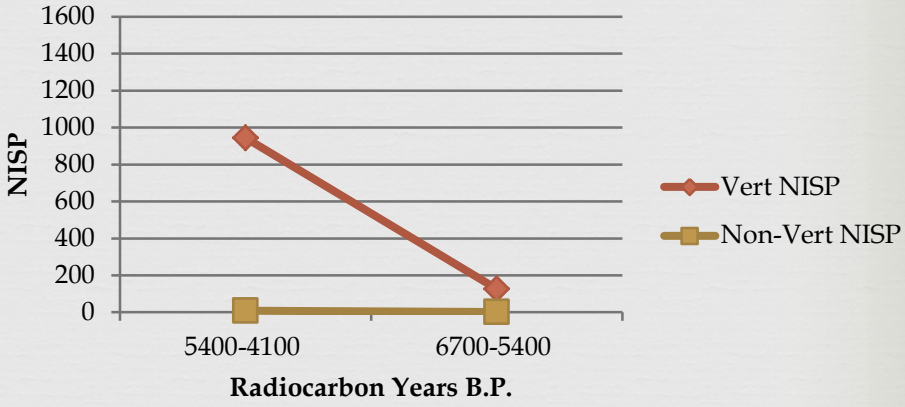
Lower Midden Gadidae Vert and Non-Vert NISP Over Time



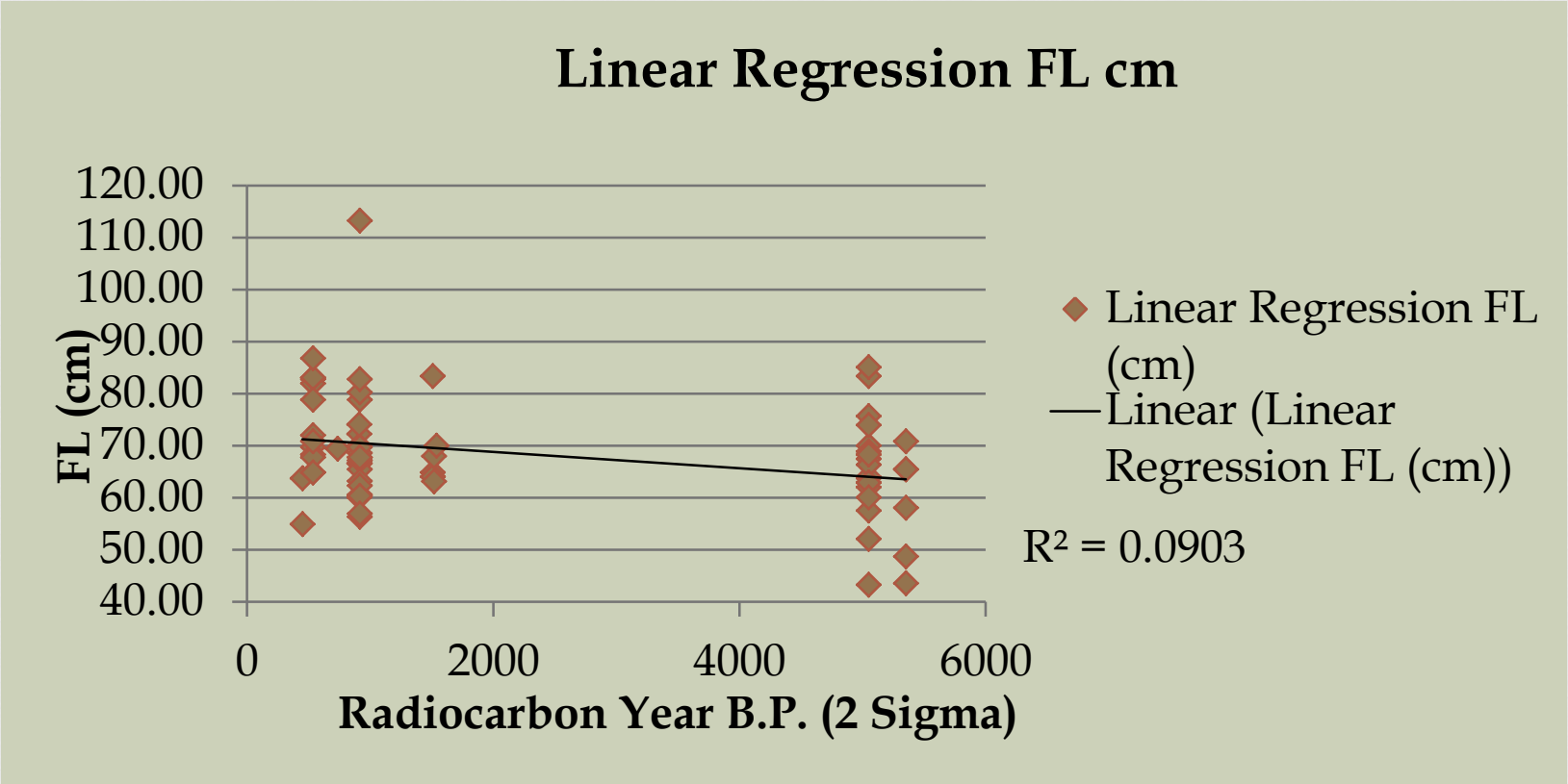
Lower Midden Pleuronectidae Vert and Non-Vert NISP Over Time



Lower Midden Salmonidae Vert and Non-Vert NISP Over Time



Linear Regression
P. Cod Quadrates



Conclusions

Zooarchaeological methods

- The densest cod and halibut bones are the most numerous (taphonomic)
- The densest salmon bones are not the most numerous (cultural/storage)
- Upper Midden: NISP and radiocarbon years B.P. not correlated (cultural)
- Lower Midden: NISP and radiocarbon years B.P. is correlated (taphonomic)

Stable isotopic methods

- Preservation (BB%N and BB%C) and Contamination (actual-expected BB%C)
  - Are significantly negatively correlated with BVD
  - Are significantly correlated with breakage class and cal. years B.P.
- Fish bones have been more contaminated by carbon-rich sources over time while still loosing overall carbon content.

Take home message

- Taphonomic analysis must be completed prior to completing zooarchaeological and stable isotopic analysis
- Pacific cod fork length: No significant change over time

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