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Diffusionism Reconsidered: Linguistic and Archaeological Evidence for Prehistoric Polynesian Contact with Southern California Author(s): Terry L. Jones and Kathryn A. Klar Reviewed work(s): Source: American Antiquity, Vol. 70, No. 3 (Jul., 2005), pp. 457-484 Published by: Society for American Archaeology Stable URL: http://www.jstor.org/stable/40035309 Accessed: 02/11/2012 15:22

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# DIFFUSIONISM RECONSIDERED: LINGUISTIC AND ARCHAEOLOGICAL EVIDENCE FOR PREHISTORIC POLYNESIAN CONTACT WITH SOUTHERN CALIFORNIA

Terry L. Jones and Kathryn A. Klar

While the prevailing theoretical orthodoxy of North American archaeology overwhelmingly discourages consideration of transoceanic cultural diffusion, linguistic and archaeological evidence appear to indicate at least one instance of direct cultural contact between Polynesia and southern California during the prehistoric era. Three words used to refer to boats including the distinctive sewn-plank canoe used by Chumashan and Gabrielino speakers of the southern California coast—are odd by the phonotactic and morphological standards of their languages and appear to correlate with Proto-Central Eastern Polynesian terms associated with woodworking and canoe construction. Chumashan and Gabrielino speakers seem to have borrowed this complex of words along with the sewn-plank construction technique itself sometime between ca. A.D. 400 and 800, at which time there is also evidence for punctuated adaptive change (e.g., increased exploitation of pelagic fish) and appearance of a Polynesian style two-piece bone fishhook in the Santa Barbara Channel. These developments were coeval with a period of major exploratory seafaring by the Polynesians that resulted in the discovery and settlement of Hawaii—the nearest Polynesians had the capabilities of navigation, boat construction, and sailing, as well as the cultural incentives to complete a one-way passage from Hawaii to the mainland of southern California. These findings suggest that diffusion and other forms of historical contingency still need to be considered in constructions of North American prehistory.

ltural transoceánica, la evidencia lingüística y arqueológica parece indicar por lo menos un caso del contacto cultural directo entre Polinesia y California meridional durante la era prehistórica. Tres palabras utilizaron para referirse a barcos—inclusive la canoa distintivo de tablón-cosido utilizada por hablantes de Chumashan y Gabrielino de la costa meridional de California son raros para los estándares fonotácticos y morfológicos de sus idiomas, y parecen tener correlación con los términos polinesios Orientales y Proto-Centrales, asociados con el trabajo de madera y la construcción de la canoa. Hablantes de Chumashan y Gabrielino parecen haber tomado prestado este complejo de palabras junto con la técnica de la construcción de tablón cosido, alguna vez entre 400 y 800 A.D. hay también evidencia del cambio puntual de adaptación (por ejemplo, la explotación aumentada del pez pelágico) y la apariencia de un anzuelo polinesio estilizado de hueso de dos-pedazo en el Canal de Santa Barbara. Estos desarrollos eran contemporáneos con un período de exploración marítima mayor por los polinesios, que tuvieron como resultado el descubrimiento de Hawaii, el puesto polinesios tuvieron capacidades para la navegación y la construcción de barcos, así como los estímulos culturales para completar el viaje en una jornada de Hawaii a la tierra continental de California meridional. Estos hallazgos sugieren que la difusión y otras formas de contingencia histórica todavía necesitan ser consideradas en la construcción de la prehistoria norteamericana.

Consider the fact that two widely separated cultures both used boats; this is no evidence at all of a shared cultural heritage. If both cultures were to paint eyes on the bows of their boats, it would be much more interesting, but still a rather obvious move in the game of design. If both cultures were to paint, say, blue hexagons on the bows of their boats, this would be telling indeed [Dennett 1995:357].

espite its status as one of the oldest and most basic theoretical principles in anthropology—one that aids in conceptualiza-

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American Antiquity, 70(3), 2005, pp. 457–484 Copyright© 2005 by the Society for American Archaeology

tion of such disparate phenomena as the Neolithic revolution (see Bellwood 2001; Diamond and Bellwood 2003) and contemporary globalization-diffusionism has been characterized in vastly different terms over the course of the twentieth century. Archaeology was originally galvanized as a legitimate scientific discipline largely in opposition to wild theories of intercontinental diffusion invoked to explain the so-called Mound-builder cultures of southeastern North America. Under the normative paradigm of the early twentieth century, diffusion on an intracontinental level was regularly employed to explain cultural successions, but modernism in the guise of the "New" archaeology brought with it a pervasive view of culture change as in situ economic adjustment to changing environmental and demographic circumstances. Even in places like California, where a startlingly complex linguistic mosaic speaks to the movements and contacts between different cultural groups over time, theories of adaptation and economic intensification, rather than seemingly outdated notions of diffusion, increasingly dominate the conceptual arena. Within the emerging postmodernist landscape, models of diffusion are also discouraged due to their potential conflict with attempts by indigenous groups to reaffirm political and ethnic identities through connection with the archaeological record-regardless of its antiquity (e.g., the Kennewick case). By the close of the twentieth century, it would be safe to characterize diffusionism as a relict principle that is maintained within archaeological theory only because of its occasional value in characterizing certain phenomena inadequately explained by other more contemporary or sophisticated perspectives.

Despite the overwhelming intellectual momentum against diffusionary models, we present in this paper evidence for a remarkable yet long dismissed case of prehistoric diffusion: adoption of two Polynesian maritime technologies (sewn-plank boats and composite bone fishhooks) by the Chumash and Gabrielino of southern California during the first millennium A.D. Evidence for this contact includes linguistic analysis showing that Chumashan and Gabrielino words for sewn-plank canoe are not lexically consistent within their own languages, but instead appear to be of Polynesian origin. Southern California is the only place in Native North America where sewn-plank boat tech-

nology was present, yet this technique was common throughout Polynesia and it seems likely, in light of the linguistics, that the Chumash and Gabrielino learned the technique from Polynesian seafarers. Sudden appearance of elaborate composite bone fishhooks of Polynesian style contemporary with both the initial archaeological evidence for sewn-plank canoes in the Santa Barbara Channel and the beginning of long-distance exploration by Polynesians complete a body of evidence substantial enough to offer few reasonable alternatives to diffusion. Recognition of this apparent case of transoceanic contact suggests that diffusion and other forms of historic contingency still need to be considered in archaeological conceptualizations of North American prehistory.

# **Trans-Pacific Diffusion Revisited**

Theories of transoceanic diffusion, of course, have been the scourge of anthropological archaeology for nearly half a century-largely for good reason. The "literature" of transoceanic contact consists primarily of a profuse amalgam of wild, illsupported theories mostly proposed by self-trained "archaeologists." Prior to the advent of processualism, however, American archaeologists also participated in this dialog, but the modernist fixation on in situ adaptation brought with it an exclusive focus on internal cultural processes to the exclusion of even the possibility of external contact. Much of the transoceanic speculation from the early twentieth century was also so naïve (see comments by Childe 1962:209) that its dismissal ultimately bolstered the overall credibility of modern scientific archaeology. Since then, geographers and historians have continued to discuss the distribution of various cultural traits around the Pacific Rim (Jett 1971, 1998; Needham and Gwei-Djen 1985; Sauer 1952), arguing for pre-Columbian diffusionary contact between the New World and such places as China (Jett 1971:13; Menzies 2002) and India (Jett 1998) at the same time that such topics have become taboo among archaeologists (Kehoe 1998, 2003). With some key exceptions (e.g., Ekholm 1964; Kelly 1974; Meggers et al. 1965; Tolstoy 1974, 1999), most archaeologists have shunned these discussions because they often incorporate archaeological information in questionable ways and, even more commonly, border on the absurd.

Two theories of trans-Pacific diffusion were particularly influential in the last half century, both in negative ways: Thor Heyerdahl's (1952) illconceived notions about colonization of Oceania from North and South America and Meggers et al.'s (1965) argument for a Jomon connection in South America. From the start, Heyerdahl's theory was hopelessly at odds with the American and Polynesian archaeological and linguistic records (Suggs 1960), but it was nonetheless heavily publicized and received great support from the general publicepitomizing the nonscholarly approach of many transoceanic theorists. Meggers et al. (1965), on the other hand, tried to mount a more scholarly case, arguing that Jomon-like pottery was introduced into coastal Ecuador ca. 400 B.C. The ceramics were thought to reflect an accidental drift voyage by a single Japanese boat that, upon reaching land, introduced both the idea of pottery making and particular stylistic elements. A major problem with this proposal was its focus on only one relatively noncomplex technology (fired clay) and simple decorative elements that together do not in most minds constitute a convincing basis for ruling out independent invention. Furthermore, the means of conveyance-a drift voyage of thousands of miles along the edge of the Pacific-is not viewed as particularly likely or even feasible at 400 B.C. The Meggers et al. theory has never been accepted by the broader academic community and in recent years has been seriously undermined by the discovery of simple pottery thousands of years older elsewhere in the Americas (Popson 2005). This failure suggested that rigorous scholarly approaches seemed likely to produce only meager, non-credible bodies of evidence. In contrast, we feel the case for trans-Pacific diffusion presented below is considerably stronger in that it includes significant technical and stylistic similarities between donor and recipient cultures in two nonrelated and complex technologies, nonmaterial (linguistic) referents for one of these technologies, and a society that had the demonstrated means (capabilities of navigation, boat construction, and sailing) as well as the cultural incentives to accomplish contact (Finney 1976, 1977, 1994; Irwin 1992; Kirch 2000). Furthermore, the physical route of contact was more than feasible, and the archaeological record suggests that the key developments were all coeval.

#### Chumashan-Polynesia Nexus

The possibility of prehistoric contact between Polynesia and California is not a new idea. It was considered in print at least as early as 1877 by Lang and was followed soon thereafter by Rau (1884) and Hamy (1885) who suggested that similarities between Hawaiian and Californian single-piece curved shell fishhooks were indications of cultural contact. Similarities between curved shell hooks of California and those of Chile were also noted some time ago (Heizer 1949; Heyerdahl 1952; Kohler 1977; Olson 1930:321; Pohorecky 1976:122; Strudwick 1986:74), but Heizer (1944) and others (e.g., Landberg 1966:484–490; Reinman 1968:97) dismissed them, suggesting instead that a migrating fish could have carried at least a single hook between Polynesia and the New World. Based on detailed analysis of the design and manufacturing techniques associated with curved shell hooks in California, Strudwick (1986) argued for independent invention of these stylistically simple implements in the different areas of the Pacific. He also pointed out that the chronology of single-piece shell hooks in California (ca. 1000 B.C.) is considerably earlier than the settlement of the remote outposts of Polynesia, which is antithetical to the pattern of Polynesian colonization of the Pacific from west to east.

Arguments for prehistoric contact between Polynesia and South America have long been championed by diffusionist geographers, partially on the basis of the distribution of the sweet potato (*Ipomoea batatas*). Grown throughout Polynesia, South, and Central America (Figure 1), the closest wild relative of this domesticate is only found in the New World and recent archaeological findings of sweet potato remains in unequivocal prehistoric contexts in South America and Polynesia have vindicated the long-held diffusionist case for at least one prehistoric contact between Polynesia and South America (Green 2001; Hather and Kirch 1991; Kirch 2000:241).

Similarity between the Chumashan *tomolo*<sup>1</sup> and the plank sewn watercraft of Polynesia has also been previously acknowledged and summarily rejected as an indication of cultural contact. In 1939 the insightful Alfred Kroeber suggested an Oceanic origin for some of the maritime technology found on the southern California coast:



Figure 1. Distribution of sewn-plank boat construction and sweet potato cultivation in the Pacific and elsewhere (approximate) (Heiser 1981; Hather and Kirch 1991; Kirch 2000; Pearsall 1992; Skinner 1904; Yen 1974).

There is a definite climax in [the southern California] area among coast and island Gabrielino and Chumash, whose culture was semi-maritime, with seagoing plank canoes. Although this climax culture was likely to have been further developed locally once it had taken root on the Santa Barbara Islands, its spontaneous origin on the mainland coast and growth to the point where it could reach the islands are hard to understand on the basis of either a Californian or a Sonora-Yuman culture basis. There is therefore a possibility that its impetus came in part either from the Northwest Coast or from across the Pacific, to both of which regions there are sporadic but fairly specific parallels: harpoon, canoe, round shell fishhooks, psychological cosmogony. The double-bladed paddle and spear thrower of the area might possibly be construed as taken over from Aleuts imported by Russian sea-otter hunters in the course of the Mission period; but the abundant archaeological evidence shows that this puzzling local climax culture as a whole far antedates any Caucasian contacts [Kroeber 1939:44–45; emphasis added].

The possibility of direct cultural contact was

quickly dismissed by Heizer (1938, 1940, 1941a), who suggested that use of cordage to bundle tules in the construction of balsa rafts could have readily led to the development of plank drilling and sewing. He also argued that there were enough differences between Polynesian, Chumashan, and Chilean plank sewn boats to suggest multiple independent inventions. Heizer and Massey (1953) associated the Chumashan plank canoe with a welldeveloped woodworking complex and argued that the sheltered waters of the Santa Barbara Channel "favored its development." Outside of archaeology circles, Durham (1960:92-93) suggested an extra-North American origin for the plank canoe, probably in Micronesia or Polynesia, arguing that a wholly plank-built hull is a complex concept and technically difficult to construct. He also correctly noted that Chumashan canoes were "radically different from any neighboring American vessels" (Durham 1960:93). Another watercraft scholar, Cunningham (1989:75) noted that the Chumash *tomolo* was nearly identical to the outrigged hull of the Marshall Islands. Fagan (2003:114-119; 2004) has recently portrayed the plank canoe in nearly opposite terms, suggesting, like Heizer, that it was simply a logical progression from earlier boat and woodworking technologies. Gamble

(2002), the latest to carefully consider similarities between Polynesian and Chumashan plank sewn boats, acknowledged the evidence for sweet potato diffusion, and also pointed to the contemporaneity of the earliest evidence for the plank canoe in the Santa Barbara Channel and the era of greatest Polynesian exploration (ca. A.D. 500–1000). Lacking the linguistic and technological data we present below, Gamble (2002) did not fully embrace the notion of direct cultural contact, but instead highlighted strong parallels between the Chumash and other intensive maritime societies of the Pacific (e.g., Polynesians and Melanesians), suggesting that such similarities were the result of similar demographic and ecological circumstances.

# The Chumashan Plank Canoe (tomolo) and Its Origins

The plank canoe, or tomolo, used by the Chumash and Gabrielino for commerce between the Channel Islands and the mainland of southern California, has long been recognized as a uniquely sophisticated craft for prehistoric North America. The distinguishing feature of these boats was their woodwork, which included hand-hewn planks, sewn together with cordage, and caulked with asphaltum sealer (Figure 2). Virtually every major European expedition to the Santa Barbara Channel produced a description of the Chumashan plank canoe, beginning with Cabrillo in 1542 (Hudson and Blackburn 1979:341). Since then, the craft has attracted the attention of generations of historians and anthropologists (Heizer 1938; Richie and Hager 1973; Robinson 1942). The ethnographic record of the construction, use, maintenance, and the culture associated with the plank canoe is profuse due largely to the efforts of John Peabody Harrington, who collected information between 1913 and 1957 (Hudson et al. 1978:12-13). The information in Harrington's unpublished notes on the canoe (nearly 3,000 pages), later translated and synthesized by Hudson et al. (1978), and Hudson and Blackburn (1979:341-365), have rendered the plank canoe the most well-documented item of Chumashan material culture. According to these notes, canoes were up to 25 feet long and could carry as many as a dozen people. They were used to fish, trade with the islands, carry passengers, and travel along the shore (Hudson et al. 1978:125). Within the Chumashan cultural context, the tomolo

represents the apex of technological sophistication, something that marks the Chumashan people as distinct from other indigenous groups in California. Prior to historic contact, the tomolo was used only by Chumashan groups that resided on the shores of the Santa Barbara Channel (Figure 3). Groups north of point Conception (Obispeño and Purisimeño) employed only tule balsas (Heizer 1941b:60). Gabrielino-speaking peoples who inhabited the southern Channel Islands also employed the plank canoe, but it is commonly assumed that they acquired it from the Chumash. In recent years, the tomolo has become more than just a historical relic and is now a symbol of Chumash cultural revitalization (Cordero and Sanchez 2001/02).

Long-standing interest in the Chumash plank canoe is due in part to its status as the only plankbuilt boat in indigenous North America. As noted most recently by Gamble 2002:303-304) and earlier by Heizer (1938, 1940, 1966) and Heizer and Massey (1953), all other Native North American watercraft were dugouts, balsa/log rafts, or skin/bark canoes. Indeed, the only other example of a sewn-plank craft in the entire New World is the dalca (Figure 2) of the Gulf of Coronado in central Chile (Edwards 1962; Gamble 2002:302; Heizer 1938), which has long been considered a possible product of Polynesian contact (Steward and Faron 1959:277). Even the sophisticated maritime societies of northwestern North America sustained their sea-based economies with dugout canoes (Jobson and Hildebrandt 1980; Olson 1927; Suttles 1990:8–9; Pilling 1978:152). When strakes or gunwales were added to the sides of these craft to increase freeboard, they were generally attached by mortising, not by sewing (de Laguna 1990:208).<sup>2</sup> Based on detailed consideration of construction techniques, and dismissing the dalca as an inferior craft, one scholar (Cunningham 1989:1) argued that the Chumash tomolo was the only example of a true sewn-plank canoe in the entire Western Hemisphere.

Detailed description of the tools and techniques involved in the construction of Chumashan sewnplank canoes is provided by Hudson et al. (1978). Logs were split into planks using bone wedges, and a hand-held adze (a wooden handle with an attached shell blade) was then used to shape planks to the desired size. Planks were also worked with shell or



Gilbert Island Sailing Canoe

Figure 2. Some Native watercraft of the Pacific. Sources: Heizer (1940, 1941a), Haddon and Hornell (1975).



Figure 3. Location of Chumashan and Gabrielino language groups on the southern California coast.

flake chisels, the edges of abalone shells, and sharkskin sandpaper. To effect the curving needed for some boards, steam was generated by excavating a pit, lining it with clay, starting a fire in the pit, adding water, and then the planks. Once they had soaked in hot water for a long time they were bent and shaped as needed. The sides of the craft were initially built up by gluing planks together (working from the bottom up) using a bonding material made of tar (asphaltum) and pine pitch. Once the lowermost planks were attached, they would sit for three days until the tar hardened. Because the hardening tar could not be exposed to direct sunlight, tule mats were placed on a wooden frame over the incipient craft while the seams dried. When the tar was set, holes would be drilled into the edges of planks using a stone trifacial drill (see Gamble 2002:309) and bone punch (Hudson et al. 1978:42). The boards were then sewn together using string made from a vegetable fiber and tar was applied with wooden caulking tools over the drill holes and to the seams as a final seal. This process was repeated for succeeding planks, slowly building up the sides of the craft, culminating with the placement of gunwale rounds.

The craft constructed in this manner have been the subject of increasing scrutiny related to alternative views on the emergence of sociopolitical complexity among the Chumash (Arnold 1991, 1992a, 1992b, 1994, 1995, 1997, 2001; Arnold and Munns 1994; Arnold et al. 1997; Colten and Arnold 1998; Erlandson and Rick 2002; Gamble 2002; Gamble and Russell 2002; Hildebrandt and Jones 1992; Johnson 2000; Jones and Hildebrandt 1995; Kennett and Kennett 2000; Kennett and Conlee 2002; Raab and Larson 1997; Raab and Bradford 1997). There is universal agreement that the historic Chumash were sedentary with high population density and hierarchical political organization (Erlandson 1994:48-50; Glassow 1996; Johnson 1988; King 1981, 1990; Martz 1992; among others), and that the plank canoe was an essential technological component of this complex adaptation. At issue are divergent opinions on the chronology and causes underlying the emergence of complexity. Arnold (1992a, 1992b) argued that the most significant transition toward complexity occurred relatively suddenly ca. A.D. 1150 when chiefdomlevel political organization, ascribed social statuses, and intensive island-mainland exchange via plank

canoes evolved in response to rapid environmental deterioration. Most if not all other researchers see the key transitions related to the plank canoe occurring earlier during the first millennium A.D. (see Gamble 2002; Gamble and Russell 2002; Kennett 1998; Kennett and Conlee 2002), and even Arnold (e.g., Munns and Arnold 2002) recognizes that the plank canoe itself initially appeared by at least A.D. 800. Others attribute the transition toward complexity to different proximate causes including catastrophic droughts (Johnson 2000; Jones et al. 1999; Kennett 1998; Kennett and Kennett 2002; Raab and Larson 1997; Raab and Bradford 1997) and/or incremental population growth (Erlandson and Rick 2002). Nearly all Chumash specialists recognize a significant if not sudden appearance of certain traits of complexity intimately related to commerce via the tomolo during the first millennium A.D. Whether viewed as the end-product of gradual maritime intensification or as a response to rapid climatic flux, the plank canoe is seen by all contemporary scholars as a strictly indigenous innovation.

Arguments concerning the absolute dating of the appearance of the plank canoe have been well summarized by Gamble (2002). Radiocarbon-dated canoe planks indicate that the tomolo was in use A.D. 625-700, while less-substantial evidence suggests initial appearance as early as A.D. 400. Davenport et al. (1993:261) suggest an even earlier date of A.D 1 based on association of the plank canoe with swordfishing and the initial appearance of swordfish regalia. Gamble (2002) also raises the possibility of an earlier appearance, but acknowledges that the available empirical record supports a date between A.D. 400 and 700. On theoretical grounds, Fagan (2003:114-119; 2004) has argued for much greater antiquity for sewn-plank boats, suggesting that no other craft would have been sufficiently seaworthy to accommodate regular trans-Channel travel. Fagan's theory is countered by the occangoing dugouts of the Northwest Coast that were regularly used to travel significant distances across ocean waters considerably rougher and more challenging than those of the Santa Barbara Channel (Jobson and Hildebrandt 1980).

# Polynesian Watercraft

Early European explorers in the central Pacific recorded Native voyaging canoes 15–30 m in length

with exceptional sailing capabilities (Haddon and Hornell 1975). Double-hulled and outrigger canoes with sails were common throughout much of Polynesia while single-hulled vessels were the norm in Micronesia. Plank construction was employed throughout the Pacific including Polynesia, Micronesia, and Melanesia (Figure 1); however, the degree to which planks were used varied according to the size of boats and the availability of trees (Johnstone 1980:209). Full plank construction was common on atolls and smaller islands where large trees were scarce, and canoe builders were frugal in their use of wood-they carefully split trees into planks that were sewn together into canoes rather than wastefully carving out the interior of an entire tree. Plank construction was well-documented in such wood-poor locations as Easter Island, Rapa, the Tuamoto archipelago, the Society, Caroline, and Gilbert Islands, and others (Figure 2). On islands with more luxuriant forests (e.g., Hawaii), the keels of boats were carved from solid logs and the sides were built up with planks added as gunwales and/or washstrakes. On the other hand, extreme conservation of wood in places like the Gilbert Islands resulted in maximal use of the plank-sewing technique creating craft of "patches of wood," rather than planks (Haddon and Hornell 1975:345). This pattern was well illustrated in the Caroline group where, on islands with large trees, all but the upper part of the sides of the canoe was hewn from a single log, but on atolls where there was no large timber available, the dugout portion shrank to a wedge-shaped keel piece with multiple strakes sewn on (Haddon and Hornell 1975:378). Despite its occurrence at only one location in Native North America, plank sewing was used throughout Oceania and clearly was a fundamental technological component of boat construction in all areas settled by Polynesians.

Hawaiian mythology states that the watercraft of the colonizing ancestors were made of planks, not hollowed logs (Buck 1957:253), and there is long-standing consensus among archaeologists and historians that eastern Polynesian watercraft and voyaging capabilities at the time of European contact showed considerable decline from the craft and skills that must have been associated with initial discovery and settlement of the islands (Haddon and Hornell 1975:343; Kirch 1985:66; Lewis 1994:313). The Hawaiian dugouts were not suitable for long-distance voyaging, only nearshore fishing and travel (Kirch 1985:66), and were not capable of traveling the 3,200 km from the Marquesas or Society Islands, the most likely homeland of the initial colonists (Kirch 2000:231). Based on their comprehensive study of the canoes of Oceania, Haddon and Hornell (1975:343) thought it likely that plank-built canoes were originally used in the colonization of Polynesia, but that the craft suffered later technological degeneration in some places. Drilled planks recovered from archaeological contexts on the Society Islands document presence of the sewing technique in central eastern Polynesia at least as early as ca. A.D. 800-1200 (Kirch 2000:232). Anderson (2000, 2001), however, has challenged the prevailing notion of technological devolution based on detailed reconsideration of the historic distribution of certain key traits of native sailing craft in the Pacific.

#### Cultural Similarities and the Case for Contact

Kroeber (1939), Olson (1930), and other early advocates of Polynesian contact with Native California based their cases largely on the geographic distribution of sewn-plank technology. Comparison of the archaeological and ethnographic records from these two regions reveals a number of additional similarities, including details of construction and the tools used to build sewn-plank craft, a distinctive compound fishhook style, and evidence for punctuated adaptive change.

Because plank sewing was widespread throughout Polynesia-even more so prehistorically than at the time of European contact-it is difficult to generalize about the construction process. Nonetheless, tools, and techniques used in the construction of Polynesian sewn-plank boats are remarkably similar to those associated with the Chumashan tomolo. Foremost among these were hand-held adzes of nearly identical design (a short handle to which was lashed a shell blade) (Buck 1957:255) used as the primary tools to work planks. In the Tuamotu group, adzes were commonly made with clam shells (Emory 1975:108-110) as they were among the Chumash. Drilling was done with bone drills in Polynesia, and with stone drills and bone punches among the Chumash. The Chumash had a well-developed biface technology and a long tradition of stone drilling, and it seems reasonable that they would have immediately adapted their superior technology to this aspect of construction. Wood was finished with sandpaper—in Polynesia derived from a plant source, not the Chumashan sharkskin. As among the Chumash, caulking in Polynesia was done with wooden caulking tools, although those of Hawaii were of more complex design. Plank canoe construction in much of Polynesia was undertaken within a specially constructed canoe shed (Haddon and Hornell 1975:328) that protected the craft from the elements during its construction. This is very similar to the structure of mats and poles used by Chumash canoe builders for the same purpose.

The archaeological record provides evidence for punctuated cultural and adaptive changes in the Santa Barbara Channel coincident with initial construction and use of plank boats that may reflect contact with Polynesian seafarers. Among the changes is a shift to a Polynesian style of two-piece bone fishhook replacing a simpler type that had been used in the same form for thousands of years. The appearance of this new type is clearly depicted in King's (1981, 1990) cultural chronology for the Santa Barbara Channel, which is the only widely accepted regional cultural sequence (Figure 4). Owing to a limited number of radiocarbon dates and uncertainty about calibration/correction of some of the dates, the calendric precision of the sequence is more illusionary than real, but few archaeologists in the Chumash region question the basic ordering of types or their approximate positions in calendric time. This sequence and other findings from southern California (e.g., Salls 1988:12; Strudwick 1986) show that the earliest archaeological fishing implements were slender, cylindrical bi-pointed bone gorges (Figure 4) that were attached to fishing lines with asphaltum. Examples of gorges have been found in the lower levels of the oldest coastal sites in southern California, including Daisy Cave (Rick et al. 2001) and Eel Point (Raab and Yatsko 1992; Salls 1988, 1992), indicating that their use extends back perhaps 10,000 years. Supplementing bone gorges were compound bone hooks made with two bi-pointed bone pieces (one a shank and the other a hook) that were bound together with cordage and asphaltum (Hoover 1973:6). In some instances the shank or hook was made of wood. The morphology of compound hooks is nearly identical to that of the bone gorges; individual pieces are straight, cylindrical,

and bi-pointed. Gorges are distinguished from compound hooks largely by the location of asphaltum residues that are found on the central portion of gorges and at one end on pieces from compound hooks (King 1981:355). For at least 7,000 years, line fishing was pursued in southern California solely with bone gorges and simple compound hooks. These implements were supplemented with single-piece curved shell fishhooks between 1000 and 500 B.C. (Glassow 1996:134; Koerper et al. 1995; Rick et al. 2002) or perhaps slightly earlier (Raab et al. 1995; Strudwick 1985). As previous scholars have noted, these hooks show strong similarities with those from Micronesia (Kirch 2000:180) and Hawaii (Emory et al. 1968:Plate 1, 65-68), but the California shell fishhooks predate settlement of eastern Polynesia by at least 1,500-2,000 years, which makes them unacceptable as evidence for direct cultural contact between Polynesia and California.

After the end of King's Phase M3 (A.D. 300) and by the beginning of Phase M5 (A.D. 900), compound hooks show an intriguing stylistic change toward hook parts made by carving and/or grinding bones to create more complex multifaceted, curved shanks and hooks.<sup>3</sup> These implements were still in use at the time of historic contact and complete examples are known from museum collections (Hudson and Blackburn 1979:180-181). They are nearly identical to two-piece hooks from Polynesia illustrated by Buck (1957:332) and Emory et al. (1968:Plate 2 specimens 38-45) (Figure 5). The appearance of this Polynesian composite hook type sometime between A.D. 300 and 900 is nearly contemporaneous with archaeological evidence for the first use of sewn-plank canoes in the Santa Barbara Channel. The bone pieces used to make these more elaborate hooks are similar but still distinct from bone barbs associated with composite harpoons that also appeared in the Santa Barbara Channel around A.D. 300 (King 1981:357). Not insignificantly, earlier scholars have concluded that the more elaborate two-piece hooks were most effective not in still water but for trolling (Tartaglia 1976:99), which is the way they were employed in Oceania to capture bonito (Anell 1955:152; Reinman 1967:135). In California this type is associated with open-water, mid-channel fishing for pelagic species (Salls 1988:134). Like the tomolo, this type of compound hook is absent from culture

SHELL FISHHOOK	Compound Bone FISHHook	BONE GORGE	
	1		L3
Ũ			L2
			L1 & M5
		Λ.Λ.	M4
$\bigcirc$			M3 & M2
	7	71	M1
	Jnchange	Unchange	Ez
			Ey
05cm			Ex

Figure 4. Archaeological fishhook chronology for the Santa Barbara region from King (1981:355-356).



Figure 5. Two-piece bone fishhook parts from the Pacific: (a), (b): archaeological specimens from the Chumashan area (King 1981:356); (c), (d): archaeological specimens from Hawaii (Emory et al. 1968: Plate 2); (e): complete specimen collected by the George Vancouver expedition, now in the British Museum. Redrawn from Hudson and Blackburn (1979:181).

areas immediately north (Greenwood 1972; Jones and Ferneau 2002; Jones 2003) and south (Gallegos 2002) of the Chumash/Gabrielino region for the A.D. 300–900 and all other time periods. Vaguely similar specimens are known from the Northwest Coast (e.g., Mitchell 1990:356, Figure 13L), although the majority of compound hooks from that region seem most similar to the lesselaborate type made from minimally modified straight bone points (e.g., Hobler 1990:302, Figure 6v). Faunal remains from the Channel show that the appearance of these two new technologies (the sewn-plank boat and curved two-piece bone hooks) was associated with a marked increase in exploitation of large pelagic fish. Based on review of data from 67 sites in the Chumash region, Bernard (2001) documented a marked upswing in the exploitation of swordfish, albacore, and other tuna ca. A.D. 700–800 (Figure 6) clearly related to use of the *tomolo*, although she argues that initial appearance of swordfish and other pelagic species



Figure 6. Number of high resolution collections containing swordfish, tuna, blue shark and and shortfin mako shark by century (from Bernard 2001), and estimated date range for the appearance of the sewn-plank canoe in the Santa Barbara Channel.

in extremely low frequencies (2–3 NISP per component) could represent the initial development of the sewn-plank canoe, with *tomolo*-based exploitation of offshore species increasing significantly later as the techniques were perfected. Her arguments mirror those concerned with the exact date of the appearance of the *tomolo*. Concrete findings and strong signs of change are consistent with a date of A.D. 700, while an earlier chronology is supported only inferentially. In our opinion, punctuated change in fish remains ca. A.D. 700 represents the more significant trend, one that is also coeval with the technological and stylistic developments.

The greatest difference between southern California and Polynesian sewn-plank craft was the absence of double hulls, outriggers, and/or sails among the former, all of which were technological features that significantly bolstered the voyaging capabilities of Polynesian vessels. Almost certainly any craft encountering the North American continent from Polynesia in the first millennium A.D. would have retained one of these innovations (most likely sails), but the Chumash did not adopt any of these technologies, and their absence would seem to argue against cultural contact. The Chumash and Gabrielino, however, had been exposed to sails by Spanish explorers Juan Cabrillo in 1542 and Sebastian Vizcaino in 1603, yet they still never adopted this seemingly invaluable innovation. Absent a truly oceanic culture, the incentive or technological ability to add sails must have been lacking among the indigenous populations of southern California. The absence of a natural material comparable to the bark used for Polynesian sails may have made it effectively impossible to duplicate the technology even if attempts were made. The Chumash seem to have adopted only those innovations that provided clear and immediate benefits to their lesscomplex hunting-and-gathering adaptation.

# Winds, Currents, and Feasibility of Voyage

The main obstacle to acceptance of Polynesian contact with the New World is the perception of a daunting physical barrier between the closest outposts of Polynesia and North and South America. This perception is largely an artifact of outdated notions of Polynesian voyaging capabilities held by North American archaeologists and not by most Polynesia scholars. The skills of Polynesians in watercraft construction, sailing, and navigation, recognized and well-documented by the earliest European explorers, were overlooked and nearly forgotten by American scholars during the early twentieth century amidst ill-conceived speculation about Polynesian prehistory that culminated with Heyerdahl's theories in 1952. Since then, experimental scafaring (Finncy 1988, 1994), computer modeling (Levison et al. 1973), analysis of the winds, currents, and sailing parameters (Irwin 1992), and increased recognition of the implications of the Pacific archaeological record (Bellwood 1979, 1987; Kirch 2000, among others) have

fostered renewed appreciation for the accomplishments and capabilities of Polynesian seafarers (Finney 1996; Kirch 2000:238; Lewis 1994). Unbeknownst to many North American archaeologists, Polynesia scholars have all but proven that the Pacific was initially settled through intentional voyaging by people with sophisticated craft and advanced navigational skills. At the forefront of this intellectual progress are the ideas of Irwin (1989, 1990, 1992), who suggests that Polynesian seafarers colonized the Pacific by intentionally sailing against the prevailing winds for great distances on a regular basis hoping to locate new lands. The logic of this strategy was that parties could at any point turn around and safely return to their point of origin by sailing with the wind. Based on careful re-reading of historic accounts of Polynesian sailing technology, Anderson (2001) has questioned whether in fact Polynesians sailed into the wind as directly or frequently as Irwin and Finney suggest. Anderson does not advocate a full retreat back to the position that colonization was accomplished solely by accidental drift voyaging (Sharp 1957), but favors a more intermediate view in which Polynesian sailors undertook less-frequent exploratory voyages that exploited common and predictable periods of light trade winds and wind reversals. Finney (1985) made similar points.

Geography and the archaeological record speak to the minimal distances that Polynesian seafarers were capable of covering in the pursuit of unknown lands. It must be assumed that these sailors could and did travel even greater distances, as untold numbers of unsuccessful exploratory voyages must have preceded the eventual discovery of the remote outposts of eastern and southwestern Polynesia. If the Marquesas were the starting point for the exploratory voyages that resulted in the discovery of Hawaii (see Kirch 2000:231), this represents a one-way voyage of ca. 3200 km, although use of Fanning Island as a stepping stone would cut the distance in half. Still, unsuccessful exploratory voyages that preceded the discovery of Fanning or Hawaii must have covered at least 3,000 km roundtrip. Reaching Easter Island from Mangareva would have required 2,300 km of sea travel. Another 3,750 km separate Easter Island from the mainland of South America; such a trip could be shortened by ca. 750 km with a stop on either Isla San Felix or Isla Santa Clara off the coast of Chile.

Geochemical sourcing of basalt adzes in southeastern Polynesia suggests routine Polynesian voyages of 1400–1750 km (Weisler 1998:528).

Pacific seafaring, however, is less about absolute distance and more about winds and currents (Irwin 1992:101). In this regard, the discovery of Hawaii represents a not insignificant accomplishment as it required voyageurs to pass from the southern hemisphere into the northern hemisphere crossing the equatorial counter-current and the doldrums (Kirch 2000:241). Nonetheless, experimental voyaging in a replicated Polynesian sailing vessel (the Hokule'a) with traditional navigation techniques showed that passage from the island of Rangiroa, southwest of the Marquesas, to Hawaii could have been accomplished in about a month (Finney 1994:236-249). Computer simulation models used to conceptualize exploration of the Pacific operate on the premise of a 90-day limit for voyages (Irwin 1992).

Hawaii is situated 3,360 km from the coast of California, which was almost certainly within the seafaring capabilities of the Polynesians. Travel from Hawaii to California via traditional Polynesian techniques would be highly feasible in the summer when modern-day sailing vessels tend to make the trip (Finney 1994:285). Passage is accomplished by traveling north into the wind until the Pacific High is cleared and strong westerly winds are encountered, at which point vessels must shift their course east and travel with the wind to the California mainland. In the summer when the northeastern Pacific is more calm, the turn to the east would be necessary when the vessel reached approximately 40° N latitude; in the winter, when the Pacific High shifts southward, it is necessary around 25° N (Figure 7). A voyage in the spring or fall would be most likely to culminate in southern California. Irwin (1989, 1992:57) suggests that with-the-wind exploratory voyages would have been the most hazardous since they would require return sailing into the wind. For that reason, such voyages were the last to be undertaken in the colonization of the Pacific. Discovery of the Polynesian outliers of Hawaii, Easter Island, and New Zealand would have required some sailing with the wind. Voyaging to New Zealand was particularly hazardous as it required travel to 35° south latitude, which is comparable to the northern latitude of the Santa Barbara Channel (34° N). Reaching the South



Figure 7. Recommended sailing routes from Hawaii to California from Jenkins (1973).

American mainland from Polynesia would have been much more challenging than reaching California from Hawaii due to fierce east-west flowing currents and winds (Finney 1994:285). Distribution of the sweet potato and the bottle gourd (Green 2001), however, indicates that at least one such contact was made prehistorically. Heyerdahl's (1952) arguments to the contrary, the most likely candidates to have completed such a voyage were the Polynesians (Finney 1994:285; Green 2001; Kirch 1985:65). In terms of wind and currents, the California coast was certainly no less reachable than Hawaii from the Marquesas, or the mainland of South America from Easter Island or New Zealand from the Society Islands-all of which were passages made by the Polynesian-in most cases probably more than once.

#### Word as Artifact<sup>4</sup>

The case for the sweet potato representing direct contact between South America and Polynesia has always included a linguistic component as diffusionist geographers have long pointed out that the word *kumara* (or a dialect variant) means "sweet potato" in both Peru and Polynesia (Yen 1974:12–20). The sweet potato and its name are widely accepted as borrowings from America into Polynesia. The problem has not been seen as one requiring demonstration that the South American and Polynesian lexical items are one and the same in origin; the only difficulty (and not a simple one) has been to explain when and how it happened. Linguistic data—in this case words—are evidence as real and solid as archaeological artifacts. With the

same kind of careful consideration that is applied to material remains, linguistic data allow us to infer historical and cultural processes that would be otherwise unattested. Further, the two kinds of information combined can allow us a fuller understanding than either alone.

Lexical diffusion as a process in language history is well-attested and thoroughly accepted as a frequent and natural occurrence. The linguist's challenge is distinguishing genetically affiliated languages from those that share characteristics over larger or smaller "linguistic areas" (Campbell 1997:330ff.; Dixon 1997:15–27; Haas 1969). The most common type of diffusion is lexical borrowing, and linguists have established firm guidelines for determining whether lexical similarities in unrelated languages are coincidental or the result of borrowing, and what the direction of the borrowing is (Campbell 1999:57–88). We offer here evidence of several kinds: phonological, morphological, semantic, and cultural.

The Chumashan language family is now generally considered an isolate within California, with no known relatives in the Americas or clscwhere. The modern family is divided into three branches: Northern Chumash (at least two dialects), Island Chumash (one known dialect), and Central Chumash (at least four dialects with further subdialect divisions) (Figure 8). Island and Central Chumash can be grouped more closely with one another (Southern Chumash) than either can with Northern Chumash, although the evidence for this is small due to the relatively poor attestation of Island Chumash. As there is no evidence that the Northern Chumash ever built plank canoes, and no word for any type of boat has been preserved into modern times, this branch of Chumashan will not be further considered here. Chumashan is an old family, but since written records are lacking for any Chumashan language prior to the eighteenth century, no absolute dating is possible for the family.

Island Chumash and all Central Chumashan languages had words for the distinct marine craft, the sewn-plank canoe, or *tomolo*.<sup>5</sup> The precise phonetic shape of each varied according to the operation of late low-level rules in the individual. Harrington recorded the forms as follow:

Central Chumash	Ventureño	tomol
	Barbareño	to'mol

	Ineseño	tomol
	Purisimeño	tomo <del>l</del> , tomo <del>l</del> o
Island Chumash	Isleño	tmolo, tomolo
Northern Chumash	Obispeño	(no attested
		form)

Speakers of both English and Spanish borrowed forms of this word during the historical period, so that the craft is called a *tomol* or *tomolo* in everyday usage today.

There are two other lexical items for Chumashan boat types. The Ventureño form /axipeneš/ means, according to Harrington, 'wooden dugout' (Hudson and Blackburn 1979:338ff). It is also attested for Ineseño, where Applegate glosses it as 'a finished piece of carpentry' (Applegate 1972:5). The word is probably from an old stratum of Chumashan development. It is clearly not related to the tomolo complex, but expresses the basic nature of woodworking technique in a maritime culture. It is also a word whose morphological and syllabic structures are transparent (unlike the tomolo forms) and decidedly Chumashan. This form contains three morphemes: the instrumental prefix /'axi-/ 'to work wood', the root /pen/ 'to strip off; to be bare, stripped', and the resultative suffix /-(V)š/. The literal meaning is 'wood stripped [of bark]'. This derivation suggests that the wooden dugout was the quintessential product of native woodworking technique prior to the introduction of plank sewing; the name of the process became the name of the product.

Ventureño /tomol 'ištapan/ is 'tule balsa', lit. 'tule tomolo' or 'tomolo made of tule.' This is a derivative of a base form /tomol/ formed by the regular juxtaposition of the modifying noun /štapan/, joined by the connective particle /'i-/. Other Central dialects have similar forms. Since it is not unlikely that the sewn-plank canoe replaced the five-bundle tule balsa as a seagoing craft, and that the former became a high-status item possessed by relatively few affluent Chumash, it is possible that an original word for 'tule balsa canoe' (perhaps derived from /štapan/) was replaced by this new formation; i.e., after the advent of plank-sewing, all boats constructed of discrete parts were called tomolo. Robert Heizer provided the only previous etymology for tomolo (Heizer 1941b) in which he attempted to derive the form from /to'/, the Northern Chumashan word for 'water.' His analysis, how-



Figure 8. Diagramatic representation of internal relationships of Chumashan languages and Proto-Chumash.

ever, can be shown to be wrong on several grounds.

The evidence from Central and Island Chumash allows reconstruction of a proto-Southern Chumashan form for 'sewn-plank canoe', viz. \*/tomolo'o/ (with an echo vowel after the final glottal stop) or \*/tomolo'o/ (with a full vowel). On Chumashan evidence alone, it is not possible to say decisively which was more likely; however, though possible phonotactically, a form with the relatively long sequence of CV syllables in \*/tomolo'o/ is less common than would be a form in which at least one of the syllables was closed, as in \*/tomolo'% (the "echo vowel" is a normal, nondistinctive occurrence in a word ending in a glottal stop). More importantly, in a form of this length, whatever the syllabic shape, there should be some morphological transparency, but none is apparent. Its meaning is irreducible; it is simply 'sewn-plank canoe'. This strongly suggests that it may not be of Chumashan origin, and when a possible source is sought, a promising candidate appears in the Chumashan family's nearest neighbor to the west: the Central Eastern Polynesian language group.

Polynesian languages have several characteris-

tics that are advantageous for comparison of Chumashan and Polynesian lexical items, including simple consonant inventories to which Chumashan speakers, with their considerably more elaborate consonant arrays, would have had no trouble adapting; and morphological compounding of a type unknown in Chumashan languages. Hawaiian, for example, has only eight consonant phonemes /w, m, p, l, n, k, h, '/ (Krupa 1982: 26), as does Marquesan /p, v, m, t, n, k, h, '/ (Lynch 2002:865). Reconstructed Polynesian has thirteen \*/p, t, k, ', f, w, s, h, m, n, ng, l, r/ (Krupa 1982:15ff.). By contrast, modern Chumashan dialects have approximately 34 phonemically distinct segments (Wash 2001:31) and the proto-language was of approximately comparable complexity (Klar 1977:10ff). The individual sounds of the minimal Polynesian corpora are largely represented by a subset of sounds within the Chumashan inventory, so that consonants in any words borrowed from Polynesian into Chumashan would be retained with relatively little change. With regard to morphology, Polynesian lexical items generally have wide semantic ranges, with discriminations of meaning

being acquired by compounding of different lexical items. Most Polynesian nouns are, in fact, compounds of smaller elements (e.g., Elbert and Pukui 1979:123ff.; Marsack 1962:27ff.). Chumashan languages have closely defined roots and a large number of very precise prefixes and suffixes which are added to stems (Applegate 1972; Klar 1977; Wash 2001).

The following compound lexical items from four Central Eastern Polynesian languages are relevant: <sup>6</sup>

HAW	kumulaa'au	'tree'	(Pukui and Elbert
			1986:188)
MQA	tumu 'akau	'arbre'	(Le Cleac'h
			1997:226)
TAH	tumu raa'au	'arbre'	(Le Maitre
			1995:103, 144)
RAR	tumu raakau	'stump,	trunk, taproot'
			(Buse and Taringa
			1995:524).

Each of these items is composed of two widespread Polynesian bases, proto-Polynesian \*TUMU 'origin, base' and \*RAQA-KAU 'wood, tree'. (Reconstructions from Biggs and Clark 1994). These forms when compounded presuppose a proto-Central Eastern Polynesian (PCEP) form \*/tumuraakau/ with a further development to \*/tumuRaa'au/ in some dialects.<sup>7</sup> We suggest that \*/tumuRaa'au/ meant, most generally, 'tree trunk', and we speculate that the specific associations of \*/Raa'au/ with 'medicine' in some languages (e.g., Rapanui, see Fuentes 1962:305, 832) imply that, when compounded with \*TUMU, the result limits the range of \*TUMU to being the source of something useful, i.e., the source for wood from which useful items could be made, produced, or obtained. One thing that could be so obtained would be wooden planking for canoes, as described above. We contend that at some time prior to 1000 A.D., there was at least one contact event between Polynesian voyagers and Chumashan speakers, and that this PCEP form (or a dialect reflex) is the source of proto Southern Chumashan \*/tomolo'o/ or \*/tomolo'0/, which designated both the tree from which planking was obtained, and the name for the premier product produced with the planking.

Among the criteria for fixing borrowed status, one of the strongest is "[w]ords which violate the

typical phonological patterns (canonical forms, morpheme structure, syllable structure, phonotactics) of a language" (Campbell 1999:64). Also, "In some cases where the phonological history of the languages of a family is known, information concerning the sound changes that they have undergone can be helpful for determining loans, the direction of borrowing, and what the donor language was" (Campbell 1999:65). In this particular case, the long string of CV syllables in our reconstructed proto-Southern Chumashan form \*/tomolo'o/ or \*/tomolo'o/ and its morphological opacity make a strong case for the form being a borrowing, and the geographical proximity of Central Eastern Polynesian dialects that had a \*/tumu-Raa'au/ form makes the latter the likely source.

We propose that a borrowed PCEP lexical compound \*/tumuRaa'au/ was realized as Chumashan /tomol/ (and variants) in the following sequence:

Polynesian	*/tumuRaa'au/	(source form)
Chumashan1	*/tumulaa'au/	(realization of /R/
		as /1/)
Chumashan2	*/tumula'o/	(reduction of
		final diphthong;
	vowel length reg	gularization)
Chumashan3	*/tomolo'o/	(vowel harmony,
	vowel length red	duction)
Chumashan4	*/tomolo'º/	(final vowel
	reduced to"echo	o")

The common (proto-Southern Chumashan) borrowed form\*/tomolo<sup>'0</sup>/ then developed in the Chumashan dialects according to late phonological processes peculiar to each idiom, including final syllable loss (see forms above).

The only other culture in North America known to have constructed sewn-plank canoes were the Gabrielino, who were part of the Takic (Southern California) Shoshonean subgroup of Uto-Aztecan (Bright 1976; Campbell 1997:134; Mithun 1999:539). The Gabrielino word for 'sewn-plank canoe', as recorded by Harrington, is *ti'at*. The word for 'boat' in general is *tarayna*. Uto-Aztecan and Chumashan languages are not related at any presently demonstrable level, and the words for 'sewn-plank canoe' (Chumashan /tomol/ and variants) and 'boat' (Chumashan /'axipeneš/) bear no relationship to one another genetically or through borrowing.

Harrington reports that consultant José María Zalvidea related to him that "[t]he ti'at "was so called because it carried many people. 'at, people" (Hudson and Blackburn 1979:342). It may be tempting to accept that this etymology is correct; it suggests that one cultural group observed another's innovative watercraft and subsequently adopted the new technology themselves, naming it for its memorable carrying capacity (a possible scenario). However, this understanding is more likely a "folk etymology," a late re-interpretation (even perhaps under pressure of Harrington's questioning) of a form whose meaning is no longer transparent. Pamela Munro (personal communication, 2003) says that Gabrielino 'at is unusual in having no cognates elsewhere in Uto-Aztecan, and that ti'at is somewhat odd in having no stress or length marked. According to Munro, the stem of the form Harrington recorded would be ti'a-; the citation form would, as is normal for unpossessed nouns in Uto-Aztecan languages, contain an absolutive ending -t, and the form would realize phonetically as te'aat. Harrington gives the plural as tetii'aatam 'canoes'. A more usual plural formation, according to Munro, would be tetii'atam; the underlying stem of a form like Harrington's would be /ti'aa-t/ and would realize on the surface as te'aa-t. We suggest that a better etymology is possible for the Zalvidea/Harrington form ti'at if we assume that the stem of this lexical item was also borrowed from a Polynesian language, most certainly during the same encounter in which the Chumash borrowed \*/tomolo'º/.

The following Polynesian forms (Biggs and Clark 1994) are relevant. Reflexes are as widespread in Polynesian as are those for \*TUMU and \*RAQA-KAU (above).

#### \*TIA.1

\*PN\* :Sew, stick in a peg or a needle, make a net. \*TIA.2

\*PN\* :Stake, post.

It is likely that the two \*TIA semantic fields are related (the primary meanings having diverged during some early phase of dialect differentiation); to sew or weave, one uses a small stake or post (i.e., a needle or shuttle).

Modern Hawaiian uses its cognate form kia 'mast, etc.' in a number of compounds relating to

boats, viz. kialoa 'long, light, and swift canoe', kiapaa 'swift-sailing canoe; any vessel equipped with cross spars, bark', kiapoho 'a canoe with a deep, curving hull', kiapoko 'a canoe with a rounded hull, as used for fishing near the shore', kia lua 'brig, two-masted vessel', kia luna 'topmast', kia nui 'mainmast', and (possibly) kiiapuapu 'a name for the curved portion of a canoe rim' (Pukui and Elbert 1986:146). Hawaiian kia (Pukui and Elbert 1986:146; Tregear 1891), the reduplicated Tahitian form titia 'short sticks used for fastening together the pieces of a canoe when building it' (Andrews and Andrews 1944), and the Mangarevan forms tia 'to pierce, bore; to fasten with a nail; to stick a piece of wood into the ground' and tiatia 'to pierce with a needle or similar instrument' (Tregear 1891) suggest not only Polynesian origin for ti'at, but that the Gabrielino named their sewnplank boat not after the source material (as did the Chumash) but after some feature of it (short pieces of wood or a mast) or a technique associated with building it (piercing the short pieces of wood to sew them together). Subsequent development in Gabrielino included regularizing the form with the addition of the native absolutive -t. Unusual vowel lengths and qualities could be a result of the borrowed status of the word, but Munro suggests that it is "unlikely that any such irregularity would have survived" for such a great length of time; "rather," she suggests, "this word was probably just not recorded as carefully as most of [Harrington's] data. There are other recordings of words that seem equally odd" (Munro, personal communication 2003).

Munro (personal communication, 2003) has also stated that the other Gabrielino word for 'boat', i.e. *tarayna*, is also anomalous. As with *ti'at*, Munro finds no cognate form in any other Uto-Aztecan language, and cannot provide further information on the morphology of this form. In light of the foregoing discussion, we suggest that this may also be of Polynesian origin. Biggs and Clark (1994) give the following reconstruction.

# \*TALAI

\*PN\* :Hew, carve.

The suffix *-na* in the Gabrielino *tarayna* is obscure in the Uto-Aztecan context. However, the most usual nominalizing suffix in Hawaiian is /-na/;

its addition derives a noun from a verb, cf. *kaalai* 'to carve', *kalai-na* (with stem vowel shortening) 'carving' (Elbert and Pukui 1979:81). As Gabrielino has no /l/ in its phonetic inventory, a PCEP form \*/taRai/ + \*/-na/ would yield *tarayna* if borrowed into Gabrielino. In this case, the process of adzing/hewing—the quintessential technique in maritime construction—is the salient feature which determines the borrowing. As in the case of the posited Chumashan borrowing of \*/tumuRaa'au/, i.e., a morphologically complex Polynesian form as a monomorphemic Chumashan form, so here Gabrielino has the morphologically simpler form, confirming the direction of transfer.

The borrowing of tarayna has a further implication. The native Chumashan /axipeneš/ 'dugout canoe' (lit. 'a finished piece of woodworking') is the semantic equivalent of Gabrielino tarayna. The Chumash borrowed only a form for 'sewn-plank canoe'. The Gabrielino, however, appear to have borrowed forms both for that item and for any other kind of boat (i.e. a dugout or perhaps a tule balsa canoe). This may be a case of replacement of an earlier (now lost) lexical item for 'boat' with a new one from a Polynesian source, but it could also imply that the Gabrielino, at the time of contact, had no native woodworking tradition for either dugout or sewn-plank vessels, i.e. that they acquired terminology for their entire maritime tradition from the Polynesians, and not from the Chumash as has been previously assumed. Since Takic language speakers are thought to have been relatively late arrivals on the Southern California coast, their arrival (from the east) could have taken place at about the same time as, or not long before, the arrival of the Polynesians. Kroeber (as reported in Bright 1976) suggested that "Shoshonean speakers reached the coast about 500 A.D." (Bright 1976:190; although see also Koerper et al. 2002; Moratto 1984:560), which accords well with our suggested range of dates for a Polynesian-Southern California contact event.

Widespread throughout Oceania are cognates of the (reconstructed) form \*/waga/ 'large sailing canoe' or '(generic) canoe', the PN reflex of which is \*/waka/. Ubiquitous as the single general word for 'canoe' is, the lexicon associated with the canoe, its construction, and sailing, is extensive and detailed, and it varies widely in different parts of Oceania. In the eastern reaches of the Pacific, there

certainly existed a localized subset of the possible Oceanic canoe terms. Some terms may represent continuations from earlier stages of migration; others would be later innovations. While the particular Polynesian base forms we cite herein were of wide Oceanic distribution, their particular usages in the forms \*/tumuRaa'au/, \*/taRai-na/, and \*/tia/ were part of the localized canoe and voyaging lexicon of Central Eastern Polynesia. In the context of canoe-building, the three forms would have designated, respectively, the source of wooden material for the planks themselves, the result of the construction process, and one salient part of the unfamiliar new technology. All Central Eastern Polynesian languages have cognates derived from the proto-Polynesian \*/waka/ 'canoe'. However, in the context in which Polynesian and Chumashan speakers would have interacted, the focus would not have been on the general idea of canoes or boats, but on specific characteristics of the craft and its production. The borrowed forms reflect this.

A final objection might be raised to assuming that Polynesian source words meaning 'tree, wood', 'stick, mast, pierce', and 'adze, hew, carve' could reasonably be thought to take on the meaning 'sewn-plank canoe' in the recipient language. This kind of metonymy-specifically, denoting an item by the material of which it is made, by a discrete part of it (pars pro toto), or by the process used to construct it-is common in languages. 'Silver' for eating utensils, 'soda' for fizzy liquid, 'iron' for an object used to smoothen cloth, "iron' and 'wood' for golf clubs, 'redwood' (lexicalized) for timber from the Sequoia tree, 'suit' for a businessman, 'brain' for an intelligent person, 'eats' for food, 'diggings' for an mining operation, a 'dig' for an archaeological site, and even the extreme metaphorical extension of 'dig' for lodgings are but a few usages in English, and the process is common worldwide. While visiting Polynesians may well have been referring to the wood (or source of that wood) that they needed to repair or rebuild their boats, the Chumash understood their word as designating the craft itself. In addition, tomolo is also used in Chumashan languages for types of wood suitable for shaping into planks. Something similar obtains if the Gabrielino 'boat' forms are also borrowed from Polynesian. The ti'at form would be derived either from the process, plank sewing, or from a salient feature or portion of the Polyne-

sian watercraft, the mast; likewise *tarayna*, from the resultant product of the process by which the Polynesians shaped wood for canoes (similar to the Chumashan /axipeneš/). These three peoples spoke entirely different languages, and communication could not have been easy or straightforward, but a strong motivation to make the effort needed to understand one another would have been a shared knowledge of and interest in the technology of maritime culture.

In general, the comparable forms of the Polynesian bases track well with languages associated with the last phase of Pacific Basin exploration. Because Chumashan speakers already had a maritime culture that included dugout canoes (referred to with their word /axipeneš/) they borrowed only the word(s) associated with construction of the sewn-plank canoe, but not the word for canoe itself. In contrast, Gabrielino speakers, who were relatively recent arrivals on the coast (see Koerper et al. 2002), did not have their own words for boats or maritime wood-working technology, and therefore borrowed both the word for 'sewn-plank canoe' and 'boat (in general)'. These words became parts of the native languages, and thereby linguistic "artifacts."

# **Summary and Discussion**

A Chumashan borrowed form \*/tomolo'0/ 'sewnplank canoe' with its four points of consonantal correspondence to the Polynesian source and its historically explicable vowels, is a stronger candidate for borrowing even than kumara 'sweet potato', the only other word generally accepted to have been diffused within the Pacific Basin (though in the opposite direction). We believe it is beyond the realm of chance that a monomorphemic Chumash word could have four points of exact consonantal correspondence with a Polynesian compound of related meaning. In addition, the Gabrielino words ti'at and tarayna are both phonologically and morphologically possible as borrowings from Polynesian. With a Chumashan word that is virtually certain to be of Polynesian origin, the probability of the Gabrielino forms being borrowings from the same source as well is much more likely than it would be otherwise.

These linguistic findings are consistent with a material record that includes two technologies

(sewn-plank boats and a particular style of twopiece bone fishhook) that also seem to reflect direct cultural contact between Polynesia and southern California. Sewn-plank boat technology is common throughout the Pacific but is known from only the Santa Barbara Channel in North America. Most estimates for the timing of its appearance in the Channel area (A.D. 400-800) overlap significantly with the era when Polynesian seafarers discovered the most distant outposts of the Pacific (A.D. 500-1100), including Hawaii. Tools (including short-handled adzes with shell blades and bone drills or punches) and techniques (construction within a special a hut or protective framework of poles and mats) used to manufacture these craft are nearly identical in both areas. Punctuated adaptive changes in the Santa Barbara Channel during this same era highlighted by a marked increase in exploitation of pelagic fish are direct results of initial use and increased reliance upon sewn-plank watercraft. Appearance of two-piece bone fishhooks of a type commonly found in Polynesia, following 5,000-6000 years of stasis in bone hook styles, completes a body of evidence that we feel is substantial enough to offer no reasonable alternative other than cultural diffusion via direct contact.

Since at least the 1930s, California anthropologists (e.g., Kroeber 1939; Olson 1930) have recognized that the intensive maritime economy of the Chumash in the Santa Barbara Channel sets the group apart from all other indigenous societies of California. The trajectory of cultural progressions over the last two millennia among the Chumash, which included the development of intensive island-mainland exchange, the emergence of craft specialization, and evolution of hierarchical political authority is profoundly different from that of any other group in Native California, including other speakers of Chumashan languages away from the Santa Barbara Channel. It should come as no surprise that growing recognition of the unique cultural sophistication of the Chumashan chiefdoms has fostered some of the most heated debate in the history of California archaeology (e.g., Arnold 1992a, 1997, 2001; Gamble and Russell 2002; Raab and Larson 1997; Raab et al. 1995, among others) as researchers have struggled to achieve the most effective explanation for these remarkable and distinctive achievements, virtually all of which are linked to the plank canoe. Since as early as

1941 (Heizer 1941b) Chumashan prehistorians sought to explain the tomolo and its associated culture and economy as indigenous developments prompted by demographic pressure, population growth, environmental richness, climatic deterioration, or some combination thereof. Extant theories recognize the tomolo as the key innovation that facilitated increased frequency of island-mainland voyaging, greater load capacity, improved effectiveness in offshore fishing and sealing, and maximal use of a depauperate wood resource. One of us (Jones in Hildebrandt and Jones [1992]; Jones and Hildebrandt [1995]) has in the past contributed to these demographic explanations, suggesting that sewn-plank craft were developed in response to increasing needs to hunt seals and sea lions in offshore contexts as a result of thousands of years of overhunting. Subsistence pressures and their corresponding incentives certainly must have created a situation that encouraged adaptive innovation, but the similarities in plank sewing and bone hook styles with Polynesian forms and the linguistic referents for these technologies require rethinking the earlier position. Demographic pressures may have created a situation that encouraged adoption or development of new subsistence strategies and technologies, but the specific designs incorporated into Chumash culture seem to have originated from outside.

Owing to the massive intellectual resistance to notions of extracontinental cultural contact (the unthinkable in North American archaeological perspectives; see Kehoe [2003]) it is unlikely that the evidence marshaled here will be viewed as indisputable proof of cultural diffusion. Indeed, we acknowledge that the case for a Chumash-Polynesia nexus remains somewhat circumstantial. The material record, while enlarged considerably from that available to Kroeber in 1939, is still not substantial enough on its own to build a convincing case for transoceanic contact. When the linguistic evidence is combined with the material record, however, the overall case for diffusion becomes considerably more compelling. Indeed, the combination of linguistic and archaeological findings and their contemporaneity offer a classic case for intersocietal diffusion (see Needham and Gwei-Djen 1985:8-15) that probably would not be questioned if not for the vast expanse of ocean sep-

arating the donor and recipient cultures. Similarities in the style of the shared cultural items are very strong, techniques of their construction are nearly identical, and their design, particularly for the plank watercraft, is elaborate and technically complex enough to make independent invention highly unlikely. Furthermore, a means of conveyance in the form of documented Polynesian capabilities in boat construction, and long-distance voyaging, and a feasible route can be clearly established. With the related linguistic record and the temporal convergence of developments in the Santa Barbara Channel with events elsewhere in the Pacific, we feel this case is comparable to that of the sweet potato that, long regarded as unthinkable, is now viewed as essentially fact.

While it may seem implausible that a region so heavily studied as the Santa Barbara Channel would produce evidence for such a seemingly unlikely event at such a late date in its research history, a fair number of credible Chumash scholars (e.g., Alfred Kroeber, Travis Hudson, and perhaps even Robert Heizer late in his career<sup>8</sup>) seriously considered the possibility of contact with Polynesia solely on the basis of material culture. Only during the era of processual archaeology, when paradigmatic emphasis shifted toward ecology and demographics, did the notion of extracontinental diffusion become unthinkable. We do not wish to negate the general effectiveness of ecological theories for explaining most cultural and adaptive variability in North American prehistory, but cultural patterning that runs contrary to ecological expectations should not be ignored either. Not everything that happened in western North American prehistory can be adequately explained simply by reference to environment, natural selection, or demographics. Historical contingencies, such as events of cultural diffusion, still need to be considered. We do not advocate a return to the kulturkreis approaches of a century ago, nor do we suggest that a neo-diffusionism would provide a host of revolutionary new insights for American archaeology. Ecologically based theories provide powerful explanations for the majority of variability and patterning in the North American archaeological record, but there needs to be room also for recognition of historical phenomena outside the expectations of such theories.

Acknowledgments. The views expressed in this paper are strictly those of the authors who nonetheless have benefited from suggestions made by a number of scholars including Atholl Anderson, Richard AF, legate, James Bayman, Robert Bettinger, William G. Davis, Ben Finney, Lynn Gamble, Victor Golla, Roger Green, John Johnson, Kent Lightfoot, Jeff Marck, Patrick McKim, Pamela Munro, Johanna Nichols, Cody Pata, William Preston, and L. Mark Raab. We are especially indebted to Patrick Kirch who recognized the similarity between Polynesian and Chumash compound bone fishhooks and also offered critical insights on many aspects of Polynesian language, prehistory, and culture. We are also deeply indebted to Renee Perelmutter for editorial assistance. Graphics were completed by Rusty van Rossman.

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#### Notes

1. Throughout this paper, we refer to the sewn-plank canoe as *tomolo*, the native Island Chumash term for the boat, and the modern attestation closest to its ancestral pronunciation.

2. At least one historical account from the Northwest Coast suggests some limited use of plank sewing. On August 8, 1774, two members of the Spanish Perez expedition, Fathers Juan Crespi and Tomás de la Peña, recorded canoes made from more than a single log in the vicinity of Vancouver Island. Crespi stated that, "most of these canoes are made of one piece, but we saw some made of different pieces" (Juan Crespi in Bolton 1971:349), while Peña observed that "these canoes appear to be of a single piece; though not all of them, for we saw some of pieces bound together" (Tomás de la Peña in Bolton 1971:349).

3. There is a range of opinions, albeit unpublished, among Chumash prehistorians concerning the reliability of distinguishing curved bone compound fishhook parts from bone harpoon barbs. The objects are similar and some argue that the two cannot be consistently distinguished from one another. Both harpoons and compound hooks were documented ethnographically among the Chumash, but only the compound hook was used in Hawaii. In the only published chronology of these artifacts for the Santa Barbara area, King (1981, 1990) distinguished between curved composite fishhook elements that appear around the end of Phase M4 (A.D. 700–900) and curved harpoon barbs that appear during Phase M3 (A.D. 300-700). Those who challenge the distinction argue that this general class of curved bone objects came into existence in the Chumash area as early as A.D. 300, and with the harpoon, represents a weapon that seems to have been independently invented.

4. This portion of the paper is a summary of a considerably longer excursus on the linguistic evidence. For more details on the linguistic analysis see Klar and Jones (n.d.).

5. Unless otherwise noted, all Chumashan forms cited in

this paper are from the extensive field notes of John P. Harrington (Mills 1985).

6. Abbreviations for Polynesian languages are as follows:

HAW	Hawaiian
MQA	Marquesan
TAH	Tahitian
RAR	Rarotongan
PCEP	Proto-Central Eastern Polynesian
PN	Proto-Polynesian

7. The symbol /R/ is used here to denote a liquid consonant whose reflex (as between [1] and [r]) cannot be determined, but which, in any case, is nondistinctive. As each Chumashan language has only one liquid, namely [1], either [1] or [r] in a source language would be realized in a borrowing as [1].

8. Travis Hudson expressed his interest in a possible Chumash-Polynesia to one of us (Klar) as a personal communication in the mid 1970s. Robert Heizer suggested the possibility of a sewn plank craft washing ashore in the Santa Barbara Channel in a personal communication to Georgia Lee in the 1970s (Lee, personal communication, 2004).

Received August 3, 2004; Revised February 3, 2005; Accepted February 10, 2005.