La protección de concheros en la costa de Baja California: un asunto de conservación arqueológica y de biodiversidad de plantas

Sula Vanderplank y Exequiel Ezcurra

Resumen

Los sitios de protección natural y cultural frecuentemente presentan conflictos en cuanto a prioridades de conservación puesto que el impacto humano por lo general resulta en destrucción de locales y reducción de niveles de biodiversidad nativa. Las lluvias invernales del noroeste de Baja California por miles de años han intemperizado el calcio de conchas aragonitas depositadas por humanos (concheros) a lo largo de la costa. La emisión de este calcio ha cambiado las propiedades del suelo, remediado suelos sódicos y salinos y resultado en un microhabitat único que incluye a flora diferente a la de los alrededores. La biodiversidad nativa y la heterogeneidad del paisaje se ven incrementados significativamente en los concheros. La protección de este paisaje cultural promovería tanto la conservación arqueológica como la de biodiversidad. Por lo que la protección de concheros podría resultar en la protección de prioridades naturales y culturales en el noroeste de Baja California

The preservation of both archeological sites and native biodiversity is fraught with challenges. In the majority of instances, conservation of both is not compatible. For example, the United Nations Educational Scientific and Cultural Organization (www.UNESCO.org) separates cultural heritage sites and natural heritage sites at the core of its goals and missions; just 2.65% have mixed properties. Among those with mixed properties, most are overlapping coincidentally, with no causal relationship or true relationship between the two. In reality, the majority of archeological sites are scars on the landscape of native biodiversity, where historic human activity has reduced or negatively impacted biodiversity, either through direct impacts, habitat conversion, the introduction or cultivation of exotic species, or overharvesting. More recently cultural conservation and biodiversity conservation can be seen to overlap significantly in the sustainable use of natural resources (Furze et al. 1996; Timmer and Juma 2005), but shared targets of elevated conservation importance for both archeological and biodiversity priorities are still few. The aragonite shell middens of northwest Baja California represent an important exception.

People have harvested food along the world's coast for more than 150,000 years, and have impacted populations of shellfish dating back more than 23,000 years (Jackson et al. 2001; Rick and Erlandson 2009). Along the coasts of the Americas, hunter-gatherers exploited coastal ecosystems, leaving behind shell mounds, or middens. Human inhabitation of the Baja California peninsula began more than 11,000 years ago (Des Lauriers 2010; Laylander and Moore 2006). People moved freely from mountains to sea (Hyland 1997; Moore 2012), relying heavily on

marine resources for protein. The indigenous people of Baja California did not leave permanent structures on the landscape (Figueroa 2009; Moore 1999, 2012), but their middens (Meigs 1935, 1938; Moore 2001) are some of the most significant archeological sites in the region. Moore (1999, 2001) dated many of the middens in the San Quintín region, and records regular occupation from the first half of the sixth millennium into historic times, with the majority of middens being 3,000–5,000 years old. The middens seen across the landscape today form microhabitats for distinct biotic communities. After thousands of years, many of these shell middens have become mounds of calcium-rich soil that provide new habitats for plants. Meigs (1938) suggested that studies on the vegetation of the middens of northwest Baja California could uncover patterns of movements of people historically and/or successional patterns in the flora. Vanderplank et al. (2014) unequivocally show that in the mediterranean climate region of Baja California, where winter rainfall is sufficient for soil development and weathering of shells, the effect of these prehistoric middens on contemporary vegetation is significantly different, increasing landscape complexity and regional native species richness.

Shells can be broadly separated into two types based on their calcium carbonate structures: calcite and aragonite. Calcitic species form mother-of-pearl layers on the inside (e.g., the California mussel, *Mytilus californianus*, and black abalone, *Haliotis cracherodii*); the shells are more stable and degrade relatively slowly. Aragonitic species (predominantly Pismo clam, *Tivela stultorum*) have shells with no mother-of-pearl; they decompose more readily and release calcium carbonate into the environment (Coan et al. 2000; Harper 2000). As a result, the concentrated prehistoric deposition of aragonitic shells impacts the contemporary distribution of native plants (Vanderplank et al. 2014). Historical human activity has increased environmental heterogeneity, resulting in increased plant diversity and a more complex species assemblage. The conservation value of past human disturbances has positively enhanced landscape heterogeneity and native plant species richness, making conservation priorities for biodiversity and archeological sites overlapping and mutually beneficial.

The beneficial effects of calcium added onto saline and sodic soils are well known (Buol et al. 2011). Species colonization of middens in different habitats is not predictable because each soil type responds differently to the addition of calcium, resulting in different plant communities. For example, the effect of aragonite shells as a soil amendment agent was strikingly visible in tidally flooded soils (Vanderplank et al. 2014). The deposition of aragonite shells did not promote the occurrence of calciphiles (calcium-loving species). Instead, it is the formation of a more heterogeneous landscape, driven by the footprint of prehistoric human activities, which promotes species richness at each site. Therefore humans have, albeit inadvertently at the time, amended soils, promoting an increase in native plant biodiversity. The human harvest of marine invertebrates leaves a trail of environmental transformation that has resulted in greater native diversity and landscape heterogeneity.

Early effects of the Anthropocene (a geological epoch marked by human domination of earth systems) can be witnessed in this system. These new anthropogenic soils show unique soil signatures and plant communities, yet they are not degraded, nor do they favor nonnative plants. The impact of aragonite shell middens on soil conditions and plant communities is evidence that the historical activity of humans can increase native plant and landscape biodiversity. These anthropogenic soils make the cultural landscape more heterogeneous, and this is reflected in the biodiversity, with unique plant assemblages within the rich landscape matrix. Cultural sites in this context thus increase native plant biodiversity, and the Anthropocene can be expected to show surprising impacts on our future native flora, given sufficient time.

Protection of this cultural landscape will encourage both archeological and biodiversity conservation. On the forgotten peninsula, natural and cultural heritage priorities are overlapping and mutually beneficial. Shell middens in northwest Mexico have been previously proposed to have great potential for ecotourism and educational purposes (Téllez-Duarte et al. 2001). The surviving indigenous people of Baja California have been largely displaced (relocated to the north). To preserve the rich history of the indigenous peoples of the peninsula and the rich biodiversity that results from their ancestral stewardship, we hereby propose that additional protection and vigilance be given to the shell middens of northwest Baja California.

Future considerations

This is the first example of past human activities inadvertently benefitting terrestrial biodiversity as a result of harvesting marine life and altering soils. In the future, the vegetation of the middens may continue to change with increasing amounts of calcium carbonate being released into the soil as shells continue to decompose. Middens will continue to maintain a flora distinct from that of the surrounding matrix, maintaining landscape heterogeneity and native plant richness, even if the floristic composition varies through time. Long-term monitoring of middens can inform our understanding of plant ecology in soils where aragonite shells are being continually eroded. An archeological team could assess soil at different levels within the midden to confirm and elaborate on the preliminary findings of Vanderplank et al. (2014), to improve our understanding of the role of factors such as burning, organic matter, soil mixing, salinity, texture, drainage and rooting depths. In deeper timescales, we can expect to see a similar effect in middens of calcite shells that decompose more slowly than aragonite, since eventually, they too will start to decompose and release calcium.

In northwest Baja California, priorities for the conservation of archeological sites and terrestrial biodiversity are overlapping and complementary in their targets. Anthropogenic soils have increased native plant biodiversity and landscape heterogeneity and will continue to do so if allowed the protection necessary. Coastal disturbance and development has destroyed significant coastal middens in California, but many still remain in Baja California, Mexico, although development pressure is increasing (Moore 2006). Conservation efforts focused on the local natural and cultural heritages will mutually benefit from increased protection of archeological shell middens. A binational, multidisciplinary team of concerned citizens is proposed here as the first step towards a safe future for natural and cultural heritage on the coast.

References Cited

Buol, Stabley W, R. J. Southard, R. C. Graham and P. A. McDaniel
2011 *Soil genesis and classification*, 6th ed., Wiley-Blackwell, Ames, Iowa.

Coan, Eugene V., Paul Valentich. Scott and F. R. Bernard
2000 *Bivalve seashells of western North America: marine bivalve mollusks from Arctic Alaska to Baja California,* Santa Barbara Museum of Natural History Monographs 2, Santa Barbara, California.

Des Lauriers, Matthew Richard
2010 *Island of fogs: archaeological and ethnohistorical investigations of Isla Cedros, Baja California.* University of Utah Press, Salt Lake City.

Figueroa Beltrán, Carlos
2010 "Las adaptaciones culturales en la prehistoria del noroeste de Baja California: inferencias arqueológicas ante el cambio climático", in *Cambio climático en México: un enfoque costero-marino*, Evelia Rivera-Arriaga, Isaac Azuz-Adeath, Leticia Alpuche Gual and Guillermo J. Villalobos-Zapata, eds., pp. 655-668, Universidad Autónoma de Campeche.

Furze, Brian, Terry De Lacy and Jim Birckhead
1996 *Culture, conservation and biodiversity: the social dimension of linking local level development and conservation through protected areas*, John Wiley & Sons, Chichester, New York.

Harper, E. M.
2000 "Are calcitic layers an effective adaptation against shell dissolution in the Bivalvia?", *Journal of Zoology* 251:179-186

Hyland, Justin Robert
1997 *Image, land, and lineage: hunter-gatherer archaeology in central Baja California, Mexico,* dissertation, University of California, Berkeley.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner and R. Warner
2001 "Historical overfishing and the recent collapse of coastal ecosystems", *Science* 293:629-637.

Laylander, Don and Jerry D. Moore (eds.)
2006 *The prehistory of Baja California: advances in the archaeology of the forgotten peninsula*, University Press of Florida, Gainesville.

Meigs, Peveril, III
1935 *The Dominican mission frontier of Lower California,* University of California Publications in Geography 7, Berkeley.
1938 "Vegetation on shell mounds, Lower California", *Science* 87:2259.

Moore, Jerry D.
1999 "Archaeology in the forgotten peninsula: prehistoric settlement and subsistence strategies in northern Baja California", *Journal of California and Great Basin Anthropology* 17-44.
2001 "Extensive prehistoric settlement systems in northern Baja California : archaeological data and theoretical implications from the San Quintín - El Rosario region", *Pacific Coast Archaeological Society Quarterly* 37(4):162-163.
2006 "The San Quintín-El Rosario region", in *The prehistory of Baja California: advances in the archaeology of the forgotten peninsula*, Don Laylander and Jerry D. Moore, eds., pp. 179-195, University Press of Florida, Gainesville.
2012 *The Prehistory of Home*, University of California Press, Berkeley.

Rick, Torben C. and Jon M. Erlandson
2009 "Coastal exploitation", *Science* 325:952-953.

Téllez-Duarte, Miguel A., Guillermo Ávila-Serrano and Karl W. Flessa
2005 "Archaeological shell middens in the Colorado delta: an option for the use of the biosphere reserve of the upper Gulf of California", *Pacific Coast Archaeological Society Quarterly* 37(4):80-86

Timmer, Vanessa and Calestou Juma
2005 "Taking root, biodiversity conservation and poverty reduction come together in the tropics: lessons learned from the Equator Initiative", *Environment* 47(4):24–44.
Vanderplank, Sula A., Sergio Mata and Exequiel Ezcurra
2014 "Biodiversity and archeological conservation connected: aragonite shell middens increase plant diversity", *Bioscience* 64(3):202-209.