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Measuring *Mytilus californianus*: an Addendum to Campbell and Braje (2015) and Singh and McKechnie (2015) including commentary and an integration of data

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This JAS issue includes two articles that address the same methodological topic: estimating California mussel (*Mytilus californianus*) shell sizes from umbo fragments (Campbell and Braje, 2015; Singh and McKechnie, 2015). The coincidental submission and acceptance of these articles in the same journal, featuring a very similar methodological approach specific to the Pacific Coast of North America, was a surprise unbeknownst to the authors. Noticing this synchronicity, the authors subsequently contacted each other and requested their articles appear in the same issue. In this addendum we provide a brief commentary on our independent observations about estimating California mussel shell length from fragmentary remains, integrate a component of the method, and comment on future research directions.

Both Campbell and Braje (2015) and Singh and McKechnie (2015) present a regression-based approach for estimating total shell length that enables a more refined size estimate than existing classification methods (e.g., Whitaker, 2008) and increases the interpretive potential for this ubiquitous shellfish beyond an 'ordinal scale' typical of zooarchaeological abundance data (Wolverton et al., 2014). Campbell and Braje generate three strong regressions based on a modern sample of 135 *M. californianus* obtained from a single intertidal location in San Diego, California, representing a relatively narrow shell size range (2–9 cm). These regressions were then assessed against archaeological samples from San Miguel Island, California, and one formula was found to be especially applicable to archaeological samples. Singh and McKechnie developed regressions on 132 mussels from samples spread across multiple sites in Southern California (Santa Barbara Channel and Point Conception), Northern California (Bodega Bay), and western Vancouver Island in British Columbia, Canada (Fig. 1), in an effort to use spatial variation as a substitute for temporal and ecological variation (cf. Pickett, 1989). Given the high degree of variability in *M. californianus* ecology over large geographic scales and heterogeneity within sampling locations (Helmuth et al., 2006), Singh and McKechnie's regressions have a weaker fit to their data than Campbell and Braje, but are likely more suitable for application to archaeological assemblages where growing conditions may vary over archeological time scales. Singh and McKechnie also apply this regression to a wider size range of mussels (0.9–19 cm), generate a curvilinear weight prediction from live collected specimens, and found their regression models to also predict morphologically similar species *M. trossulus*.

The papers show broad complementarity in geographic coverage and morphometric measurements, including a directly comparable measurement – umbo thickness – which results in a nearly identical predicted shell size between the two studies. Given the relevance of this measure to fragmentary archaeological assemblages, we have taken this opportunity to integrate these data to develop an even more robust model for predicting umbo thickness (Fig. 2, referred to as umbo length in Campbell and Braje). We note that the San Diego data presented in Campbell and Braje (2015) is adjacent to the Southern California samples presented in Singh and McKechnie (2015).

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0305-4403/

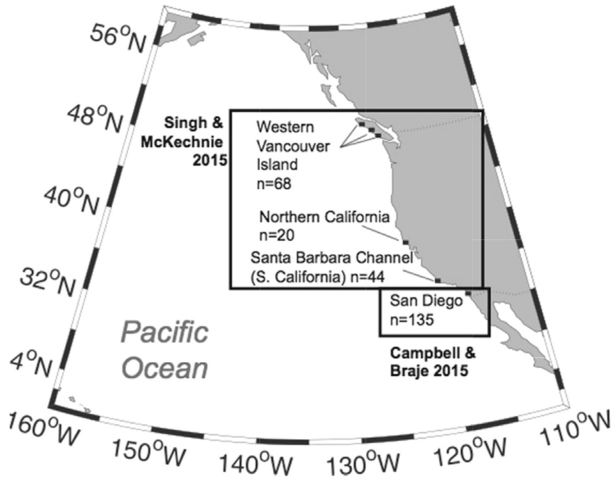

Fig. 1. Map showing locations and numbers of *M. californianus* specimens presented in the two separate studies.

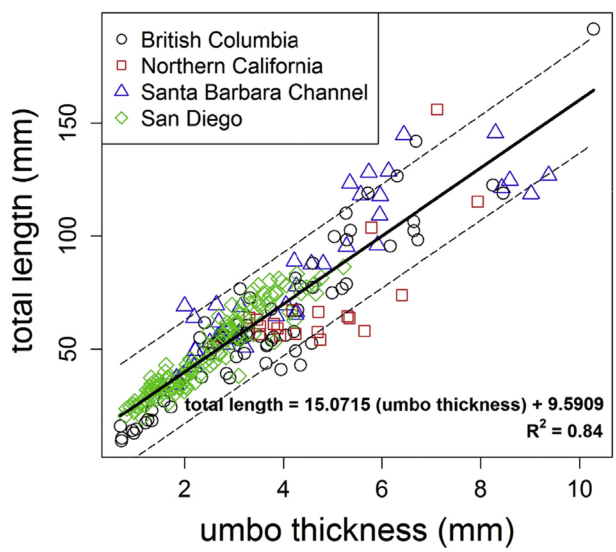

Fig. 2. Linear regression model fitted to data relating umbo thickness to total shell length. Differently shaped points correspond to shells collected in different coastal areas shown in Fig. 1. The regression equation and resulting R^2 value are included in the bottom right corner. The broken lines represent a 95% prediction interval, which indicates an estimate of where observations are predicted to fall 95% of the time.

The methods presented in both papers are intended for application and potential refinement in the future through the addition of geographically underrepresented sampling areas and the inclusion of more live collected specimens that may strengthen the applicability of the regressions. For instance, the integration of the umbo thickness measurement across studies increases the predictability of the model, especially among smaller size classes (under 9 cm), but there is presently room to improve this for the larger size classes and for under-represented regions (Fig. 2). Interested researchers can access these data in the supplemental online materials associated with Singh and McKechnie (2015) and for Campbell and Braje (2015) in the file associated with this addendum (see supplementary data).

A broader goal discussed in both papers is to bring zooarchaeological research into more direct conversation with marine ecologists and resource managers who are assessing climatic change and human impacts in the contemporary marine environment. Finding points of translation across these datasets is critical, particularly when the zooarchaeological record is increasingly relevant to contextualizing the magnitude of change between preindustrial and modern marine ecosystems (e.g., Erlandson and Rick, 2010; Kittinger et al., 2014). In order to achieve such complementarity, we encourage archaeologists to find productive intersections with ecological data and avoid debates focused exclusively on methodological issues internally oriented within the discipline (cf. Glassow, 2000; Mason et al., 1998), particularly when these data often have a much broader interdisciplinary relevance.

A major challenge of applied zooarchaeology (Lyman, 2012), and research in historical ecology more generally, is in developing methods that integrate modern, historical, and ancient archaeological data. Size estimates of shellfish, fish, and other organisms are one readily available intersection. Ecologists and resource managers often consider such data over relatively shallow time frames to assess the health and structure of local populations. When archaeological data can be integrated into these frameworks, they offer deeper historical perspectives and a more holistic view of climatic variability and human harvesting. Developing appropriate methods that accomplish these goals will benefit from a multi-disciplinary oriented community to further historical ecological research.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jas.2015.03.011.

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