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To Sea or not to Sea: Further Notes on the "Oceangoing" Dugouts of North Coastal California

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IN a recent article, Jobson and Hildebrandt (1980) offer a model to characterize the function and occurrence of "oceangoing" canoes of north coastal California, demonstrating what they consider to be "idealized trends" relating canoe types and functions with marine resources and environment. They frame these correspondences into the tentative proposition that as distance increases to offshore resources, larger oceangoing canoes were necessary to reduce risk. They suggest that this proposition may help to account for the distribution of other "oceangoing" craft in California, notably the Chumash plank canoe. Their discussion ends with the warning that additional testing of their model is necessary before it can be confirmed or rejected (Jobson and Hildebrandt 1980:172).

Rather than confirm or reject their model, this paper will attempt to expand it, based on direct experience in Chumash marine architecture, craft handling capabilities, and comments by two Santa Barbara master boatbuilders who took part in the reconstruction of our Chumash plank canoe, *Helek* (Hudson 1976, 1977; Hudson, Timbrook, and Rempe 1978; Howorth 1980). Our experiences provide a slightly different view of the variables involved and their relative importance, but are offered constructively to clarify various aspects of the Jobson-Hildebrandt model. It will be shown that larger dugouts were not more seaworthy than smaller ones, and that the reasons for large dugout use in offshore waters were associated with their greater cargo capacity.

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THE ASSUMPTIONS

In the model there are several assumptions and statements about the marine environment, marine architecture, and craft function. Comments on each of these follow. There are also a number of socio-cultural parameters within the model which should be of primary importance for the archaeologist, but due to the already considerable length of this paper they will have to await a future study. The interested researcher will find helpful information in Waterman (1920*b*:220-221, 225), Drucker (1937:241-243, 245, 248, 262), Nomland (1938:112), and Gould (1968: 20-38).

Marine Environment

The marine environment is the major

factor in design and use of boats in either nearshore or offshore waters. Clearly, any discussion or models of the term "oceangoing" must first cope with such factors as swell, current, and wind not only to determine the relative degree of seaworthiness of the craft itself, but also to define the environmental conditions to which it was adapted.

During calm seas with little or no wind and periods of minimal currents, any watercraft is capable of voyaging a substantial distance seaward with relative safety. For example, in 1928 a 19½-ft. canvas canoe made a Transatlantic crossing (McWhirter 1978:549); in native California the makeshift log rafts of the Pomo are another example with their trips to offshore mussel rocks and sea lion habitats (Heizer and Massey 1953:297, 299). In contrast, times of stormy seas necessitate beaching any sort of watercraft. The question is: at what point between calm and storm do the limitations of dugout form and size entail such risk that the craft can no longer put out to sea? In short, how seaworthy were these boats?

This question is relevant to the Jobson-Hildebrandt model, since they equate dugout size with seaworthiness, by stating that only the large dugouts were capable of traveling a "substantial distance" (at least 10 km.) from shore safely (Jobson and Hildebrandt 1980:167, 170). The question is also relevant to archaeological reconstructions that involve pinniped exploitation, since sea mammal availability is not only contingent upon watercraft, extraction technology, seamanship, and animal distributions, but also upon the conditions of the sea under which all of these cultural systems are operating.

In their efforts to define "oceangoing," they have unfortunately failed to define the sea conditions involved, and by so doing have left us to assume that either the large north-coast dugout was completely seaworthy at all times, or that the sea itself was forever static. Since neither of these conditions is reasonable, it would be better to redefine "oceangoing" with a dynamic marine environment in mind.

As defined in U. S. navigation laws, any vessel is oceangoing which, in the usual course of its employment, can navigate seaward of a line of demarcation between inland waters and high seas (McEwen and Lewis 1953:370). Obviously, this definition is more appropriate to modern watercraft than to log dugouts or plank-built canoes, but nonetheless it does call our attention to the primary factors of marine adaptability and environment. To acquire a definition better suited for native watercraft, I posed the problem to boatbuilder Harry Davis. He defined it in these terms: "an oceangoing craft is one which is able to survive and maneuver under the normal sea conditions of that area, as opposed to operating only under select conditions" (Harry Davis, personal communication). This sort of definition best clarifies the term "oceangoing" within the framework of a dynamic marine environment. The question can now be asked: did the north-coast dugout operate under normal seas or just under select (calm) ones? To answer, one must first determine the normal sea conditions for the north coast, and then compare this with dugout operation.

The rugged and often mountainous exposed coastline of northern California, with its many rocky headlands and outlying islets, is well known for its rough seas. As shown in Table 1, winter and spring are very windy seasons; sea swells are higher at this time of year, broken by periods of calm seas. Summers are also marked with winds. Fog is typical from July to September, with August being the worst period, when visibility drops to less than one nautical mile for about ten days. Autumn represents a gradual return to winter conditions. In general, mornings are calmest, and south of Cape Mendocino the

Table 1
CLIMATOLOGICAL AND METEOROLOGICAL DATA FOR THE NORTH COAST OF CALIFORNIA

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Notes
WIND													
Mean wind speed (kts)	6.0	6.3	6.6	6.9	6.7	6.4	5.9	5.0	4.8	4.9	5.2	5.6	(1)
Maximum wind speed (kts)	47	42	42	43	35	34	30	30	38	49	37	49	(1)
Gale force		5			5			5-10			5		(2)
Winds 20 to 30 (kts)		15-20			15-20			10-20			10-15		(2)
VISIBILITY													
Under 2 nautical miles	6.5	5.9	3.2	3.0	1.9	3.4	7.0	6.6	5.6	7.6	5.5	4.8	(2)
WAVES													
Under 1 foot		23			23			24			40		(3)
Over 10 feet		15-28			15-28			10-15			5.9-14.2		(2)

(1) U. S. Department of Commerce 1979:T-5, Eureka.

(2) U. S. Department of Commerce 1979:196, summary for San Francisco Bay to Point St. George. Numbers represent percentage frequencies.

(3) National Marine Consultants 1960: Tables 1.1 to 1.12, Point St. George. Numbers represent percentage frequencies.

seas are rougher due to more frequent winds.[1]

Translating these sea conditions into Beaufort's scale (McEwen and Lewis 1953:38; Bowditch 1977: Appendix C) for the region during the summer months in which the Indians were involved in dugout voyaging in offshore waters, the typical (or "normal") are sea conditions of 4 (moderate seas) or 5 (fresh breeze, whitecaps), broken by periods of calm and frequent fog. Drucker (1937:243) reported that the Tolowa moved into their summer camp at Point St. George when seas were smooth enough to consider voyaging. A Tolowa consultant reported to Gould (1968:27) that:

> In the early morning while it was still dark, a man was sent down to the beach to listen to the surf. If the ocean was calm, the crew from each village would proceed. . . .

Other ethnographers were also told that the seas had to be calm for voyaging. Waterman (1920*b*:186) mentioned that Yurok sailors frequently sang songs and offered formulae while at sea to keep the water smooth and prevent their boat from capsizing. Nomland (1938:111) stated that the Bear River dugouts put out to sea only on calm, windless days. The method used by these people to measure sea conditions was to hold a human hair up and see if it moved; if not, the canoes embarked, even the larger ones with their crew of four or five paddlers.

Since in Beaufort's scale a condition 2 represents such effects as wind being felt on the face, leaves rustling, or vanes beginning to move (McEwen and Lewis 1953:38; Bowditch 1977: Appendix C), we can conclude that Bear River dugouts did not put to sea when conditions were 2 or greater. This leaves conditions 0 (calm, sea mirror-like, no wind) and 1 (light airs, small wavelets without crests) as being the "select" or "ideal" times under which offshore voyaging was undertaken. This is further supported by Nomland's (1938:114) statement that "people did not venture into the ocean except under the most favorable conditions." In short, the north-coast dugouts were not used under the "normal" sea conditions of that area.[2]

Defining favorable conditions in native terms surely also included two other marine factors, current and fog. The direction and force of a current can greatly affect canoe operation, as we found during the voyage of our Chumash replica, the *Helek*. On a very calm morning off the south coast of Santa Cruz Island, the *Helek* encountered a strong head current which nearly brought the craft to a complete standstill. By early afternoon the current reversed direction. Had we known in advance, we could have delayed our voyaging to take advantage of this factor and thus reached our destination with far less physical effort (Hudson 1977:64; Hudson, Timbrook, and Rempe 1978:131-132, n. 278, 139). Chumash consultants placed great importance on observing currents under calm conditions, and I suspect that this was true for north-coast mariners as well.

The other consideration is fog, especially important to a people using line-of-sight navigation in offshore waters (Peter Howorth, personal communication). When conditions were foggy, Chumash mariners would voyage in nearshore waters but not so far that important landmarks could not be seen (Hudson, Timbrook, and Rempe 1978:140). The situation was probably similar for the Tolowa, as this account suggests:

> The men who hunted sea lions needed much courage. The last sea lion hunt took place when I was about 12 or 13. The men went out in a canoe and were caught in a bad fog–they were lost at sea for three days and three nights. They had no food or water with them and were almost dead from the experience [Gould 1968:34].

Being "caught" in a bad fog implies that they had put out to sea under better conditions, and the resulting experience shows that voyaging in fog was hazardous. Therefore, "select" conditions were not just calm, summer days, but also ones with little or no fog. The distinction is important in defining the conditions for offshore voyaging.

Marine Architecture

According to Drucker (1937:242, 245), a rich Tolowa man who held claims to sea lion rocks hired men to construct his "sea lion" dugout. These men did not represent any sort of artisan class or guild, nor were they paid enough money to make them rich. Gould (1968:17) stated that construction was undertaken by close relatives of the boat's owner, and that because the craft was larger than other boats, there was more investment in time and labor. Unlike their Tolowa counterparts, Chumash boatbuilders, as well as boat-owners, were wealthy. They belonged to a specialized, elite guild called the Brotherhood-of-the-Canoe (Hudson, Timbrook, and Rempe 1978:152-167). Their knowledge of marine architecture easily separated their plank-built boats from the humble dugout. Such socio-cultural differences between these two coastal peoples suggests to me that the Chumash placed a far greater value upon marine-related technology and specialized knowledge. It also implies that little, if any, specialized marine knowledge and technology was involved among the Tolowa to construct a "sea lion" dugout as opposed to a river dugout. It would appear that the woodworking and design principles were basically similar for both types of dugout.

Ethnographic data does indicate that there was a great deal of similarity in woodworking and design in both dugout types. Jobson and Hildebrandt (1980:165-169) state that each was made from a single redwood log hollowed by burning; the river dugout was about 15 feet long, blunt ended, with peaked prow, while its seagoing counterpart was of the same general shape but larger, being about 30 to 40 feet long by 5 to 10 feet in beam. They clearly emphasize that the distinction between the two types of dugout "was based on differences of sheer size–the oceangoing canoes being roughly twice as large as the others." However, these writers failed to state that the large dugouts used in their model were ones which had already undergone the incorporation of historically introduced

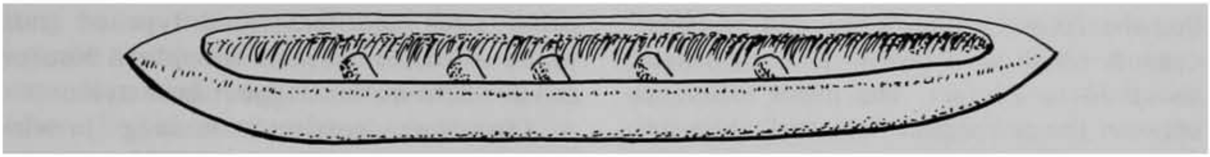

Fig. 1. North-coast oceangoing dugout (after Gould 1968:14, Fig. 2), showing the historically introduced features of pointed prow and stern. Approximate scale: 1 in. equals 8 ft.

Anglo watercraft features, such as pointed prow and stern (cf. Figs. 1 and 2), and in some cases even sails! Moreover, the function of these larger dugouts was expanded during historic times, when they were used for hauling freight as well as for transporting passengers (Gould 1968:12, 15, 20, 22, 38, and Fig. 2). It can be argued, therefore, that since they changed craft design and function in historic times, boatbuilders may have also changed hull length, especially when the primary function of the craft shifted to hauling freight and passengers. Gould (1968:20) was well aware of these changes in his study on north-coast dugouts, inferring that it was possible that long-hulled dugouts were also used in precontact times. He does cite the observation made by the first known Spanish vessel within Yurok territory that the Indians, upon seeing them, embarked in about 10 canoes with 28 to 30 persons in each (Gould 1968:20). The statement is used to infer long-hulled dugout canoes, but it could also be applied to shorter ones given sufficient beam and freeboard. Certainly the description is most applicable in terms of carrying capacity, rather than canoe length.[3]

Since the Jobson-Hildebrandt model should really be concerned with traditional as opposed to acculturated dugout features, it is important to review the available ethnographic data. Drucker (1937: 236-237) stated

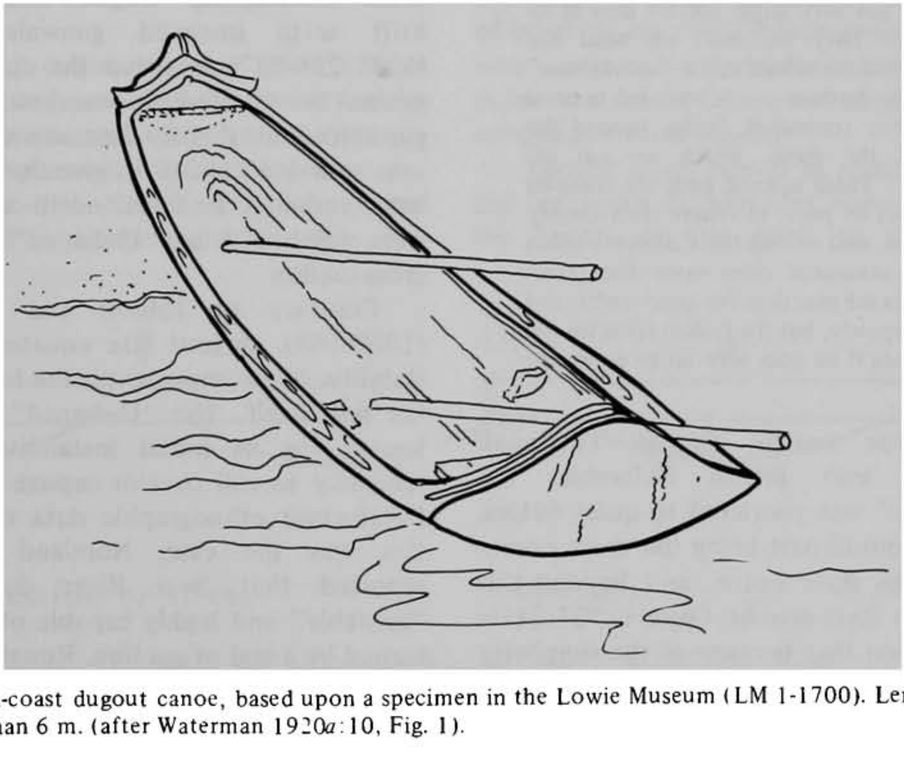

Fig. 2. North-coast dugout canoe, based upon a specimen in the Lowie Museum (LM 1-1700). Length is slightly less than 6 m. (after Waterman 1920*a*:10, Fig. 1).

that the Tolowa had both river and "sea lion" dugouts which were nearly the same length, about 24 to 27 feet. The major difference between the two was in freeboard and beam; the sea lion boats were larger, measuring about 3 feet deep by 6 feet in beam. Thus the "larger" in the Jobson-Hildebrandt model should more correctly apply to draft and beam, not length.

In the model, data on the occurrence of "oceangoing" dugouts is also skewed, since these craft, described as the "shovel-nosed" dugout, also extended northward. They were present along the Oregon coast among the Rogue River and Upper Coquille people (Drucker 1937:272), as well as in coastal Washington and British Columbia (Waterman 1920*a*:10-11; Olson 1927:19), where they were used strictly in navigating estuaries, rivers, sloughs, creeks, and other quiet waters. Waterman 1920*a*:10) described them as follows:

> South of the Columbia River . . . Indian boats are not very large, nor are they at all seaworthy. They are built on what the northern Indians would call a "shovel-nose" model. The bottom . . . is rounded in cross section, but somewhat flatter toward the bow and the stern, which are cut off square. . . . These squared ends are crowned up in a sort of peak, to relieve their clumsy appearance, and among the California tribes a carven ornament rides upon the prow. Such boats are excellent for quiet water, and are quite speedy, but the Indian takes his life in his hands if he goes very far to sea in one of them.

From the coastal Oregon Tillamook northward into British Columbia, the "shovel-nose" was restricted to quiet waters, its marine counterpart being the more oceangoing Nootka style canoe, and beyond this the northern style dugout. Olson (1927:21) is of the opinion that because of the simplicity of design and lack of seaworthiness of the "shovel-nose," it probably represents an older, more undifferentiated type of craft which antedates the more specialized Nootka and northern-marine dugout canoe styles.

Olson's emphasis on craft design in relationship to seaworthiness is lacking in the Jobson-Hildebrandt model, for as noted earlier their model places the emphasis on size. According to both boatbuilders consulted, the primary factor in seaworthiness is design; the size of a boat is considered secondary (Harry Davis and Peter Howorth, personal communication). Therefore, it is essential to the Jobson-Hildebrandt model to determine whether or not north-coast dugout design was marine adapted. The design features involved are shape of the hull, gunwale, and prow, and the materials used.

According to Heizer and Massey (1953:296-297) the "Yurok" type dugout had a blunt, rounded prow with a prow-stern rise of only about a foot above amidships; in cross-section, the hull was rounded. Gould (1968:14, Fig. 1) also noted that the north-coast "oceangoing" dugout had a rounded hull with incurved gunwales. Drucker (1937:236-237) reported the same features: peaked but blunted prow and stern, inturned gunwales, hull slightly flattened on the otherwise rounded bottom to give the craft a little more stability. In short, north-coast dugouts were full-hulled or "U-shaped" in midship cross-section.

Contrary to Jobson and Hildebrandt (1980:168), dugout size equates little with stability. More important is the basic shape of the hull itself. The "U-shaped" hull is well known for its initial instability, having a tendency to roll over or capsize quite easily. North-coast ethnographic data confirm that this was the case. Nomland (1938:111) reported that Bear River dugouts were "unstable" and highly capable of being overturned by a seal or sea lion. Rough waters also easily capsized the craft. One consultant mentioned a taboo that restricted a menstruating woman from approaching a shore; it was believed that her presence could result in the water becoming rough and thus capsizing the canoe. Emphasis was also given to the dugout's instability in frequent stories of sea lion boats capsizing and the occupants drowning (Nomland 1938:114). Tolowa mariners faced similar concerns (Drucker 1937:234).

Clearly the "U-shaped" hull was poorly adapted to sea conditions that exceeded a near calm. The form sacrificed speed and initial stability in favor of cargo-carrying capacity (McEwen and Lewis 1953:240; Basch 1972:38). By contrast, the "V-shaped" hull is better adapted for speed, and when ballasted, for stability; the shape is also better able to handle structural stress and waves (Hudson, Timbrook, and Rempe 1978:63-64 n. 115, 101 n. 209; Howorth 1980:84; Harry Davis, personal communication). This more marine-adapted "V-shaped" hull is a feature of the seagoing dugouts of the Pacific Northwest Coast (Waterman 1920*a*:12, 20, Fig. 6) and the plank canoe of the Santa Barbara Channel.[4]

Increasing dugout size can provide some protection from seas if it entails increasing the distance between gunwale and waterline, or freeboard. Apparently Tolowa sea lion dugouts did just that: they had more beam and freeboard than boats built for river use, though hull length for both craft was nearly the same. Increased freeboard would help to keep the craft drier when sea conditions exceeded 1 on the Beaufort scale, and the added beam would have provided some stability against capsizing (Peter Howorth, personal communication). Both of these features made the sea lion boats a little more seaworthy in calm seas than their river counterparts.

But increasing hull length—Jobson-Hildebrandt examples reach 30 to 40 feet—offers little in terms of increasing craft seaworthiness, and it may even have been a slight handicap due to the potentials of racking (Harry Davis, personal communication). As illustrated in Fig. 3, racking refers to the structural stress created when the hull is briefly supported by waves at prow and stern (sagging), and when the hull is briefly suspended by a wave amidships (hogging) (McEwen and Lewis 1953:232, 392, 595; Harry Davis, personal communication). Such up-and-down flexing, repeatedly shifting from amidships to ends and back again, is capable of breaking up a stiff-hulled canoe, especially when cargo is unevenly distributed. Weight in prow and stern promotes hogging; weight amidships fosters sagging.

Though more typical of rough seas, racking can occur in calm seas when the ratio of the height of the swell to the distance

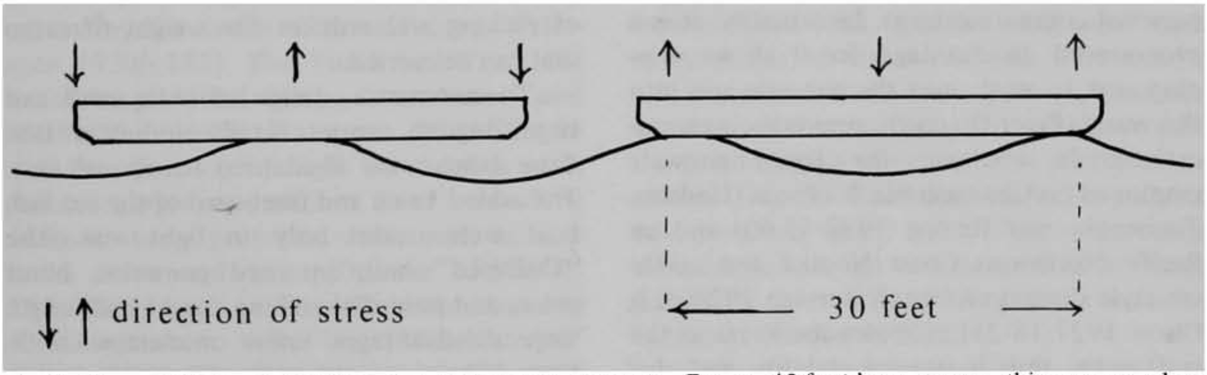

Fig. 3. The problem of racking for long-hulled dugouts. For a 40-foot-long canoe, this occurs when crest-to-crest distance is under 30 feet. Example at left shows hogging stress; that at right shows sagging stress.

between their crests is about 1:30. Thus, for an "oceangoing" dugout with a length of 30 to 40 feet, racking would occur in a 1-foot swell when the distance between crests was about 30 feet. When there are wind-driven waves, or over shallow water or in the surf zone, this ratio can drop to less than 1:10 or even lower under extreme conditions.

Small dugouts have the ability to ride the swells, but larger boats would undergo some degree of racking, depending upon swell height, draft of the canoe, and load distribution. If the craft were low in the water, it might never rise out in a small swell such as one foot; but under windy conditions and high swell, it might very well rack. In addition, thicker-hulled craft are less likely to flex (and thus to rack) than thinner-hulled boats (Harry Davis, personal communication). Unfortunately, we do not know whether north-coast boatbuilders employed some sort of ratio between hull thickness and boat length to increase strength and reduce racking.

The north-coast dugout is also poorly adapted to the marine environment because it features incurved gunwales (cf. Drucker 1937:236-237; Gould 1968:14, Fig. 1), termed a "tumble home" by modern boatbuilders. This gunwale form reduces craft stability, since it does not increase the beam of the boat as it rolls in the sea (Harry Davis, personal communication). In actuality, it is a pronounced disadvantage, for it allows shipping seas to wash over the gunwale and into the vessel (Peter Howorth, personal communication). In contrast, the flared gunwale employed on Chumash plank canoes (Hudson, Timbrook, and Rempe 1978:55-60) and on Pacific Northwest Coast Nootka and northern-style dugout canoes (Waterman 1920*a*:12; Olson 1927:18-23) increases the beam as the craft rolls, thus increasing stability and also repelling washover.

The last design feature to be discussed is the blunt prow. In a head sea, the oncoming waves striking a blunt prow not only make progress difficult, but can also overpower the craft and make maneuvering extremely difficult (Harry Davis, personal communication). Launching through the surf zone would also be difficult. A blunt prow is clearly not an efficient design for sea conditions, or for wind either.

Regarding materials, the ethnographic data state that the north-coast dugout was constructed from a single redwood log (Jobson and Hildebrandt 1980:165-169). Redwood had a number of advantages in boat construction for these people; it was easily available, soft and therefore easy to work, lightweight, straight grained, and remarkably durable under all kinds of exposure (Sudworth 1908:138, 145-146; Hudson, Timbrook, and Rempe 1978:49 n. 75). However, it is not very strong compared to pine and other woods and it easily absorbs water (Hudson, Timbrook, and Rempe 1978:127 n. 266). The "U-shaped" hull design is stronger than the "V-shaped" hull; and as noted earlier, it is possible that hull thickness was increased to give more support to longer canoes. Water absorption is a major problem. The longer the craft is, the more water is absorbed, thereby making the boat heavier. The added weight increases draft and therefore stability, but it also increases the stresses of racking and reduces the weight of cargo that can be carried.

To summarize, design of both small and large dugout canoes clearly indicates that these boats were ill-adapted to normal seas. The added beam and freeboard of the sea lion boat were useful only in light seas. The "U-shaped" hull, inturned gunwales, blunt prow, and potential racking due to hull length were disadvantages under moderate conditions. These points support my view that these dugouts were only operational under favorable marine conditions (see Fig. 4).

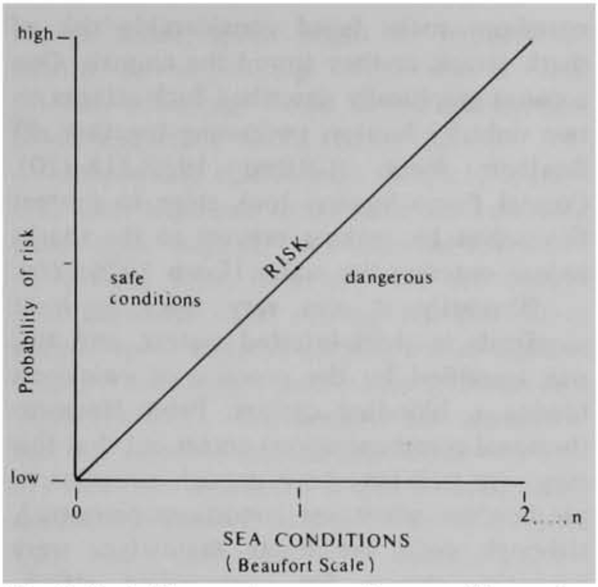

Fig. 4. Probable marine operating conditions for north-coast dugouts.

From the standpoint of design, the north-coast dugout was better suited for river travel than for ocean voyaging.

Craft Function

In portions of the southern California bight and throughout most of the Pacific Northwest Coast, seagoing craft in precontact times served principally for fishing, sea mammal hunting, and trading. Among the north-coast groups, the dugout seems to have been restricted to use in sea mammal hunting, the boat itself being considered insufficiently seaworthy for use in offshore fishing (Waterman 1920*b*:185). The Yurok and Wiyot, for example, preferred fishing from shore (Loud 1918:238, 278-281; Waterman 1920*b*:22). So did the Tolowa, though sea angling with 2-point gorges was said to have been done from boats in protected areas such as sheltered coves and bays (Drucker 1937:231, 233). Based upon analysis of remains found in what appears to have been "fish dumps," Gould (1968:37) offered the opinion that the Tolowa did fish from "oceangoing" dugouts. However, an alternative explanation is that the deep-sea fish in question may have come from the stomach contents of sea lions. The list of fish in Gould's report are ones eaten by sea lions, and it may be more than just coincidence that these fish are present in the same habitat as the sea lion–Point St. George Reef (Charles Woodhouse, personal communication). Thus, if these people, with their highly developed riverine fishing technology, were indeed in possession of efficient "oceangoing" boats, the Jobson-Hildebrandt model fails to explain why offshore fishing was of so little importance.

Their model focuses upon sea mammal hunting, and gives seaworthiness as the reason for use of smaller dugouts in nearshore exploitation, larger ones in offshore exploitation. They note that small dugouts operating in nearshore waters made several trips to tow the animals ashore, while larger dugouts were capable of voyaging further seaward and operated on a single-trip basis (Jobson and Hildebrandt 1980:167-168, 172).[5]

Again, by equating canoe length with seaworthiness, they have missed what may be the real significance of dugout size differences. As shown, neither craft was substantially more seaworthy than the other, but the larger dugouts would have a larger carrying capacity. That larger dugouts did venture further offshore, according to their model, suggests to me that the reason was not greater seaworthiness but greater yield–the risks being similar for either craft. In other words, where seaward distance increases and number of potential trips decreases, it is evident that the larger dugout would be more profitable to operate (Fig. 5). The larger craft also permits a larger crew, which in the Tolowa accounts were needed in the various tasks of hunting, stabilizing the boat, and bringing the sea lions onboard (Drucker 1937:234).

While it is perhaps true that as risk and distance increase, the "pull" or attraction of the resource diminishes (Jobson and Hilde-

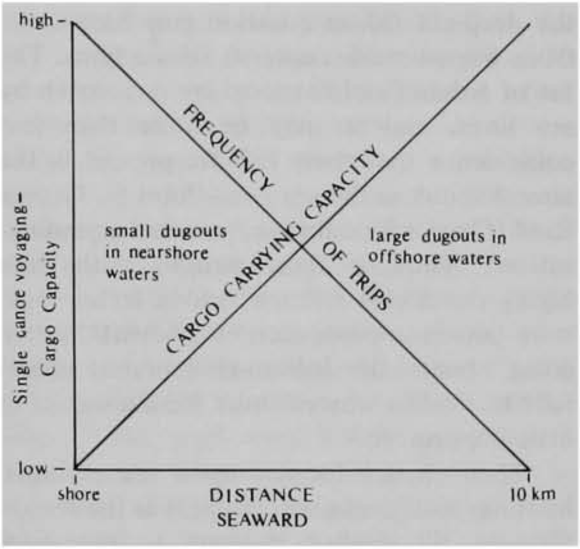

Fig. 5. Relationship of cargo capacity and frequency of single canoe voyaging to seaward distances. The plot assumes low-risk conditions as defined in Fig. 4.

brandt 1980:170), a better formula would be: as risk and distance exceed potential resource yield and the ability to transport it, the "pull" or attraction of the resource diminishes. This adds cargo capacity as a factor in the canoe's ability to transport the resource and as a determinant of potential resource yield. The relationship is essentially one of profit versus loss.[6]

The north-coast-dugout mariners also faced another risk in both nearshore and offshore waters: the great white shark, *Carcharodon carcharias*. In California, the greatest number of unprovoked attacks occur along the north coast (Miller and Collier 1981:78-79, 86). The danger in this area is as great as that in the more publicized shark-infested waters of Australia, southern Africa, or the eastern United States.

The great white shark feeds on harbor seals, sea lions, elephant seals, and sea otters (Miller and Collier 1981:93), and very likely would have had contact with Indians engaged in hunting these same animals. Coastal Yuki swimmers hunting seals and sea lions along nearshore rocks faced considerable risk of shark attack as they towed the animals. One account graphically described such attacks on two unlucky hunters swimming together off Sealion Rock (Gifford 1939:318-320). Coastal Pomo hunters took steps to protect themselves by making prayers to the sharks before entering the water (Loeb 1926:169).

Obviously it was very risky to hunt pinnipeds in shark-infested waters, and this was amplified by the practice of swimmers towing a bloodied carcass. Peter Howorth (personal communication) points out that this may very well have been enough incentive to use dugouts where sea conditions permitted, although even the boats themselves were potential objects for unprovoked attack. Great white shark attacks on boats are documented in the literature (Miller and Collier 1981:92; Follett 1974:196-197).

Even so, it would be safer to use a boat than to swim, sufficient reason for the use of small dugouts on calm seas to hunt pinnipeds and tow them to shore. Frequent trips could be made because: (1) it was comparatively easy to tow one animal at a time; (2) the short distance to shore lessened the time of being sensed by a shark and therefore exposure to attack; and (3) the limited carrying capacity of the craft made it more productive to operate in nearshore waters (Peter Howorth, personal communication).

Equally important to the Jobson-Hildebrandt model is whether or not the larger dugouts also operated in nearshore waters. In view of cost and weather considerations, in all likelihood they did, especially when offshore localities presented such problems to voyaging as fog or potential change in sea conditions. When operating in offshore waters, the greater cargo carrying capacity of these boats meant that more animals could be acquired and carried onboard, rather than towed, so that the dugout itself would retain a more streamlined potential during the long voyage home; speed might be required to outrun an impending rough sea or fog. Another advantage would be the absence of a blood trail which would attract sharks.

Jobson and Hildebrandt (1980:170) state that such trips had to be made on a one-day basis, since daylight was essential for visual navigation. Such, however, may not always have been the case. Among the Bear River people, some dugouts did stay out all night in their hunting activities (Nomland 1938:111-112). The reasons are not given, but two possible explanations come to mind: (1) with calm seas and a bright, moonlit night, the hunters decided to offset risks by reaching their boat's full capacity of animals; (2) the sea became rough, thereby making the voyage home dangerous. In the latter case the sailors could have found it more advantageous to haul the boat up on the rocks or tie it up in the kelp, waiting out the storm or fog. The return trip the next morning would be when the seas were likely to be at their calmest.

CONCLUSIONS

First, I agree with Heizer and Massey (1953:296-297) that the design of the north-coast dugout was better suited for river than for ocean use. Viewing dugout design in relation to marine factors reveals that use of the craft was restricted to ideal sea conditions, and that the functions of different sized vessels were related to cargo-carrying capacity, or in other words, risk-yield factors. Since these boats were not capable of maneuvering safely under the normal sea conditions in the area, it is incorrect to consider them "oceangoing." I suggest using Drucker's terms, "sea lion" and "river" dugout, neither of which suggests any preconceived notions of seaworthiness.

Second, before the model is expanded to explain the distribution of other native California watercraft, it must come to grips with the term "oceangoing" in order to compare and contrast marine craft with function and environment. Certainly "oceangoing" means far more than the ability to voyage a craft with safety a substantial distance seeward—it means that the craft must be designed to handle the usual wind, swell, current, and fog conditions of the region, and it means the craft must have skilled and knowledgeable mariners.

Last, it is curious that the sea lion boats should lack such marine-adapted features as the sharp pointed prow, "V-shaped" hull, and flared gunwale. These design elements were basic to the seagoing craft of the Pacific Northwest Coast and the Santa Barbara Channel, while dugouts lacking these features were relegated to calmer waters. Given the risks involved, we can certainly understand the need to increase beam and freeboard; but why did the boatbuilders ignore other, more seaworthy elements too? The answer cannot be based entirely on an "economy of labor" argument, since an investment was already made in terms of draft and beam. Moreover, the woodworking qualities of redwood versus cedar are not that much different. It would therefore seem that the answer must involve a number of sociocultural and economic variables. The similarity of these boats (with the exception of those with such historic, introduced features as pointed prow and stern and in a few cases sails) to their riverine counterparts may hold a part of the answer: exploitation of offshore resources was not significant enough in profit versus loss to warrant designing more marine-adapted watercraft, any more than it was a stimulus for the development of offshore fishing.

Unlike the north-coast dugout, the ancient Chumash dugout appears to have undergone such architectural changes—strakes were added and through time the dugout itself was gradually reduced to become the plank bottom board—thus evolving into a new craft, better adapted to the sea, while the humble dugout and the tule balsa were retained for use on calmer waters (Hudson, Timbrook, and Rempe 1978:22 n. 6). In a similar way the shovel-nose dugout also underwent design changes to increase its marine efficiency among peoples north of the Tolowa (Olson 1927:21). Why the Tolowa shovel-nose did not also evolve into a more marine-adapted craft illustrates that the processes which concern the origins and distributions of sea-adapted watercraft are far more complex than might otherwise appear. Though Jobson and Hildebrandt "may have missed the boat," they should be commended for taking the initial steps to model some of these complex processes, and in so doing call our attention to the diversity of design and use of watercraft in the seas off California.[7]

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NOTES

1. Detailed data on currents, winds, etc., for specific areas are lacking; general data, however, can be found in the U. S. Coast Pilot (U. S. Department of Commerce 1979). The reader may wish to refer to this source (Tables 13 and 15) to compare the north coast against the relatively sheltered waters of the Santa Barbara Channel or of Puget Sound, both of which are usually considerably "calmer."

2. I could find only one account at odds with this statement. Powers (1877:48) mentioned having seen large dugouts going "boldly to sea in heavy weather."

3. At the time of contact, the Chumash plank canoe was already well suited to sea conditions, with its elongated dory form and flared sides, sharp bow and rakish stern. Historical introductions were thus not needed to improve the craft. During the Mission Period, however, the lucrative sea otter trade did lead to attempts by the Church to introduce the plank canoe north of Point Conception (Hudson 1976). There were also efforts to increase cargo capacity by increasing hull length. These changes required the introduction of such features as dowelled battens and ribs (Hudson, Timbrook, and Rempe 1978:100-102). The carrying capacity of these boats is unknown, but from direct experience with our 27-foot *Helek* (which lacked battens and ribs), the carrying capacity was nearly two tons (Hudson, Timbrook, and Rempe 1978:122 n. 257). Moreover, during the Chumash Revolt of 1824 at Mission Santa Barbara, we are told that about 25 people were transported by canoe to Santa Cruz Island. We estimated that the mixture of children and adults on this voyage probably represented 3200 pounds (Hudson 1976:13). Thus, Gould's reference to 28 to 30 persons in a north-coast dugout is equally reasonable for the dimensions of the sea lion boat as described by Drucker (1937:236-237). A length of about 27 feet would be consistent with the plank canoe, but both draft and beam (nearly double in size) are greater in the case of the north-coast dugout. Therefore, not only could the "U-shaped" hull of the north-coast dugout provide even a greater carrying capacity over its Chumash plank-canoe counterpart, but we can expect that it was filled with excited people desiring to get a close look at the first European vessel to visit their waters.

4. Waterman (1920*a*:12) stated that the best canoes in the Pacific Northwest Coast, whether Nootka (Chinook) or Northern styles, "show an outward 'flare' in the side just below the gunwale." He concluded that the feature was probably dependent upon the skill of the boatbuilder, meaning that it was not always present on both canoe types.

5. In addition to ethnographic data and inferences, more information on north-coast dugouts could be acquired by actually reconstructing one and taking it to sea. But due to the sea conditions and frequency of white shark attacks in these waters, I personally would prefer just to think about such a project.

6. Jobson and Hildebrandt (1980:170) err in their assumption that "due to our inability at this point in time to quantify the relative abundance of the marine-mammal resources" seals and sea lions are

evenly distributed and equally available in all areas of consideration. If this were the case, why would the Indians risk dangerous offshore voyages when it could be just as profitable to exploit these animals in safer, nearshore waters? According to Dr. Bruce Mate (personal communication), harbor seals are more typical of nearshore waters, while sea lions prefer to haul out on the rocky, offshore islands. If this pattern held in precontact times, it would support my contention that greater cargo-carrying capacity was needed for exploiting larger animals more typical of the offshore region.

7. The model should also be considered for the Pacific Northwest Coast, where the shovel-nose dugout is found. Such a study could examine the relationship of this craft to the Nootka-type canoe (Oregon to Vancouver Island) and the Northern-type canoe (Vancouver Island to Yakutat Bay). The various functions of these and other craft would be interesting to incorporate into a model.

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