DONAX EXPLOITATION ON THE PACIFIC COAST: SPATIAL AND TEMPORAL LIMITS

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ABSTRACT

The marine mollusk genus Donax spp. is widely distributed and was exploited prehistorically in several regions of the world. On the west coast of North America, the focused exploitation of Donax gouldii seems to have been largely limited, in space, to the San Luis Rey River - Buena Vista Creek area of northern San Diego County and, in time, to the Late Prehistoric period. Possible explanations for these limits are discussed.

DISCUSSION

The marine mollusk genus Donax spp. is represented in the intertidal zone of open, sandy beaches along the tropical and temperate margins of the continents washed by the Atlantic, Pacific, and Indian Oceans.

Most species of Donax consist of rather small individuals, and their size would seem likely to have limited the appeal of these clams as efficient food packages for littoral collecting peoples. Despite this drawback, Donax is known archaeologically to have been exploited prehistorically in several regions. D. trunculus and D. cornea were found in Franchthi Cave in southern Greece (Shackleton 1988:18-20; Shackleton and van Andel 1986). D. serra was found in archaeological contexts in the Western Cape area of South Africa. D. deltoides was apparently used very extensively in eastern Australia (Godfrey 1988). D. variabilis, which occurs along the coastline of the southeastern United States from Texas to Virginia, is found in prehistoric middens as far north as northern Florida (Larson 1980:71; Miller 1980).

Two species of Donax are present along the southern California coastline: D. gouldii, which ranges south from Santa Cruz or San Luis Obispo, and D. californicus, which ranges south from Santa Barbara (McLean 1978; Morris 1966; Rehder 1981). Five other Donax species are found in the Gulf of California. Aboriginal Donax exploitation in the region seems to have focused primarily or exclusively on D. gouldii.

Donax gouldii lives in the intertidal zone of sandy beaches, generally in the upper 4 cm of the deposit. The size of individuals ranges from under one-half inch (1.25 cm) to just over 1 inch (2.5 cm). Populations of the animals have been estimated to reach as high as 20,000 individuals per m^2 in a band of La Jolla beach 2 to 5 m in width and more than 8 km in length (Garrison 1968). Summer gathering of Donax may have been inhibited by the potentially toxic algal blooms known as "red tide" which affect some open

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coast bivalves, although the seriousness of this impediment has been questioned (Quintero 1987:150-152).

When present in substantial numbers, Donax is evidently easy to harvest. They can be harvested by scooping sand into a box with a screen on the bottom. One person with the proper equipment "can easily harvest several bushels of this shell in an hour", according to George Radwin of the San Diego Museum of Natural History (Flower et al. 1977:181). It seems likely that, prehistorically, basketry or net bags, used with wooden shovels or with bare hands, would have been suitable for harvesting Donax.

It is uncertain how the collected Donax were processed by aboriginal peoples. In modern accounts, preparation is said to take little time and energy: When put in water for a few minutes, the shells open and the meat detaches. A possible alternative method is suggested by an ethnographic account of aboriginal Australians' large-scale processing of Tapes hiantina, a slightly larger clam (2.5 to 5 cm in length) which belongs with Donax to the family Donacidae (Meehan 1982). Tapes sp. were individually placed in clean sand with the hinges up, and grass and brush were burned over them to open and to cook them. This method of processing may have been possible for Donax as well, although its efficiency seems questionable.

Numerous shell middens along the southern California coast have been investigated archaeologically. Detailed reports of these investigations sometimes mention Donax among the shellfish genera which are represented in the middens. However, Donax is rarely more than a very minor constituent.

One Donax-rich midden which has been studied in some detail is site SDI-5445. Located on the San Luis Rey River in Oceanside, about 3 km from the coast, the site now lies under paved surfaces and in agricultural fields. The archaeological remains are primarily marine shell, with some ceramics but almost no lithic artifacts. Donax gouldii accounts for over 75% of the recovered shell and for an even higher proportion of the shell in the richest central core of the site. Radiocarbon dating (Table 1) and the presence of Tizon Brownware ceramics indicate that the deposit dates from the Late Prehistoric period. Ethnographically, the site lies within Luiseño territory.

SDI-5445 was tested in 1990 by Joyce M. Corum for a Caltrans highway project (Corum 1991). Work at the site included shovel tests, conventional unit excavations, and the screening of volumetrically-measured samples from backhoe trenches. In all, about 85 m^3 of deposit were sorted through 1/8-inch mesh screen, yielding about 33 kg of marine shell. For purposes of analysis, the site was divided into 6 subareas or sampling strata. The unit and backhoe trench locations were not randomly selected, and the sampling strata were defined only after the fieldwork was completed. Nevertheless, some inferences about the overall content and character of the site can perhaps be legitimately inferred on the basis of the extensive "stratified" sampling. Projections on this basis suggest a total site content of some 82,000 kg of Donax shell. Nutritionally this may represent about 30 million kcal of energy and 5 million g of protein, which would correspond to about 11,000 person-days worth of calories and 95,000 person-days worth of protein (Table 2). It seems fair to conclude that Donax was a more-than-negligible food resource and that its harvesting was a substantial activity at this location prehistorically.

However, an examination of the archaeological record suggests that the focused exploitation of Donax on the Pacific Coast of North America was distinctly limited, both in space and in time. Spatially, the occurrence of Donax as one of the major shellfish genera within substantial middens seems to be largely limited to northern San Diego County, and more specifically to sites within or near the San Luis Rey River and Buena Vista Creek drainages. Chronologically, Donax middens seem to be restricted to the Late Prehistoric period.

In a summary of shellfish remains recovered from 42 sites in 6 Southern California counties, Wlodarski (1985) reported no evidence for a focus on Donax exploitation out-

Table 1

Marine Shell Radiocarbon Dates for Site SDI-5445

Lab. No. Beta-	Shell-fish Genus	C-14 Age (yrs. B.P.)	C-4 Adjustd Age (yrs B.P.	Cali-brated[1] Date (A.D.)	One-Sigma Date Range (A.D.)	Reservoir-Effect[2] Date Range (A.D.)
44185	Argopecten	1230 ± 60	1650 ± 60	410	275-440	775-1240
44186	Chione	810 ± 60	1230 ± 60	780	680-880	1180-1780
44187	Donax	790 ± 60	1230 ± 60	780	680-880	1180-1780
44188	Argopecten	400 ± 60	850 ± 60	1200	1055-1245	1555-present
44189	Donax	560 ± 60	980 ± 60	1024	999-1153	1499-present
44190	Donax	390 ± 60	840 ± 60	1217	1159-1260	1659-present

[1] Based on the calibration of Stuiver and Pearson (1986)

[2] Based on the reservoir correction of -700 ± 200 years, suggested by Taylor et al. (1986)

Table 2

Nutritional Value Represented by Projected Donax sp. Remains at Site SDI-5445[1]

	Energy	Protein
per 100 g of clam	76 kcal	13 g
recommended daily allowance, for a male aged 19-22 years	2,900 kcal	56 g
estimated Donax sp. contribution represented at site SDI-5445	31.2 10^6 kcal	5.3 10^6 g
person-days of nutrient represented at site SDI-5445	10,800 person-days	94,600 person-days

[1]Nutritional data based on Whitney and Hamilton (1987)

Table 3

Donax sp. Ocurrence in Selected Southern California Archaeological Sites[1]

County	Sites in Sample	Sites with Donax Present	Sites with Donax as One of Main Genera
San Luis Obispo	5	1	0
Santa Barbara	6	2	0
Ventura	9	3	0
Los Angeles	10	2	0
Orange	9	1	0
San Diego	3	2	1

[1]After Wlodarski (1985)

side of northern San Diego County (Table 3). Farther south, systematic or quantified evidence concerning Baja California shell middens is scarce. In a study of sites in the vicinity of Bahía Concepción, on the southern Gulf of California coast, 30,000 identified specimens included no Donax (Ritter 1979). Around Bahía de los Angeles, on the northern Gulf of California coast, the 23 shellfish species which were identified as typical of the sites did not include Donax (Davis 1968). For Baja California middens in general, including those of the northwestern coast, Téllez Duarte (1987) did not note Donax as a common or characteristic shellfish genus. However, at least 1 Donax-rich midden is reportedly present on the northwestern coast of Baja California, north of Laguna Guerrero Negro (John Foster, personal communication, 1992).

A review of reports on archaeological sites in San Diego and Orange counties (Ta-

bles 4 and 5; Figure 1) helps to define more closely the pattern of Donax exploitation in time and space. Chronologically, out of 34 studies of Late Prehistoric sites, Donax accounts for 10% or more of the recovered shell in 12 cases. Of 32 studies of Archaic-period sites, Donax represents considerably less than 10% of the shell in all cases except one. The shell from the single Archaic exception, SDI-9588, was reported in terms of the numbers of valves belonging to each genus, rather than by weight. Donax gouldii valves which were recovered archaeologically weighed an average of 0.3225 g, according to one sampling (Corum 1991:131), whereas, for example, Argopecten sp. valves weighed 4.3 g and Chione sp. valves weighed 5.2 g. If the average non-Donax valve at site SDI-9588 weighed 5 g and the average Donax valve weighed 0.3225 g, the proportion of Donax by weight at that site was only 3.5%, which is not out of line with the general Archaic-period pattern.

Spatially, Donax middens show a strong clustering in the San Luis Rey-Buena Vista drainage systems. As has been noted, Donax yields of 10% or more were reported from 12 Late Prehistoric sites or site-clusters. Of these, 7 are in the coastal zone near the San Luis Rey River or Buena Vista Creek, in the Oceanside-Carlsbad area. Another 3 are located inland: On the San Luis Rey River, near Bonsall; in Moosa Canyon, a tributary of the San Luis Rey River; and on Deer Springs Creek, a tributary of San Marcos Creek which is close to the headwaters of Buena Vista Creek. One apparent exception to the geographical pattern, a sampling at site SDI-4513 in Sorrento Valley, involves an analysis which, like the study of the Archaic-period site SDI-9588, was reported in terms of valve counts; when the suggested conversion to weight percentages is made, the proportion of Donax is only about 1.4%, which is more consistent with several other archaeological samples taken from this same site. A single remaining, as-yet-unexplained geographical anomaly is the high proportion of Donax found at sites SDM-W-1837 and SDM-W-1838, which are located near Encinitas Creek, well to the south of the main Donax area.

To account for the apparent restrictions in space and in time which seem to characterize the exploitation of Donax in western North America, several hypotheses may be considered. The present evidence is not sufficient for definitive conclusions, but at least some factors favoring acceptance or rejection of some of the hypotheses may be briefly noted:

1. The Donax resource might not have been available in economically-attractive quantities at places and times other than those at which it was exploited. As has been noted, the overall geographical range of the genus in western North America is much wider than the area within which evidence of its exploitation has been identified. Donax may have been present within this wider area but may have been present in large concentrations only within a smaller area; however, there is no specific evidence to support such a supposition. Chronologically, Donax may have been available in abundance only in the latest prehistoric period. It is unlikely that such a temporal change, if it occurred, was related to ocean temperature changes; the study area is closer to the northern than to the southern limit of the genus, and what little evidence is available concerning Holocene climatic changes in the region points to a cooling rather than a warming trend during the Late Prehistoric period (Tartaglia 1976). A more plausible cause of a late florescence for the genus would be a change in the physical environment. During the early Holocene, the rising post-glacial seas flooded many estuaries along the San Diego coast, creating lagoons and bays which acted as sediment traps for San Diego's rivers. In the late Holocene, when the sea level had become essentially stable and when some of the estuaries had filled with sediment, more sand presumably found its way to the open coast to create the sandy beaches which are the habitat for Donax.

2. Elements of the procurement and processing technology which was used in exploiting Donax might have been unavailable at other times and places. The equipment necessary for harvesting would appear to have been extremely simple: A basketry container for sifting sand from Donax in the surf. A more plausible technological limitation might be efficient preparation equip-

Table 4

Donax Occurrence in Selected Archaic-period Archaeological Sites in San Diego and Orange Counties

Site(s)	Sample Size[1]	Percent Donax[2]	Reference
CA-ORA-85	9,317 g	-	Eberhart 1989
CA-ORA-183	96,421 p	0.0	Cottrell et al. 1985
CA-ORA-323	12,194 p	-	Barter 1987
CA-SDI-48	379,606 g	0.0	Gallegos and Kyle 1988
CA-SDI-197	1,618 g	0.0	Gallegos et al. 1988
CA-SDI-222/4281	1,870 p	1.8	Bingham 1978
CA-SDI-1087	1,548 g	2.6	Hector 1987
CA-SDI-1246	7,127 g	0.0	Hector 1985b
CA-SDI-4358	23,307 g	-	Carrico and Gallegos 1983
CA-SDI-4405	3,583 g	0.0	Gallegos 1985
CA-SDI-4619	4,316 g	-	Smith 1989
CA-SDI-5130	16,874 g	-	Carrico 1978
CA-SDI-5130	55,982 g	-	Quillen et al. 1984
CA-SDI-5216	11,132 g	-	Hector 1981
CA-SDI-7197	1,210 g	-	Pigniolo and Gallegos 1990
CA-SDI-9588	2,403 v	35.3	Gilbert and Reinoehl 1987
CA-SDI-10,220	14,825 g	0.5	Smith 1986b
CA-SDI-10,238	34,137 g	0.0	Smith 1986a
CA-SDI-10,915	17,873 g	0.0	Smith 1989
CA-SDI-10,945	83,445 g	0.3	Pigniolo et al. 1991
SDM-W-19	8,904 g	0.0	Hector 1983b
SDM-W-20	187,004 g	0.0	Smith and Moriarty 1985
SDM-W-51A	1,429 g	-	Smith 1982
SDM-W-106	16,084 g	0.0	Kaldenberg and Hatley 1976
SDM-W-110	7,681 g	0.0	Hector 1985a
SDM-W-131	37,576 g	0.0	Gallegos 1991
SDM-W-132	70,026 g	0.3	Carrico and Phillips 1981
SDM-W-179/951/942	12,629 g	-	Bull 1976
SDM-W-192	43,852 g	0.1	Carrico and Ainsworth 1980
SDM-W-920	8,675 g	-	Apple and Olmo 1983
SDM-W-2115	11,361 g	-	Connors and Bull 1980
Cal E:8:15/E:8:17	182,995 g	-	Leach 1975

[1]g = weight in grams; v = count of valves; p = count of pieces
[2]hyphen indicates no Donax recovered; 0.0 indicates Donax present but less than 0.05%.

Table 5

Donax Occurrence in Selected Late Prehistoric Archaeological Sites in San Diego County and Orange Counties

Site(s)	Sample Size[1]	Percent Donax[2]	Reference
CA-ORA-22	6,296 g	0.4	Cook and White 1977
CA-ORA-129	12,917 g	-	Demcak 1988
CA-ORA-130	6,741 p	-	Barter 1987
CA-SDI-2739/6142/6144/6147	24,770 g	-	Gallegos and Carrico 1984
CA-SDI-4513	221 v	18.1	Eidsness et al. n.d.
CA-SDI-4513	3,703 g	0.4	Hector and Wade 1986
CA-SDI-4513	7,732 g	1.0	Gallegos et al. 1989
CA-SDI-4609	10,086 g	3.4	Carrico and Taylor 1983
CA-SDI-4609	35,645 g	0.4	Hector 1985c
CA-SDI-4807	1,144 g	23.8	Cook 1978
CA-SDI-4845	39,160 g	0.0	Gallegos 1986
CA-SDI-5081	1,645 g	0.8	Eckhardt 1980
CA-SDI-5443	3,954 g	0.1	Carrico and Taylor 1980
CA-SDI-5445	32,936 g	77.7	Corum 1991
CA-SDI-5589	432 g	43.2	Fulmer 1984
CA-SDI-5601	9,189 g	14.0	Hector 1983a
CA-SDI-5634	7,516 g	0.0	Berryman and Varner 1981
CA-SDI-6753	2,410 g	98.4	Cheever 1989
CA-SDI-6754	364 g	0.9	Cheever 1989
CA-SDI-6819	598 g	0.7	Cheever 1989
CA-SDI-9473	6,580 g	28.8	Corum and White 1982
CA-SDI-9476	842 g	0.3	Hector 1984
CA-SDI-9967	1,926 g	22.2	Gallegos and Carrico 1984
CA-SDI-10,955	971 g	0.5	Smith 1990
SDM-W-143/146	407,424 g	10.1	Cardenas and Robbins-Wade 1985
SDM-W-147	263,822 g	0.0	Bull and Norwood 1977
SDM-W-149	130,739 g	0.6	Bull 1978
SDM-W-150	27,709 g	0.0	Heuett 1979
SDM-W-223A	4,120 g	19.0	Quintero 1987
SDM-W-459/1277/1278/1279/1280	2,135 g	8.9	Hatley 1979
SDM-W-977A	3,274 g	8.6	Bull 1978
SDM-W-1257	447 g	46.8	Flower et al. 1979
SDM-W-1837/1838	5,187 g	58.1	Franklin and Carrico 1979
SDM-W-2131/2132	2,595 g	3.5	Wade 1986, 1987

[1]g = weight in grams; v = count of valves; p = count of pieces
[2]hyphen indicates no Donax recovered; 0.0 indicates Donax present but less than 0.05%.

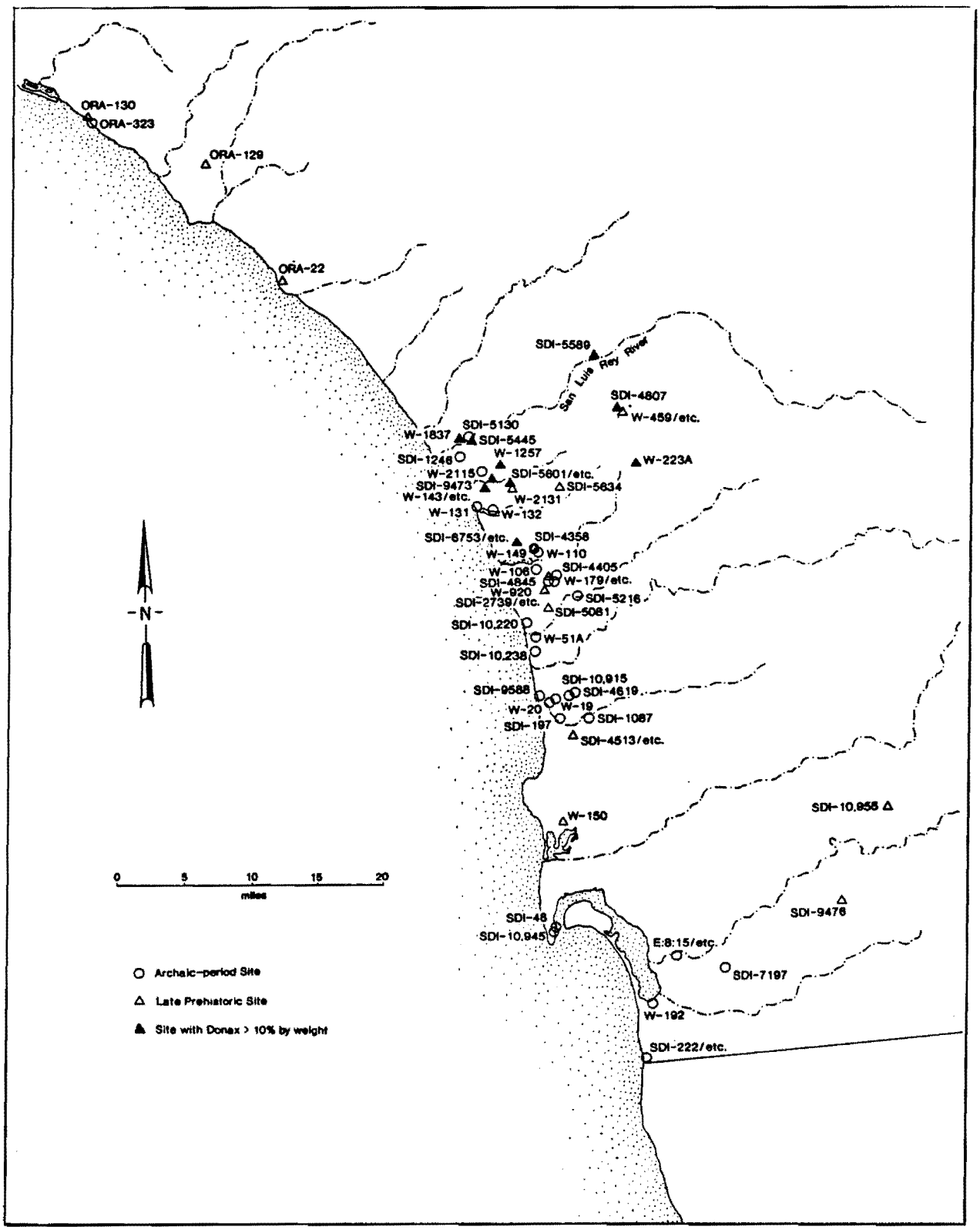

Figure 1. Selected sites with marine shell assemblages, San Diego and southern Orange counties.

ment, specifically pottery cooking pots in which to boil Donax. The apparent chronological and spatial limits for Donax exploitation on the Pacific Coast coincide with the only time period and with one of the few areas in which pottery was in use. During earlier periods, steatite vessels were made in southern California but were never abundant in the San Diego region. Stone-boiling in tightly-woven baskets was probably practiced earlier, but it may have been a substantially less efficient method than cooking directly over fires in ceramic containers. This suggests that the attractiveness of harvesting Donax may have increased substantially as ceramic containers became available.

3. Interest in Donax procurement might have been limited by high procurement/processing costs. As discussed above, it appears that the costs were not high, at least when Donax was available in considerable concentrations.

4. Interest in Donax might have been limited by low nutritional value. This also appears fairly unlikely. The meat-to-shell ratio for at least 1 species of Donax is 1:2 (Miller 1980), which is relatively high. The nutritional values calculated for clams are not particularly high as compared to vertebrate faunal and to floral food resources. This would perhaps have been a limit on the exploitation of shellfish in general. In the particular case of Donax, ease of procurement would seem likely to have been able to offset this factor. Problems caused by red-tide poisoning might have affected the summer-season exploitation of Donax, which is an open coast species. This would not have interfered with its exploitation during the remainder of the year. The red-tide problem did not block the early and widespread exploitation of Mytilus sp. (mussel), which is subject to red tides and which is relatively common in Archaic-period middens.

5. Donax exploitation might have been attractive only after preferred shellfish resources had become unavailable due to overexploitation or habitat loss. It has been suggested that Chione and Argopecten may have been more efficient food sources but that these genera may have been slow to recover from predation and hence have become less available through time. Donax may have provided an acceptable substitute for or supplement to these genera (Fulmer 1984). Late Holocene silting up and closure of lagoons in northern San Diego County may have caused a shift to open-coast resources.

6. Irregularities in the availability of Donax sp. might have made this resource attractive only within certain settlement system contexts. Fulmer (1984:7) suggested that:

> Donax, as it appears in large rapidly growing but transient colonies, may have appeared as a supplement or surplus in shellfish foraging strategies, and thus the right to its exploitation may not have been as regulated as for other molluscan species. The sporadically appearing Donax colonies may have been exploited by groups that did not normally exploit shell fish to a large extent.

7. Compatibility or incompatibility with seasonal scheduling of the exploitation of other resources might have influenced the value assigned to Donax. Larson (1980:71) suggested that Donax variabilis exploitation in the southeastern United States may have represented a seasonal replacement of oyster use. Donax populations would apparently have been optimal for exploitation in the fall season (Miller 1980; Quintero 1987:153). Ethnographic evidence suggests that acorn harvesting was a major element, perhaps the most important one, in aboriginal subsistence in this region and that the exploitation of that resource was most intensive in the fall. Archaeological evidence seems to suggest the initiation of, or at least an expanded involvement with, acorn processing during the Late Prehistoric period. Although this line of evidence does not seem to make Donax particularly well suited to complement acorns in seasonal scheduling, it is possible that a Late Prehistoric focus on acorns, associated with a rise in population density, created a vulnerability to periodic stress, either on a seasonal basis or in association with irregular failures in the natural acorn crop, which was relieved by Donax harvesting. However, if Donax was

used as a fill-in resource to bridge periods of nutritional stress, it may have been exploited at seasons of need rather than at the times when it was most efficiently available.

Future investigations may help to resolve these issues by focusing on the chronological and geographical ranges of Donax exploitation, its technological associations, its seasonality, and the evolution of Holocene coastal environments and of prehistoric use of other shellfish genera.

REFERENCES CITED

Apple, Steven A., and Richard K. Olmo
1983 An Archaeological Evaluation of SDM-W-920 and SDM-W-921, Santa Fe Ridge, Carlsbad, California. New Horizons Planning Consultants, Inc., San Diego.

Barter, Eloise Richards
1987 Excavations at CA-Ora-130 and CA-Ora-323, Coastal Bluff Sites at Crystal Cove State Park. Pacific Coast Archaeological Society Quarterly 23(4):31-75.

Berryman, Judy A., and Susan Sapone Varner
1981 Archaeological Testing Program Carried out on SDi-5634, Shadow Ridge Site, Vista, California. Archaeological Consulting & Technology, San Diego.

Bingham, Jeffrey C.
1978 Archaeological Test Excavations within Border Field State Park, San Diego County. California Department of Parks and Recreation, Sacramento.

Bull, Charles S.
1976 Archaeological Investigations at Santa Fe Knolls. RECON, San Diego.

1978 Prehistoric Lifeways at La Costa North: An Investigation of Archaeological Sites. RECON, San Diego.

Bull, Charles S., and Richard Norwood
1977 The Archaeology of Villa La Cumbre: Results of Testing Three Archaeological Sites at Batiquitos Lagoon. RECON, San Diego.

Cardenas, D. Sean, and Mary Robbins-Wade
1985 An Archaeological Investigation of SDM-W-143/146: An Unique Coastal Luiseño Occupation Site in Carlsbad, California. RBR & Associates, San Diego.

Carrico, Richard L.
1978 Archaeological Excavation and Testing at Site SDi-5130, Oceanside, California. WESTEC Services, Inc., San Diego.

Carrico, Richard L, and Peter Ainsworth
1980 Archaeological Salvage at W-192A, Imperial Beach, California. WESTEC Services, Inc., San Diego.

Carrico, Richard, and Dennis R. Gallegos
1983 Archaeological Testing Program and Literature Review for Site W-108 (SDi-4358, SDi-6149 and SDi-8195), Carlsbad, California. WESTEC Services, Inc., San Diego.

Carrico, Richard L, and Roxana Phillips
1981 Archaeological Salvage at W-132A, Carlsbad, California. WESTEC Services, Inc., San Diego.

Carrico, Richard L., and Clifford V.F. Taylor
1980 Phase I Test Excavations of Portions of SDi-5443 Situated on Hallmark Circuits, Inc., Property. WESTEC Services, Inc., San Diego.

1983 Excavation of a Portion of Ystagua: A Coastal Valley Ipai Settlement. WESTEC Services, Inc., San Diego.

Cheever, Dayle M.
1989 Cultural Resource Significance Testing at SDi-6753, SDi-6754, SDi-6819 and SDi-2046: Four Prehistoric Sites within the Aviara Development, Carlsbad, California. RECON, San Diego.

Connors, Deborah T., and Charles S. Bull
1980 Eternal Hills: Preliminary Site Testing at SDM-W-2115. RECON, San Diego.

Cook, Roger A.
1978 Archaeological Test Excavations in Moosa Canyon, San Diego County, California. Caltrans, Sacramento.

Cook, Roger A., and Christopher W. White
1977 Final Report: Archaeological Test Excavations at 4-ORA-22. Caltrans District 11, San Diego.

Corum, Joyce M.
1991 Phase II Archaeological Test Excavation at Site CA-SDi-5445, City of Oceanside, California. Caltrans District 11, San Diego.

Corum, Joyce M., and Chris White
1982 Final Report for an Archaeological Test Excavation at Site CA-SDi-9473, Carlsbad, California. Caltrans District 11, San Diego.

Cottrell, Marie, Constance Cameron, Vade Drummy Chapel, Theodore Cooley, and Adella Schroth
1985 Archaeological Investigations Conducted at the Newland House Site (CA-Ora-183), Huntington Beach, California. Pacific Coast Archaeological Society Quarterly 21(1):1-74.

Davis, Emma Lou
1968 An Archaeological Reconnaissance in the Central Desert of Baja California. Archaeological Survey Annual Report 10:176-208. University of California, Los Angeles.

Demcak, Carol R.
1988 Archaeological Salvage Operations at CA-Ora-129, Laguna Niguel, Orange County, California. Pacific Coast Archaeological Society Quarterly 24(4):1-33.

Eberhart, Hal
1989 Report for Field Work at Bolsa Chica. Pacific Coast Archaeological Society Quarterly 25(3):53-72.

Eckhardt, William T.
1980 An Archaeological Investigation of SDi-5081. Archaeological Systems Management, San Diego.

Eidsness, Janet, Douglas Flower, Darcy Ike, and Linda Roth
n.d. Archaeological Investigation of the Sorrento Valley Road Pipeline Project, Limited Linear Test, City of San Diego, California: SDM-W-654. Flower, Ike and Roth, San Diego.

Flower, Douglas M., Darcy Ike, and Linda Roth
1977 Archaeological Investigations at W-137. Flower, Ike, and Roth, San Diego.

Flower, Douglas M., Darcy Ike, Linda Roth, and Susan Sapone Varner
1979 Archaeological Investigation of the Miracosta Estates Project, Oceanside, California. Flower, Ike and Roth, San Diego.

Franklin, Randy L., and Richard L. Carrico
1979 Cultural Resource Test Sampling Program for a Proposed Flood Control Project in the Lower San Luis Rey River Drainage, Oceanside, California WESTEC Services, Inc., San Diego.

Fulmer, Scott
1984 Request for Determination of Eligibility for Inclusion in the National Register of Historic Places, Archaeological Site CA-SDi-5589 (Bonsall Site). Caltrans District 11, San Diego.

Gallegos, Dennis R.
1985 The La Costa Site SDi-4405 (W-945) 7000 Years Before Present, Carlsbad, California. WESTEC Services, Inc., San Diego.

1986 Early and Late Period Occupation at Rogers Ridge (SDi-4845, W-182), Carlsbad, California. WESTEC Services, Inc., San Diego.

1991 Antiquity and Adaptation at Agua Hedionda, Carlsbad, California. In Hunter-Gatherers of Early Holocene Coastal California, edited by Jon M. Erlandson and Roger H. Colton, pp. 19-41. Perspectives in California Archaeology No. 1. Institute of Archaeology, University of California, Los Angeles.

Gallegos, Dennis R., and Richard L. Carrico
1984 Excavation of Diegueño/Ipai Subsistence Camps above Encinitas Creek: A Data Recovery Program for Fieldstone Northview, Units 5-9, Encinitas, California. WESTEC Services, Inc., San Diego.

Gallegos, Dennis R., and Carolyn Kyle
1988 Five Thousand Years of Maritime Subsistence at Ballast Point Prehistoric Site SDi-48 (W-164), San Diego, California. WESTEC Services, Inc., San Diego.

Gallegos, Dennis R., Carolyn Kyle, and Richard L. Carrico
1988 CEQA Test and Evaluation of Prehistoric Site SDi-197, Sorrento Valley, San Diego, California. WESTEC Services, Inc., San Diego.

1989 Village of Ystagua (Rimbach SDi-4513) Testing, Significance, and Management. ERC Environmental and Energy Services Co., San Diego.

Garrison, Tom Sherman
1968 Tidal Migration in the Bean Clam Donax gouldii (Dall) (Bivalvia, Donacidae). Unpublished Master's thesis, Department of Biology, San Diego State University.

Gilbert, Carlys, and Gary Reinoehl
1987 Archaeological Investigations for Parking Lot Improvements at Torrey Pines State Beach and Reserve. California Department of Parks and Recreation, Sacramento.

Godfrey, Michael C.S.
1988 Oxygen Isotope Analysis: A Means for Determining the Seasonal Gathering of the Pipi (Donax deltoides) by Aborigines in Prehistoric Australia. Archaeology in Oceania 23:17-21.

Hatley, M. Jay
1979 Cultural Resources Impact Mitigation Report for Circle R Ranch. RECON, San Diego.

Hector, Susan M.
1981 Archaeological Investigation of South Pointe Farms. RECON, San Diego.

1983a Archaeological Excavation of SDi-5601 (SDM-W-1293), Carlsbad, California. RECON, San Diego.

1983b Excavation of SDM-W-19 in the PDU-2A Project Area. RECON, San Diego.

1984 Late Prehistoric Hunter-Gatherer Activities in Southern San Diego County, California. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

1985a Excavation of Six Sites in La Costa near Batiquitos Lagoon, San Diego County, California. RECON, San Diego.

1985b Test Excavations at SDi-1246, Oceanside, California. RECON, San Diego.

1985c Excavations at SDi-4609, a Portion of the Village of Ystagua, Sorrento Valley, California. RECON, San Diego.

1987 Archaeological Investigations of the Calle Cristobal Assessment District and Genstar Assessment District Parcel 16, City of San Diego. RECON, San Diego.

Hector, Susan M., and Sue A. Wade
1986 Excavation of a Portion of SDi-4513, the Rimbach Site, City of San Diego, California. RECON, San Diego.

Heuett, Mary Lou
1979 Preliminary Archaeological Investigations at the Village of La Rinconada de Jamo, SDMM W-150. Archaeological Consulting and Technology, San Diego.

Kaldenberg, Russell L., and M. Jay Hatley
1976 The Archaeology of Green Valley Knolls: A La Jolla Complex Shellfish Processing Site. RECON, San Diego.

Larson, Lewis H.
1980 Aboriginal Subsistence Technology on the Southeastern Coastal Plain during the Late Prehistoric Period. University Presses of Florida, Gainesville.

Leach, Larry L.
1975 Archaeological Investigations at the Handyman Site (Cal E:8:15) and the Edgemere Site (Cal E:8:17). Department of Anthropology, San Diego State University.

McLean, James H.
1978 Marine Shells of Southern California. Natural History Museum of Los Angeles County Science Series No. 24. Los Angeles.

Meehan, Betty
1982 Shell Bed to Shell Midden. Australian Institute of Aboriginal Studies, Canberra.

Miller, James J.
1980 Coquina Middens on the Florida East Coast. Florida Anthropologist 33:2-16.

Morris, Percy A.
1966 A Field Guide to Pacific Coast Shells, Including Shells of Hawaii and the Gulf of California. 2nd ed. Houghton Mifflin Company, Boston.

Pigniolo, Andrew, Theodore G. Cooley, Joyce M. Clevenger, and Lynne E. Christenson
1991 The Archaeology of a La Jolla Complex Coastal Camp: Data Recovery Program at CA-SDi-10,945, Point Loma Naval Facilities, San Diego, California. ERC Environmental and Energy Services Co., San Diego.

Pigniolo, Andrew, and Dennis Gallegos
1990 Investigation of Early and Late Period Occupation at SDi-7197 Loci A-1 and E and SDi-11626, Salt Creek I Project, Chula Vista, California. ERC Environmental and Energy Services Co., San Diego.

Quillen, Dennis K., Richard L. Carrico, and Dennis Gallegos
1984 Archaeological Investigations at SDi-5130, Mar Lado Project, Oceanside, California. WESTEC Services, Inc., San Diego.

Quintero, Leslie
1987 Room and Board at Deer Springs: Faunal Analysis as an Aid to Settlement Studies. Unpublished Master's thesis, Department of Anthropology, San Diego State University.

Rehder, Harald A.
1981 The Audubon Society Field Guide to North American Seashells. Alfred A. Knopf, New York.

Ritter, Eric W.
1979 An Archaeological Study of South-Central Baja California, Mexico. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Davis.

Shackleton, J.C.
1988 Reconstructing Past Shorelines as an Approach to Determining Factors Affecting Shellfish Collection in the Prehistoric Past. In The Archaeology of Prehistoric Coastlines, edited by Geoff Bailey and John Parkington, pp. 11-21. Cambridge University Press, Cambridge, MA.

Shackleton, J.C., and Tj.H. van Andel
1986 Prehistoric Shore Environments, Shellfish Availability, and Shellfish Gathering at Franchthi, Greece. Geoarchaeology: An International Journal 1:127-143.

Smith, Brian F.
1982 An Archaeological Reconnaissance of the Solana Point Project and a Test Evaluation of Site SDM-W-51A. Brian F. Smith & Associates, San Diego.

1986a A Report of an Archaeological Sampling Program at Site W-36 (SDi-10,238), La Vida del Mar Project, Solana Beach, California. Brian F. Smith & Associates, San Diego.

1986b An Archaeological Survey of the 11-Acre Shelley/Manchester Property and the Evaluation of Site SDi-10,220. Brian F. Smith & Associates, San Diego.

1989 Results of an Archaeological Data Recovery Program at Sites CA-SDi-4618(A), SDi-4619, and SDi-10915. Brian F. Smith & Associates, San Diego.

1990 A Report of the Archaeological Mitigation Program Conducted at Site SDi-10,955, Brown Lot Split Project, Alpine, California. Brian F. Smith & Associates, San Diego.

Smith, Brian F., and James R. Moriarty, III
1985 The Archaeological Excavations at Site W-20, Sierra del Mar, a Site Occupied by the La Jolla Complex from 7,140 B.P. (5,190 B.C.) to 2,355 B.P. (400 B.C.) on the Shores of Los Penasquitos Lagoon near Del Mar, California. Brian F. Smith & Associates, San Diego.

Stuiver, Minze, and Gordon W. Pearson
1986 High-Precision Calibration of the Radiocarbon Time Scale, AD 1950-500 BC. Radiocarbon 28:805-838.

Tartaglia, Louis James
1976 Prehistoric Maritime Adaptations in Southern California. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Taylor, R.E., Paul J. Ennis, Louis A. Payen, Christine A. Prior, and Peter J. Slota, Jr.
1986 Encino Village (CA-LAn-43) Site Radiocarbon Determinations: Geophysical/Geochemical Considerations. Pacific Coast Archaeological Society Quarterly 23(3):35-48.

Téllez Duarte, Agustín
1987 Los Concheros de Baja California y sus Perspectivas de Investigación. Estudios Fronterizos 5(14):111-116.

Wade, Sue A.
1986 Archaeological Testing of SDM-W-413, SDM-W-2131, and SDM-W-2132, Oak Riparian Park, City of Oceanside, California. RECON, San Diego.

1987 Archaeological Excavations at SDi-4926/SDM-W-2131, Oak Riparian Park, City of Oceanside, California. RECON, San Diego.

Whitney, Eleanor Noss, and Eva May Nunnelley Hamilton
1987 Understanding Nutrition. West Publishing, St. Paul.

Wlodarski, Robert J.
1985 A Preliminary Report on the Excavation of Ven-629, a Simi Valley Rockshelter. Pacific Coast Archaeological Society Quarterly 21(2):15-31.