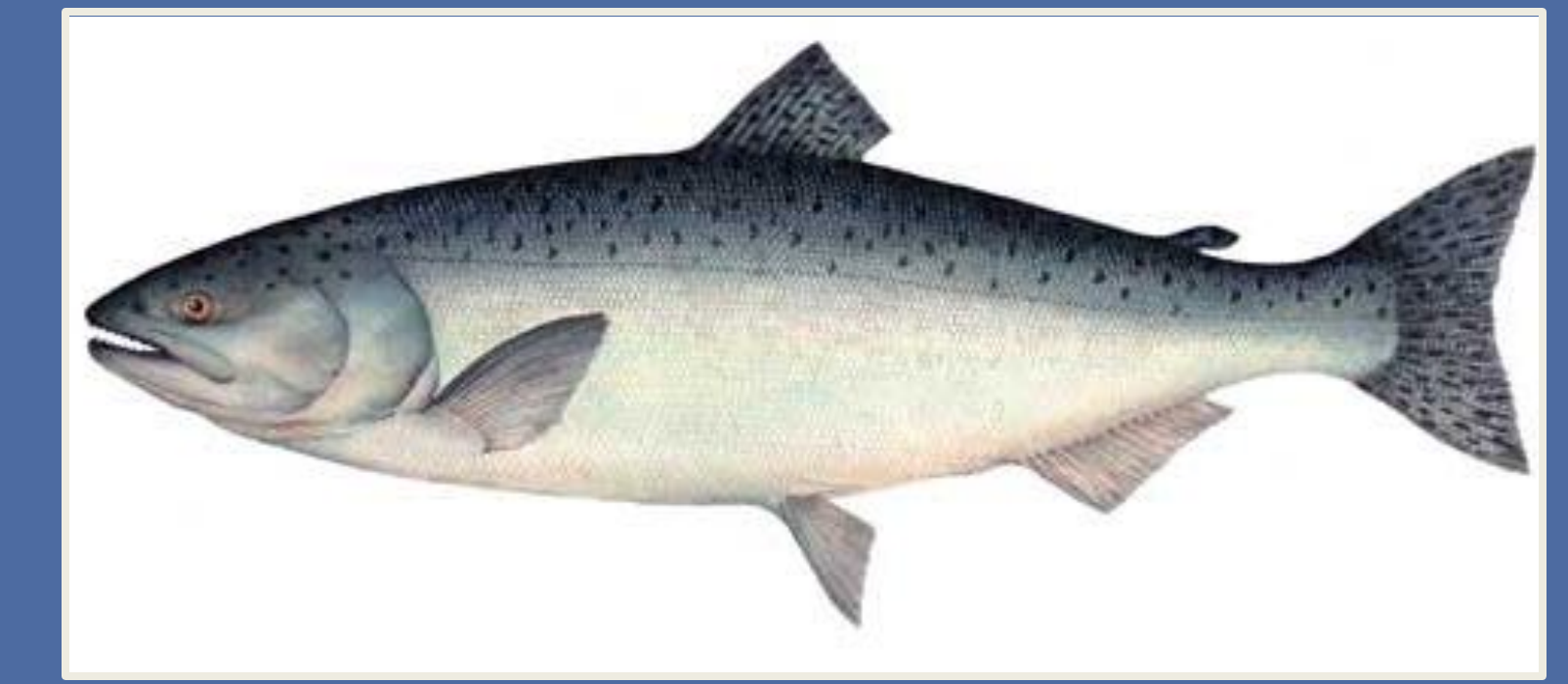
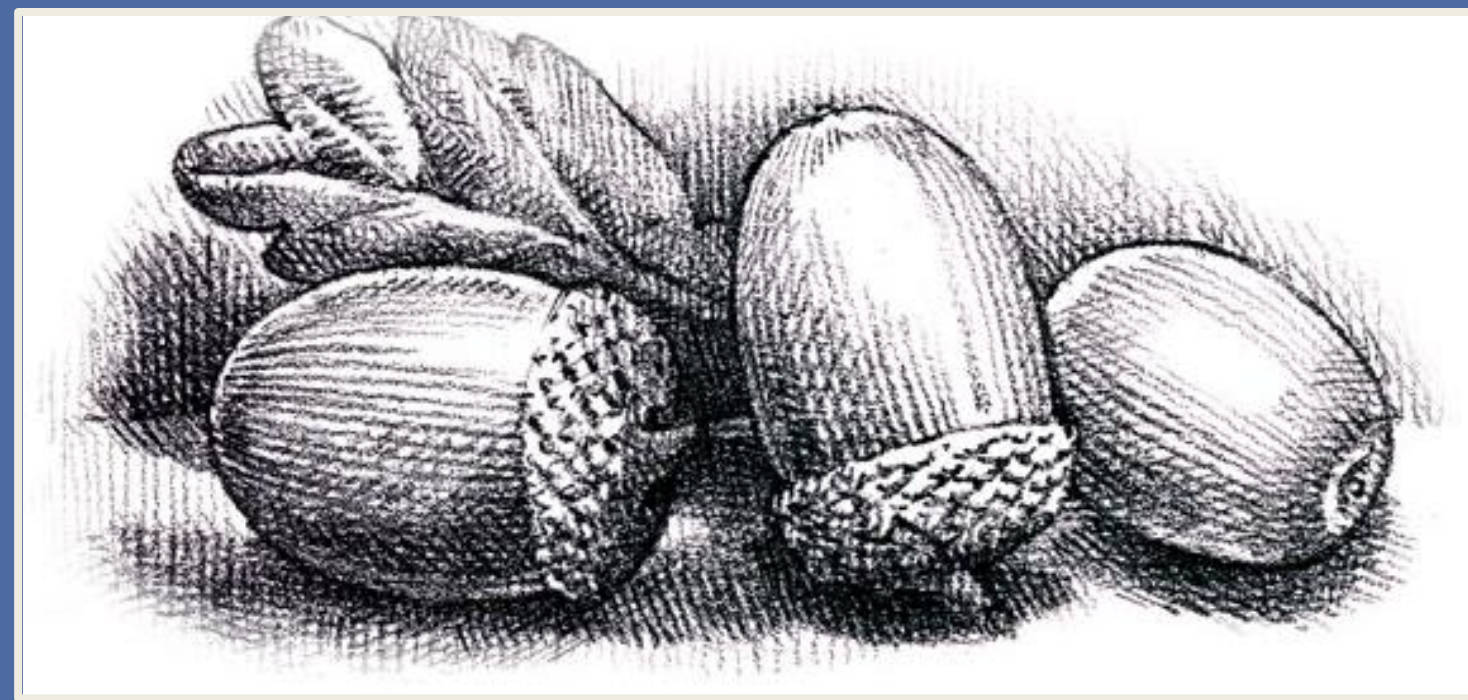


Why foragers choose acorns before salmon: Modeling back-loaded vs. front-loaded resources

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The Problem

Salmon & acorns in ethnographic northwestern California

Salmon and acorns were the most important terrestrial foods in the diet of contact period groups in northwestern California. Throughout the ethnography salmon is said to be the primary staple, while acorns come in a close second.



Intensive acorn leaching methods were identical to those employed throughout California.

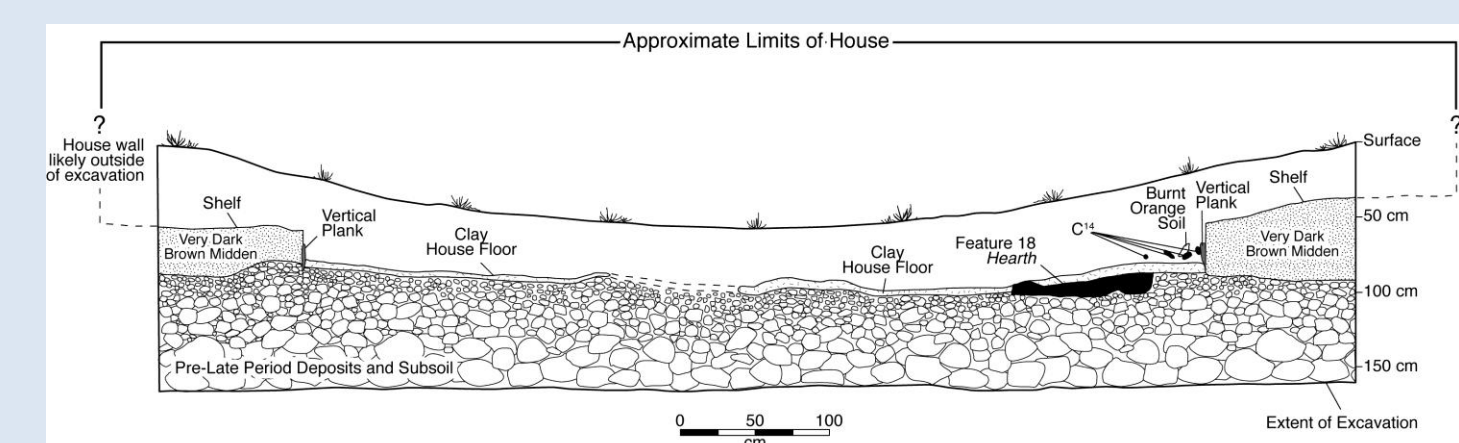


A great range of facilities and implements were used to capture salmon, from large communal weirs, to nets and basketry traps to simple fish spears.

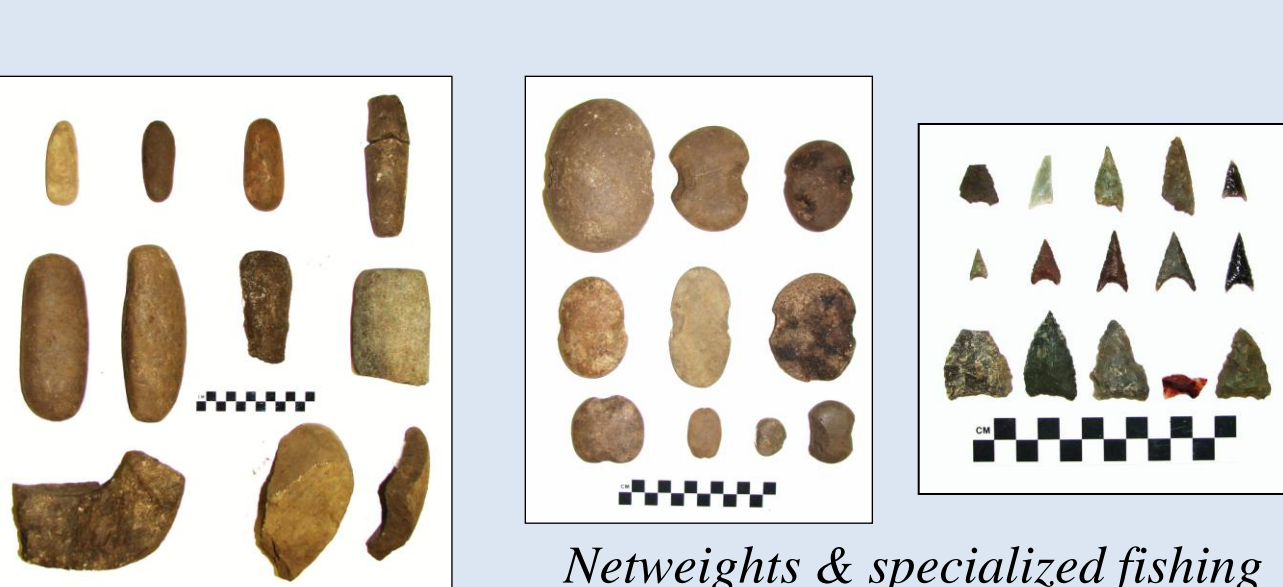
The archaeology

While salmon was clearly important ethnographically, it appears that foragers did not intensify salmon (i.e. mass extract and store the resource in quantity) until relatively late in the archaeological record. Acorns, however, were an important staple early in time.

Excavations at 5 sites on the Smith River in Tolowa ancestral territory revealed an 8,500 year chronological sequence and the earliest documented plank houses in northwestern California (Tushingham 2009). Site residency increased after 3100 Cal BP as plant processing became more important, but mass extraction and storage of salmon was not a focus until after the emergence of linear plank house villages by 1267 Cal BP.



Floor profile of earliest (1267 Cal BP) semi-subterranean plank house recorded in northwestern CA, at DNO-26 (Red Elderberry Place)



Plant processing tools are common in pre Late Period deposits. Netweights & specialized fishing gear (harpoon tips) are common in Late Period deposits, but absent in earlier contexts.



Though bone preservation is poor, there is a significant increase in salmon bone in Late Period houses (93% of 55), suggesting salmon intensification or storage.

While previous excavation at river basin sites is limited, McKee Flat (HUM-405) and Redwood Creek (HUM-452) provide "evidence for acorn use and some degree of occupational stability" but no "direct evidence for the exploitation of salmon or the extensive use of storage facilities" during Mendocino Pattern times (5000-1500 cal BP) (Hildebrandt and Hayes 1993:104).

Salmon are traditionally viewed as a low cost (high ranking) resource, while acorns are viewed as a high cost (low ranking) food. If correct, why are salmon not taken and stored en masse earlier?

The Model

Back-loaded and Front-loaded resources

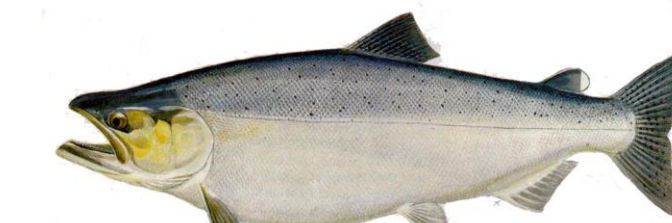
The back-loaded front-loaded model addresses situations where a forager must decide between taking two resources which vary significantly in terms of their susceptibility to storage. The model recognizes two broad categories of resources:

Back-loaded resources (e.g. acorns and piñon nuts), are cheap to procure and store, but a great deal of effort is involved in processing them before consumption.



When intensive leaching techniques are employed, acorns are back-loaded in the extreme, storage time constituting just 6 percent of its total handling time (McCarthy 1993).

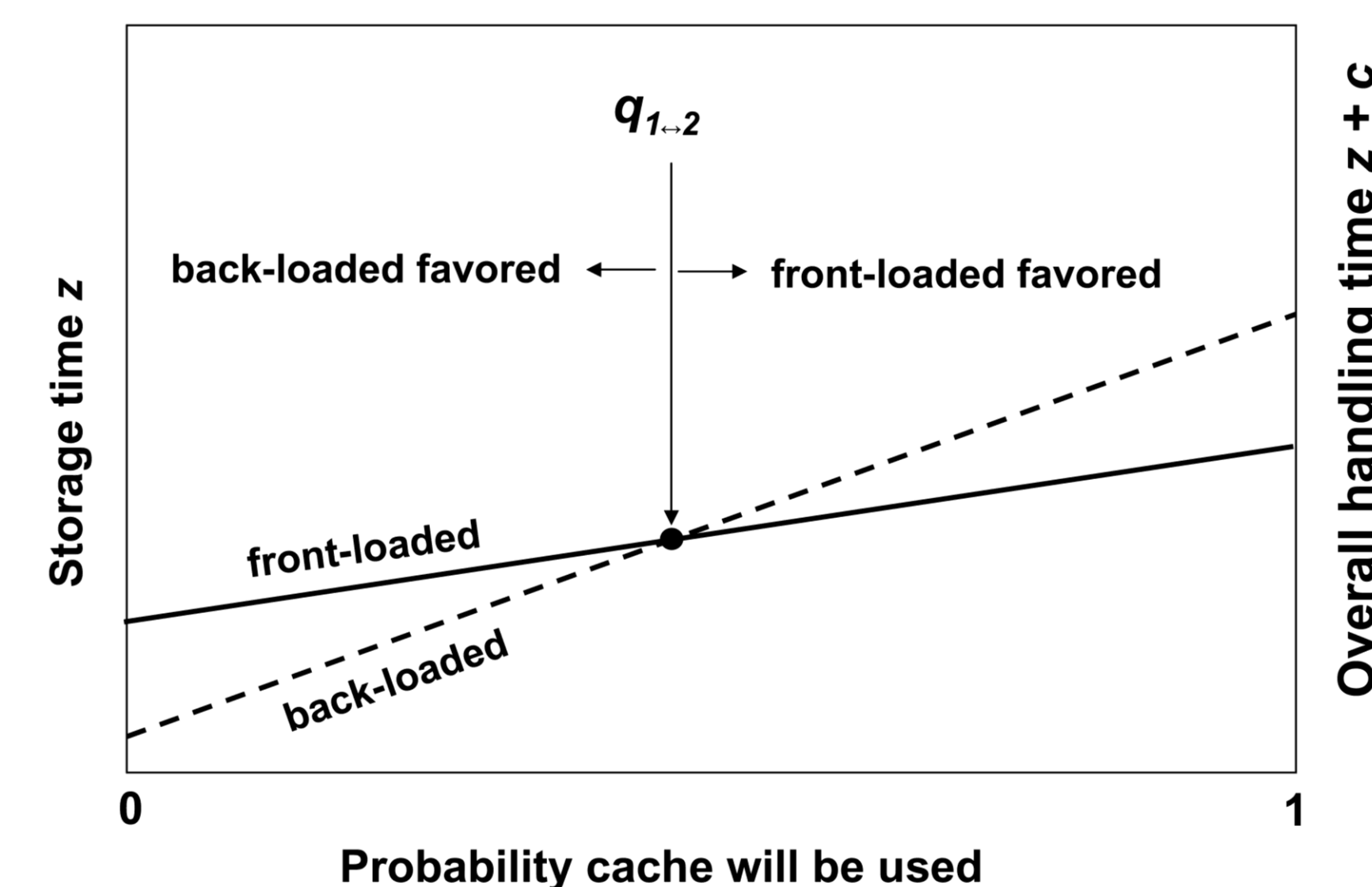
Front-loaded resources include fish, game and most roots. They are expensive to procure and process before storage, but once stored, do not take a lot of time to prepare.



Mass harvested, stored and dried salmon are extremely front loaded, being costly to catch and dry, but easy to prepare.

Risk and caching

Mobile groups first experimenting with caching would have been particularly sensitive to the risk of not using stored reserves. While overall handling time for back-loaded resources may be higher than it is for front-loaded resources, front-loaded resources are clearly more risky for more mobile foragers because the chances of not using stored reserves is relatively high. Why not choose to store a back-loaded resource instead, since not much is lost even if the stores are not used?



Front-back loaded problem graphically depicted. Axis on the left represents storage time, axis on the right overall handling time (storage time + culinary time). Back-loaded resource is initially cheaper (to store) but ends up being more costly (storage time + culinary time) if the cache is actually used. $q_{1 \leftrightarrow 2}$ is the probability of cache use at which both resources are equally costly. When actual probability is lower, the back-loaded resource is favored; when actual probability is higher, the front-loaded resource is favored. If the cache is always used but in variable amounts, $q_{1 \leftrightarrow 2}$ is the proportion of use at which both resources are equally costly.

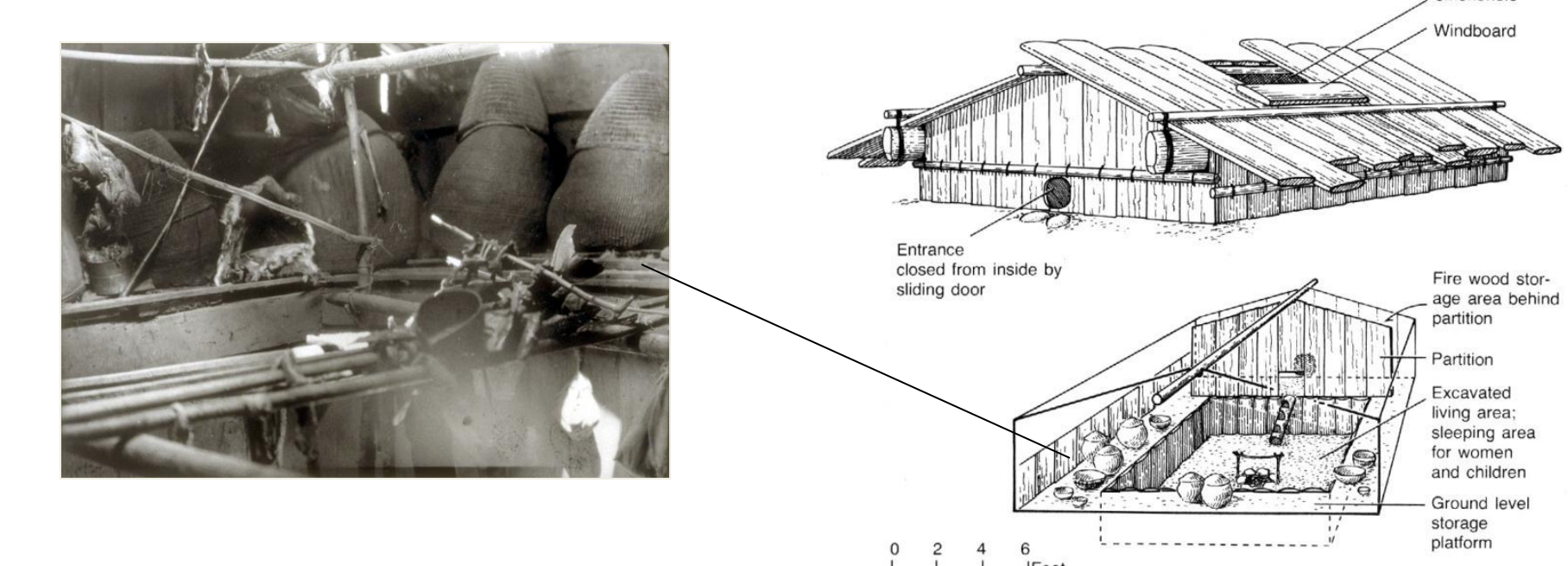
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The Solution

The development of intensive foraging systems in northwestern California

While salmon and acorns are both abundant, harvestable foods, when taken with high cost techniques, salmon is an extremely "front-loaded" resource, compared to acorns, which is a "back-loaded" resource. Intensification of the anadromous fish resource required a qualitative "jump" that foragers simply chose not to take until the Late Prehistoric. After the rapid emergence of linear plank houses, however, the rules dramatically changed.



Plank houses were large, permanent storage facilities where a broad range of foods were kept.

There is every indication that dramatic social changes took place after the rise of linear plank house villages by 1267 Cal BP, when low residential mobility, storage, a focus on mass extractive methods, and logistical pursuit of distant seasonal resources became dominant hunter-gatherer strategies. A restructuring of long distance obsidian exchange relationships is consistent with the developing insularity of social groups and increased sedentism characteristic of the Late Prehistoric.

Conclusion

Despite the enormous potential of anadromous fish, it is not until after 1250 CAL BP when foragers mass extract and store salmonids in quantity. Intensification of this front-loaded resource was resisted because foragers had an attractive back-loaded alternative, acorns. Once people began living in large semi-subterranean plank houses, the probability of using stored resources immediately increased to the point that salmon and other front-loaded resources could enter the diet.

Acknowledgements

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