THE WISE USE FRONT
"Countering the human fallacy
of loving trust resources to death"

5302 Neptune, Newport Beach, California 92663 (949) 650-9426

December 2, 2002

BY FIRST CLASS U.S. MAIL
Tina Robinson
California Department of Parks and Recreation
Southern Service Center
8885 Rio San Diego, Suite 270
San Diego, CA 92108

Re: Draft Environmental Impact Report for the El Morro Conversion to Campground and Day Use (SCH # 2001111088)

I am a member of the ***Wise Use Front***, an environmental group dedicated to promoting and enforcing the wise and sustainable use of California's trust property and resources. Although a relatively new resident of Orange County (I've lived here for the past fifteen years) I have experienced the dramatic and extensive impact to the environment caused by the unsustainable use of the County's resources. The culprit is not just urban sprawl, but the land use decisions made by our representative governing bodies that accommodate such sprawl.

On June 20, 2002, I commented on the DEIR for the El Morro Conversion to Campground and Day Use (SCH # 2001111088). Many of my unanswered concerns resonate here as the Department of Parks & Recreation ("State Parks") is amazingly preparing yet another environmental document for its ongoing, fractured reuse effort for Crystal Cove State Park.

126 Most troubling is State Park's ongoing series of chopped up projects affecting the Crystal Cove State Park that appear to be little more than a haphazard planning effort. The several Notices of Preparation ("NOPs") issued over the past year for Crystal Cove State Park signify a segmented planning project, or "piecemealing" under CEQA. The ***Wise Use Front's*** review of the Resources Agency's CEQA database and other records indicates that the Department has issued three NOPs in little more than a year for projects in the Crystal Cove State Park. In doing so, the Department

#127 Please see response # 70

#128 Please see response # 24. State park cultural resource staff are qualified to evaluate the potential effects of adaptive use and will continue to monitor the Historic District throughout the implementation of the PPUP.

126 is relying on a twenty year old General Plan that is just now being amended in conjunction with this final reuse Project.

During the "interim" EIR for reuse of the Crystal Cove Historic District the Department obtained a Coastal Development Permit (CDP No. 5-01-269) that serves the opposite role of protecting historical resources and instead presumably allows the Department to destroy the historic cottages and waives the shoreline protection provision of the Coastal Act (Public Resources Code Section 30235) that would otherwise be available to Crystal Cove State Park. (See, Coastal Commission Staff Report for CDP No. 5-01-269.) Please address how it is that a State Park "policy" that may result in a significant impact on historical resources doesn't need to be addressed in the DEIR? As a feasible mitigation measure, the overall transient cottage use should be reduced and shoreline protection devices kept as a viable option.

127 The ridiculous alternative set forth in Section 2.3.5 (p. 23) doesn't get around the fact that State Parks will likely avail itself of an exemption that violates State Law as an excuse to not protect historic resources. Section 2.3.5 states that: "This alternative would inhibit natural processes and therefore is not preferred as it is contrary to Department policy for coastal protection." The irony of this statement is that everything about the reuse project is far more contrary to coastal protection than a shoreline protection devise.

The nature of the project is to dramatically increase transient occupancy and use of Crystal Cove State Park notwithstanding the offshore ASBS, tidepools, coastal sage scrub and other significant habitat of the Park. Shoreline armoring is a drop in the bucket that appears to be a very feasible alternative to the extent that State Parks is holding Section 2.3.5 out as an alternative. Having any interpretive, or transient use in a cottage along Crystal Cove State Beach inhibits the natural process of a beach so stop using shoreline protection devices as a cop out to protecting the existing physical setting of Crystal Cove.

Now that State Parks is living comfortably in the beach cottages with record low visitation to Crystal Cove State Park, it is time for State Parks to assume the obligation of protecting the Historic District resources absolutely – not just to the extent that it is convenient.

128 Sections 2.3.3 through 2.3.16 appear to be minor variations of the reuse project that don't amount to a substantive alternative as the variations don't really serve as a contrast to the main goals and objectives of the reuse project. How about a real alternative like a reuse option that uses less than 15 cottages for any purpose and further ensures that the public will not destroy the coastal resource of Crystal Cove State Park by overuse (taking into consideration that State Parks is simultaneously proposing multiple new and improved access points in a segmented manner – including a new light signal and crosswalk at El Morro)?

#129 Restoration of the cottages would be a beneficial effect over the existing condition yet the same restoration involves risk or potential adverse effects due to the sensitivity of the historic resources. Please see Sections 4.2.1, 7.1.1 and 7.1.2 of the DEIR.

#130 State Parks respectfully disagrees. Please see Section 5.4 of the EIR.

Tina Robinson, CDPR
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How is it that State Parks is committed to using close to 30 cottages for various transient
purposes? Is this a financial conclusion or is State Parks bound by an existing contract, agreement,
or memorandum of understanding, to use a specific number of the cottages for transient uses? As
a feasible alternative (and mitigation measure to cumulative impacts to affordable housing stock)
128 non-transient use of the cottages should be considered. A more permanent use of the cottages by
qualified individuals (as opposed to government bureaucrats in a time of significant fiscal deficit)
that will minimize the overall intensity of the reuse of Crystal Cove must be assessed by the DEIR.

Meanwhile, the impact to historical resources is described in the DEIR as both a potential significant impact and as a beneficial impact. How can an impact be potentially significant and beneficial?

Section 4.5.2 of the DEIR (p. 73) concludes that State Parks access to the historic structures
and features in a beneficial effect of the Project. My understanding is that at the time of the NOP
for the DEIR, State Parks had full access to the historic structures. Moreover, only a loss of historic
features (i.e., cultural landscape) has occurred since State Parks has gained "access" to the Historic
District. In accordance with CEQA Guidelines 15125, the Project baseline is a physical setting
where State Parks fully controlled the Historic District (at the extensive exclusion to the general
129 public) . Therefore the beneficial effect of Section 4.5.2 is both unsubstantiated and an incorrect
application of the baseline set forth in the DEIR.

How exactly will the PPUP allow State Parks to rehabilitate, restore and maintain all the cottages in the Historic District in perpetuity? It does not appear that any substantial evidence indicates that the Project will preserve the Historic District. How exactly is the restoration of all 46 cottages (comprising the historically significant resource at issue) going to take place under the DEIR or PPUP? Cumulative economic impacts associated with direct, physical environmental impacts to Crystal Cove need to be assessed in the EIR.

The DEIR and PPUP do not adequately address how the proposed project will affect the
"carrying capacity" of Crystal Cove State Park. The cumulative impacts of State Park's recent
piecemeal planning efforts and the direct impacts of the conversion of the El Morro Mobile Home
Park, on the carrying capacity of the Crystal Cove State Park, are not addressed. Accordingly,
consistency with the General Plan (and its established carrying capacity), as amended, cannot be
determined. (See Pub. Resources Code Section 5019.5.). How can the growth impact associated
130 with the reuse project be assessed without a clear and understandable establishment of the existing
use of the Historic District at the time the NOP was issued? This lack of analysis is based on a
project description that remains vague and unclear (See page 1 and 2 of the NOP commentary from
the Environmental Quality Affairs Citizens Advisory Committee, City of Newport Beach). Trip
traffic and parking will increase with enhanced use (limited/nonuse of the Historic District to
extensive interpretive and transient uses requiring daily trips and multiple daily commuter trips).
Like the El Morro reuse project, this DEIR fails to account for the total cumulative acreage of State

#131 State Parks respectfully disagrees. The public can now access the Historic District. There will be no increase in the capacity of the Los Trancos parking lot. Additionally, these issues were addressed and approved in the Crystal Cove General Plan. The Historic District is a developed site that will be reused to benefit the people of California. Although more visitors will be come to the site than presently occurs, much of this use will occur during non-peak hours. Cumulative impacts to the area from State Park's projects are discussed in Section 5.4 of the EIR.

#132 Please see response # 101.

#133 The Park Headquarters entrance road may have a minor redesign at some point in the future. However, there is no funding or design proposed at this time.

#134 State Parks agrees that overuse of the tidal and marine resources could have potential adverse impacts. That is why it was addressed in Sections 4.2.5, 7.1.3 and 7.1.4 of the DEIR.

#135 Please see response # 68.

Park, the use (abuse) of which is being accommodated by this Project.

131 The cumulative impacts analysis of Section 5.4 (pp. 77-78) is entirely deficient. The only cumulative impact addressed, as between the segmented reuse projects of Crystal Cove State Park, is the biological impacts to coastal sage scrub and California gnatcatchers. What about traffic, parking, land use, housing, growth, water quality, air quality, public safety, and coastal resource impacts associated with the cumulative nature of the two contemporary reuse projects slated for El Morro and the Historic District? The basic premise for the reuse projects are the same – increased access and use of Crystal Cove State Park. In fact, for the Historic District, the reuse project goes from no use or limited State Park use (one of the perks of State employment that explains the significant delays over the past several years) to a full blown interpretive and transient use. This intensified use must be assessed for its ongoing impacts to the many resources of Crystal Cove. These ongoing impacts are far more significant than the cumulative impacts to coastal sage scrub associated with the bifurcated reuse projects of Crystal Cove.

132 Is State Parks claiming that past restoration of CSS is sufficient mitigation for current impacts to CSS (p. 78)? If so, the reader must be informed of the basis for this mitigation banking concept. What document authorizes and enforces this form of mitigation? Otherwise, the description of the 50 acres of CSS that have been restored in the past appears to have no relevancy to the cumulative impacts analysis – i.e., the analysis of impacts associated with past, present, and future projects.

133 The "future Department project" that may include reconstruction of the park headquarters entrance road is a foreseeable extension of the reuse project of the Historic District (p. 78.) The impacts of that road extension must be assessed presently. Otherwise, there is not purpose in mentioning the road extension. The absence of a road design does not justify the omission of the road extension from the "whole of the project" that must be currently assessed.

134 The illogical conclusion of the cumulative impacts analysis states that: "The project, when considered with other projects in the area, will not have significant adverse cumulative effects but will have significant beneficial effects to public recreational and educational access." The public recreational and educational access facet of this Project is what will cause the most significant impacts to Crystal Cove State Park. The added human interaction, when unmitigated, will have a devastating impact on the historic, marine, and biological resources of Crystal Cove State Park.

135 CEQA mandates that the government – not the public – conduct an environmental assessment of project impacts. It is time for State Parks to do its job and to share with the public how it formulated the conclusions set forth in the DEIR. CEQA is intended to inform not only the public, but the decision-making government as well. Historical resource impacts are a major concern with this project. The cottages are the historical equivalent of an endangered species population. The loss of one cottage is significant (unless of course the DEIR is saying otherwise?). And yet it

#136 The comment period for the DEIR closed on December 2, 2002. Your letter was received on December 3, 2002, after the close of comments. The comment period was not extended but public comment will be accepted at the Park and Recreation Commission hearing before final approval of the PPUP General Plan Amendment.

135 appears that the National Trust for Historic Preservation and the California Preservation Foundation were left out of the notice loop on this DEIR.

136 The ***Wise Use Front*** will need to confer with the historic preservation stewards before formulating additional commentary on the impacts of the reuse project that are not addressed in the DEIR. The ***Wise Use Front*** intends to do this over the next week and, in any event, will be sure to submit additional comments before the Parks and Recreation Commission certifies the DEIR as final and approves the reuse project and general plan amendment.[1]

Stewardly yours,

THE WISE USE FRONT

For: Wayne Delisser,
Member, Orange County Chapter

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[1]As a procedural clarification, The Wise Use Front is aware that State Parks has managed to certify EIRs at the staff level in the past (rather than certify them at the legislative level of the Parks and Recreation Commission.) Is the Acting Director or a staff level designee planning on certifying this DEIR?

This letter was received after the close of comments on December 2, 2002. However, in the interest of full public disclosure, this letter is printed in its entirety and responses have been prepared.

#137 State Parks hopes to serve you and other members of the public with improved access and enjoyment of the Historic District. Some cottages and all programs will be available for those with physical disabilities.

Edmund Charles Tarbell
Portrait of a Lady
Private Collection

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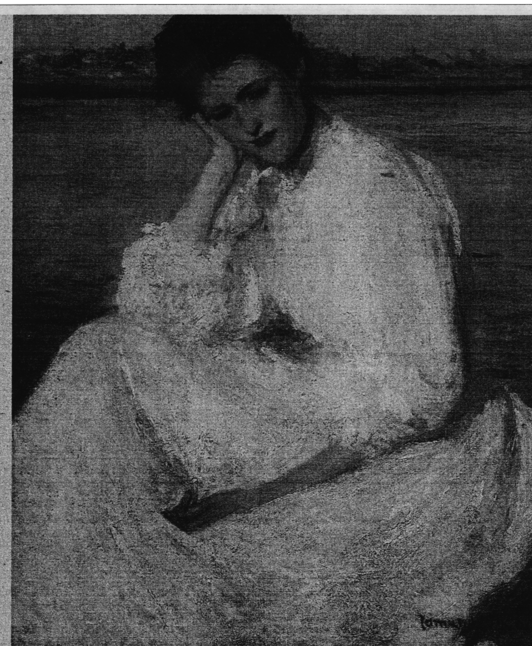


Dear Tina,

My name is Alice Bruns. We spoke some ime ago regarding my usband and myself renting ne of the beach properties 1 the comming months. In ur conversation I had mentioned y disabilities and how I n bulate or get around with walker/cane. You had mentioned property with a ramp or something , that extent. Nevertheless ny property would be fine for a few days so that my husband and I could enjoy a few days in a cottage on the beach.

Please accept my apologies for waiting so long to get this out to you.

Thank you so much for your attention.

Sincerely, ☺

Alice Bruns

The following pages are attachments to Dennis L. Kelley's letter.

APPENDICES

A Dennis L. Kelley Attachment

Document #1

January 2, 1996

Mr. Kenneth Mitchell
California State Department of Parts and Recreation
c/o Crystal Cove State Park
8471 Pacific Coast Hwy
Laguna Beach, CA. 92652

Dear Mr. Mitchell,

I am writing you out of my concern for Pacific Coast Bottlenose Dolphin (Tursiops truncatus) that utilize the nearshore waters off Crystal Cove in a very special way. In fact, the way they utilize this specific coastal area is for the most important thing that these dolphins do - namely reproduction. Crystal Cove is one of only two sites along the Orange County coast that dolphins frequent when they are preparing to give birth to offspring. The other spot is far to the south at San Onofre State Park.

Over the past 19 years I have conducted research on the coastal dolphin population of Orange County (see enclosed report). During that time I have made numerous coastal boat surveys of the Orange County coast in search of pods (groups) of dolphin. Although my students and I have observed pods of bottlenose dolphins at almost every location along this busy coast, I have observed that several places along the coast are very special to the dolphins. What I mean by that is dolphins utilize a few specific sites in ways that are unusual compared to the rest of the coast. For instance, north Newport Beach, Huntington State and City Beach, and Bolsa Chica State Beach are sites where the dolphins slow down and begin exhibiting feeding behavior. Another similar site is San Clemente State Beach and San Onofre State Beach.

The most interesting and important behavior of the dolphins, however, is reproduction. During birthing dolphin pods usually stop completely and seven to eight individuals (we suspect they are females) will surround the female giving birth. They will drift slowly along a coast, just offshore, sometimes for several hours awaiting the birth of the calf. Afterward, all of the dolphin present will touch and accompany the calf for short periods of time as the mother recovers from the birth. In nineteen years of studying and observing these dolphins I have observed this unique behavior eight times. Six of those eight times, according to my records, were right off Crystal Cove. The other two times were off south San Onofre State Beach.

It is my belief that Crystal Cove represents a "safe" haven for these dolphins when they are performing this most important of

Document #1

behaviors. The dolphins are not molested at Crystal Cove or at San Onofre State Beach due to two different facts, in my opinion. One the human density at these two sites tends to be very low. Secondly, I believe, in the case of Crystal Cove, the long-term residents there are very aware of the dolphins and are careful not to bother them (swim out or paddle out on a surfboard) while this behavior is going on. In addition to that the residents there have been very good about calling me whenever there has been a stranding of dolphins at the beach at that location or when the animals are exhibiting this birthing process.

The reason I am concerned is due to the plans your agency has to move these long-term residents out of Crystal Cove. These residents have acted, over the years, as unofficial "wardens" of this tiny beach area and of the local dolphin population. They report sittings of dolphins and strandings of dead dolphins to me. They report jet skiers harassing dolphins and warn people who visit not to molest the dolphins when they are nearby. In recent years there has been increasing incidents of people (probably tourists but some residents as well) swimming out to try to touch or grab dolphins off north Newport Beach, Huntington Beach, and Bolsa Chica State Beach. This doesn't happen at Crystal Cove since there are so many people watching and ready to report. Informative signs are simply not enough to deter this behavior by irresponsible people. I urge you and your agency to reconsider these plans in lieu of the potential damage that making this area of the coast more accessible to the general public could have on the local marine mammals.

Sincerely,

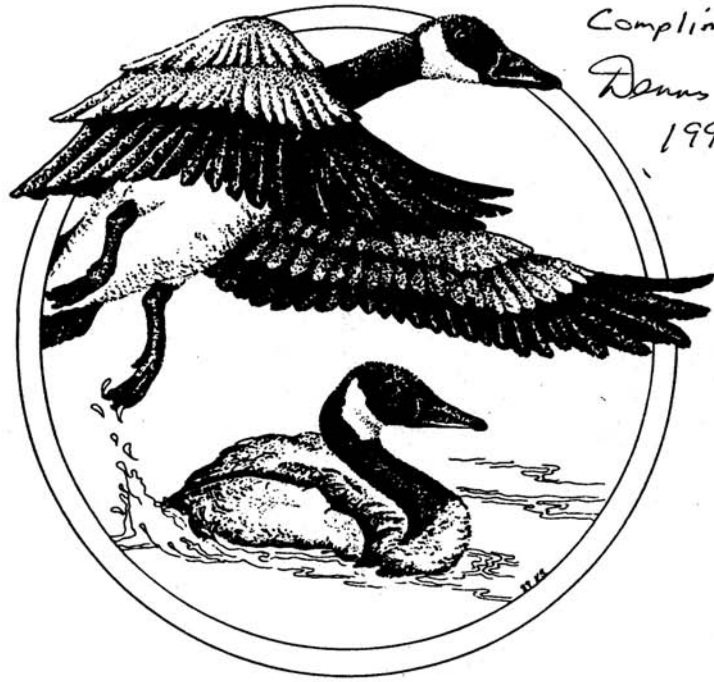
Dennis Kelly

Dennis L. Kelly, Professor of Marine Biology
Marine Science Department
Orange Coast College
Director - The Coastal Dolphin Survey Project

Document #2

MEMOIRS OF THE NATURAL HISTORY FOUNDATION OF ORANGE COUNTY; VOLUME 3

With My Compliments.
Dennis L. Kelly
1990



ENDANGERED WILDLIFE AND HABITATS IN SOUTHERN CALIFORNIA

Edited by Peter J. Bryant and Janet Remington

Published by the Natural History Foundation of Orange County

Document #2

THE POPULATION BIOLOGY OF THE BOTTLENOSE DOLPHIN ALONG THE COAST OF ORANGE COUNTY, SOUTHERN CALIFORNIA

by Dennis L. Kelly

Professor of Marine Biology
Orange Coast College
Costa Mesa, California

ABSTRACT

A two-part study was conducted between 1982 and 1986 on the population biology of the bottlenose dolphin (*Tursiops truncatus*) along the coast of Orange County, Southern California. (1) Thirty five photographic surveys covered a coastal strip from Anaheim Bay in the north to San Onofre State Beach in the south. From 581 sightings of individuals, 89 dolphins were photographically identified. We estimate those 89 to be approximately 65% of the total population, putting the estimated total at 137. This is a far larger population of bottlenose dolphins using the Orange County coast than has been previously documented or assumed. Of this population, 6.9% were calves. There was no indication of a home range within the dolphin community nor of fidelity of any individual to any specific part of the study area. The greatest numbers of sightings, however, were clustered at the north and far south ends of the study area, and we believe they represent significant habitat to the coastal dolphins. (2) Six dead bottlenose dolphins stranded on local beaches were necropsied and found to have suffered multiple pathologies, and DDT and PCB levels in all tissues analyzed (five dolphins) were very high compared to those in previous studies of offshore dolphin species.

INTRODUCTION

The literature contains numerous descriptions of the biology and ecology of the Pacific bottlenose dolphin (*Tursiops truncatus*) from the coast of Southern California and northern Baja California, Mexico (Scammon, 1874; Norris and Prescott, 1961; Dohl et al., 1978; Orr, 1963 and 1976; O'Shea et al., 1980; Walker, 1981; Kelly, 1983; Hansen, 1990; Defran, 1985; and Shane et al., 1986).

There is documentation of extended travel by coastal bottlenose dolphins. Wells et al. (1990) reported that five individuals from Hansen's 1990 sample along the San Diego coast were sighted 750 km to the north in the coastal waters near Monterey. Dolphins seen in Orange County have been identified as far south as Ensenada, Baja California Norte, Mexico (Defran et al., in press).

From boat surveys and photo-identification, Kelly (1983) identified 60 dolphins off the Orange County coast. Along the northern coast of San Diego County, Hansen (1983) estimated a population of 175 to 250 dolphins, based on a count of 118 identified individuals. Defran et al. (1985) suggested that coastal movement rather than local residency is characteristic of this open coastline population.

Information on the long-term effect that contaminants have had and will have on the coastal bottlenose dolphin population is important to any attempt to understand the population biology and ecology of this species. Shafer et al. wrote in 1985:

"Since these animals are long-lived and many feed high in the food web, they are most likely to show chronic effects from the accumulation of organic contaminants... and are therefore the most likely candidates for study in our effort to understand the long-term effects of exposure to contaminants in the natural environment."

The current research was conducted in collaboration with Dr. R.H. Defran and personnel of the Cetacean Behavior Laboratory at San Diego State University. It involved extensive observations north of Hansen's study area and made use of a new technology developed by Dr. Defran for identifying animals. The goals of this research were to determine

1) population parameters: group size, composition (calf proportion), and coastal density
2) uses of the habitat, and
3) the organochlorine content of organs and tissues collected from dead, beach-stranded individuals.

METHODS

Study Area

The term "study area" refers to the coast of Orange County from Anaheim Bay, in the north (33° 44' 00" north), to San Onofre State Beach, in the south (32° 20' 00" north), and offshore to a distance of 2 nautical miles from the beach (Figure 1).

Survey Procedure

All surveys were done from shipboard, usually one of two 23-foot Seacraft (inboards).

1) Complete Surveys. For complete surveys we traveled, first, 50 to 100 m beyond the surf-line at Newport Harbor, and then north until the team spotted a group of dolphins. At 100 to 200 m from the pod, the boat was stopped for 5 to 10 minutes. The team recorded the time and location, scanned the coast above and below the pod to determine if other dolphins were near, and began the count. At the same time the principal investigator noted behavior within the pod -- feeding, playing, milling, traveling, mating -- and made a judgment as to whether closer contact would harass the dolphins severely, moderately, or not at all.

The boat was maneuvered to pass on the ocean side of the dolphins at slow, continual speed and at a distance of 10 to 20 m. During this initial pass, part of the shipboard team attempted to take close-up photographs of each dolphin's dorsal fin, while other team members counted adults and calves. (A calf was defined as an animal estimated to be one half the length or less of an adult, that swam next to an adult so as to be touching it at most times, and that was always accompanied by an adult during the course of the observation.)

Contact with the animals was maintained until photographic and other census work was completed. Then we left the pod and resumed the search, continuing up the coast as far north as Anaheim Bay, then south to San Onofre.

2) Partial Surveys. Partial surveys covered either the northern portion of the study area (Newport Bay to Anaheim Bay) or the southern portion (Newport to south San Onofre State Beach).

Animal Identification and Census by Dorsal Fin Analysis

The majority of our photographs were taken with a Nikkromat 35 mm SLR camera with a Vivitar 80-280 mm zoom lens of F2.5. We took most with a Kodachrome 64-slide film. Since Dr. Defran prefers to work directly with developed negatives, we switched to Tri-X black-and-white print film in the last year of the research.

All dolphin photographs (black-and-white negatives and color slides) were sent to Dr. Defran's laboratory, where, by analysis of the natural variations (notches) that develop with time in the dolphin dorsal fin, coded identifications could be established for all dolphins with two or more fin notches. According to Dr. Defran, this technique is simple and easily learned by laboratory personnel; it reliably identifies dolphins as resights or new additions to the catalog, in many cases even after new notches appear (Defran, 1988); and it permits laboratories to exchange data on dorsal fins inexpensively.

A slide of each dorsal fin photographed is projected and enlarged to fill a 10 x 17 cm frame drawn on white paper, and the contours of the fin are traced. As shown in Figure 2, the top point of

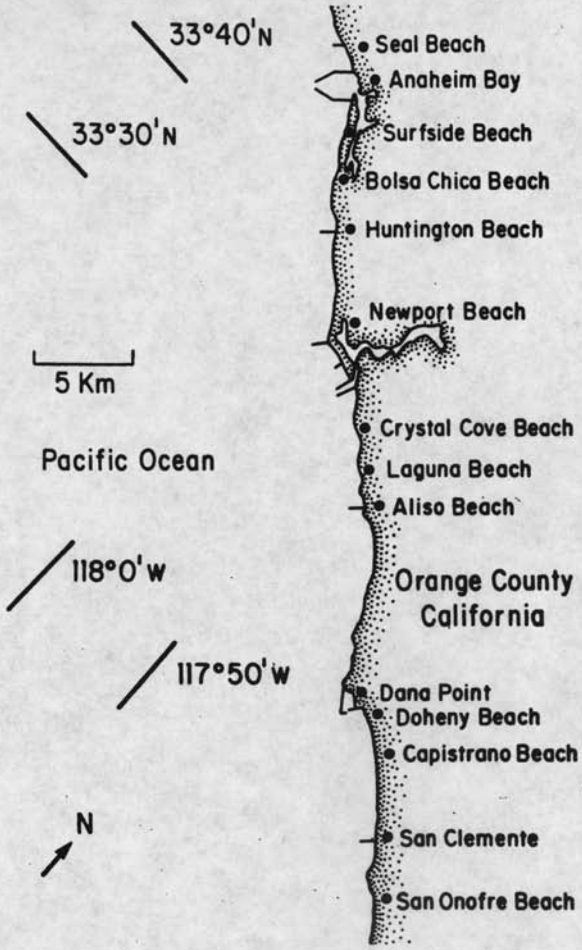


FIGURE 1. The study area.

the two largest notches are labeled A (top) and B (bottom). The identification code for each dolphin, then, is the ratio of the distance between A and B to the distance from B to the top of the fin. Because it is a relative measure, this dorsal ratio is unaffected by the size of the fin in photographs or enlargements, or even by severe cases of parallax.

Census Data

The cetacean behavior lab recorded and filed the fin identification for each dolphin and counted

1) the total number of dolphins photographed
2) the total number of resightings, and
3) the total number of dolphins new to the existing catalog.

Carcass Studies

With the aid of lifeguards and citizens, we established a network for locating dead, beach-stranded marine mammals and set up a necropsy laboratory at Orange Coast College. Carcasses were weighed, measured and necropsied. Also, blubber, liver, muscle, brain and kidney tissues were analyzed for DDT and PCB levels.

RESULTS

We planned and attempted 45 boat surveys (Table 1). Ten were cancelled due to bad weather or engine problems, and 35 were actually conducted. Of the 35, 19 were surveys of the entire area, 13 covered only the northern portions of the study area, and three covered the southern portion. We spotted no dolphins in eight of the 35 surveys. One was of the entire study area, and

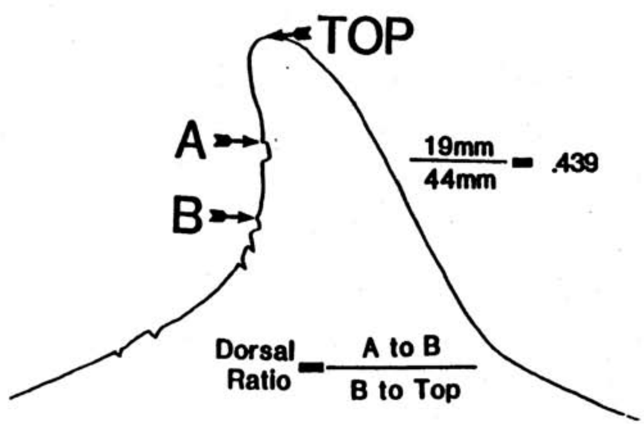


FIGURE 2. Measurement of the dorsal ratio.

TABLE 1. Boat Surveys, 1982 - 1985

Survey No.	Date	Location of Dolphins	No. Dolphins: Adults	Calves	Behaviors
1	12/21/82	Huntington City Beach-Bolsa Chica State Beach	20-25	2	milling, feeding, foraging
2	12/29/82	San Onofre State Beach	25-30	4	milling, feeding, foraging
3	5/12/83	Bolsa Chica State Beach	6-7	1	traveling
4*	7/18/83	Bolsa Chica State Beach	6		traveling
4*	7/18/83	Newport Beach	25-30		traveling
5	7/24/83	Huntington State Beach	20-25		traveling
6	7/29/83	Newport Beach	40-45		traveling
7	7/31/83	San Onofre State Beach	30-35	4	foraging, feeding
8	8/3/83	Bolsa Chica State Beach	25-30		milling, foraging, feeding
9	8/7/83	Bolsa Chica State Beach	25-30		milling, foraging, feeding
10	11/14/83	none seen	0		--
11	11/22/83	none seen	0		--
12	11/30/83	Huntington City Beach	20-25	4	milling, foraging, feeding
13	12/04/83	San Clemente State Beach	5		traveling
14	12/13/83	Newport Beach	25-30		foraging, feeding
15	3/12/84	Huntington State Beach	6	1	milling
16	4/09/84	none seen	0		--
17	4/18/84	Huntington State Beach	25-30	2	foraging, feeding
18	4/22/84	Huntington State Beach	35-40		play, foraging, feeding
19	5/14/84	none seen	0		--
20	6/26/84	Bolsa Chica State Beach	25-30	5	milling, play
21	7/03/84	none seen	0		--
22	7/17/84	Irvine Coast	8	1	traveling
23	9/29/84	Bolsa Chica State Beach	20-25	5	traveling
24	10/28/84	Huntington State Beach	5-6		feeding
25	11/11/84	none seen	0		--
26	11/18/84	San Onofre State Beach	8-10	2	traveling
27	11/19/84	Bolsa Chica State Beach	15-20	2	play, milling
28	12/02/84	San Onofre State Beach	15	3	play, milling
29	2/23/85	San Onofre State Beach	18-20	2	foraging, feeding
30	3/16/85	none seen	0		--
31	8/13/85	San Onofre State Beach	25-30		play, milling, feeding
32	9/08/85	Bolsa Chica State Beach	25-30	2	play, feeding
33	9/15/85	none seen	0		--
34	10/06/85	Newport-Point Loma Beaches	32-39		play, traveling
35	12/15/85	Doheney State Beach	7		traveling

*separate pods sighted the same day

seven were of either the northern or southern portions.

There were seven spring surveys (March, April May), 10 in summer (June, July, August), 11 in fall (September, October and November) and seven in winter (December, January, February).

Number of Pods and Distribution

We observed 28 separate pods between 1982 and 1985. Eighteen pod sightings occurred at the northern end of the study area: off Bolsa Chica State Beach, south Huntington State Beach, and north Newport State Beach. Seven took place at the far south end of the study area, off San Onofre State Beach. The three remaining sightings occurred between Newport and San Onofre State Beach. On only one survey trip did we sight more than one pod; on our fourth trip we spotted two.

Pod Sizes

Pod sizes ranged from six to 42 dolphins, with a median of 21. There were 22 or more animals in 14 of the groups. We saw only one significantly larger pod, of 42 dolphins. The most common size was between 20 and 30 animals. Pods of six to eight were so rare that we usually followed for some time to see if they regrouped with other dolphins.

Individuals Sighted and Identified

We sighted a total of 581 individual dolphins, and from all photos, 89 dolphins were identified.

Resightings

Animals photographed more than once were sighted an average of fewer than three times. Of the 89 identified animals, 59 (66%) were photographed once, 21 twice, and 5 three or more times. The record was of a dolphin photographed five times (Table 2).

Calves

The proportion of calves to the whole group, summarized by month and across years, was 6.9%. We generally observed and recorded two to four calves in each pod. On two occasions we observed what appeared to be dolphin births.

Beach-stranding recoveries, necropsies, and tissue analysis

Between 1983 and 1986, ten bottlenose dolphins were examined after stranding on Orange County beaches (Table 3). These included one adult female, six juvenile to adult males, one neonate female, one neonate of undetermined sex, and one dolphin whose sex and age could not be determined because of advanced decomposition.

We performed necropsies on six of the stranded dolphins and removed tissue for chemical analysis. Some bore injuries and all bore multiple pathologies that included stomach ulcers, parasitic infestations, enlarged lymph nodes, verminiferous pneumonia, infected organs, infected wounds, cysts, and tumors. One, a male juvenile, showed signs of having been entangled and subsequently drowned in a gill net: his epidermis bore net cuts, his tail had been sliced off at the peduncle, and his trachea contained frothy foam.

All tissue samples (including blubber, muscle, liver, kidney, and brain tissue) revealed high levels of the pesticide DDT (range 150 to 1,922 ppm; average for blubber 854 ppm) and of the industrial chemical PCB (range 3.1 to 265 ppm; average for blubber 105 ppm).

DISCUSSION

Distribution

Dolphin pods were observed throughout the study area, but never more than 1 km offshore. On most occasions, the dolphins of a pod were spread out over 500 to 1,000 m of coastline in several subgroups that frequently coalesced and then broke apart in a fluid and unpredictable manner. It was not uncommon for one subgroup to swim

TABLE 2. Dolphins resighted off the Orange County coast, and the intervals between Orange County sightings. Additional sightings of these dolphins off the San Diego coast are listed in parenthesis and italics.

ID	Date Sighted	Location	Interval
003	5/21/83	Bolsa Chica	
	11/14/83	Newport Beach	6 mo
	(4/10/85	*San Diego coast)*	
004	*(10/23/81*	*San Diego coast)*	
	8/7/85	Bolsa Chica	
	10/6/85	Newport Beach	2 mo
	12/15/85	Doheney Beach	2.3 mo
017	*(7/27/82*	*San Diego Coast)*	
	7/31/83	San Onofre	
	8/3/83	Bolsa Chica	3 days
	(3/17/84	*San Diego coast)*	
	(8/3/84	*San Diego coast)*	
	(5/1/85	*San Diego coast)*	
021	*(8/2/82*	*San Diego coast)*	
	7/18/83	Newport Beach	
	7/31/83	San Onofre	13 days
	8/3/83	Bolsa Chica	3 days
	(6/10/84	*San Diego coast)*	
	(7/13/84	*San Diego coast)*	
	(2/23/86	*San Diego coast)*	
	(4/9/86	*San Diego coast)*	
040	*(3/24/84*	*San Diego coast)*	
	4/22/84	Huntington Beach	
	12/2/84	San Onofre	7.3 mo
	(5/3/86	*San Diego coast)*	
	(6/7/86	*San Diego coast)*	
047	*(6/18/82*	*San Diego coast)*	
	12/29/82	San Onofre	
	7/18/83	Newport Beach	6.6 mo
048	*(11/4/82*	*San Diego coast)*	
	(8/24/84	*San Diego coast)*	
	12/2/84	San Onofre	
	2/23/85	San Onofre	2.7 mo
	(7/31/85	*San Diego coast)*	
	(11/6/85	*San Diego coast)*	
	(4/25/86	*San Diego coast)*	
055	*(7/20/82*	*San Diego coast)*	
	11/30/83	Huntington Beach	
	4/22/84	Huntington Beach	4.7 mo
	(6/23/85	*San Diego coast)*	
057	*(8/2/82*	*San Diego coast)*	
	8/3/83	Bolsa Chica	
	10/6/85	Newport Beach	2 yr 2 mo
	(4-25-86	*San Diego coast)*	
065	*(7/27/82*	*San Diego coast)*	
	7/29/83	Newport Beach	
	8/3/83	Bolsa Chica	5 days
	(11/16/85	*San Diego coast)*	
	(4/9/88	*San Diego coast)*	
079	*(10/23/81*	*San Diego coast)*	
	8/3/83	Bolsa Chica	
	(11/16/83	*San Diego coast)*	
	2/23/85	San Onofre	1.6 yr
	(6/23/85	*San Diego coast)*	
	(6/26/85	*San Diego coast)*	
090	*(3/24/84*	*San Diego coast)*	
	4/22/84	Huntington Beach	
	(2/8/85	*San Diego coast)*	
	10/6/85	Newport Beach	1.5 yr
	(12/19/85	*San Diego coast)*	
	(4/11/86	*San Diego coast)*	
095	*(8/30/82*	*San Diego coast)*	
	4/30/83	Huntington Beach	
	8/7/83	Bolsa Chica	3 mo
	4/18/84	San Onofre	7.4 mo
	(7/13/84	*San Diego coast)*	
	(6/23/85	*San Diego coast)*	

(continued)

TABLE 2 (continued).

ID	Date Sighted	Location	Interval
100	*(11/20/81*	*San Diego coast)*	
	12/13/83	Newport Beach	
	(3/17/84	*San Diego coast)*	
	(3/24/84	*San Diego coast)*	
	4/18/84	Huntington Beach	4 mo
	4/22/84	Huntington Beach	4 days
	10/28/84	Huntington Beach	6 mo
	12/2/84	San Onofre	1 mo
	(2/27/85	*San Diego coast)*	
	(7/24/85	*San Diego coast)*	
	(7/31/85	*San Diego coast)*	
106	*(11/4/82*	*San Diego coast)*	
	7/31/83	San Onofre	
	8/3/83	Bolsa Chica	3 days
	(3/16/84	*San Diego coast)*	
	(5/8/85	*San Diego coast)*	
	(11/6/85	*San Diego coast)*	
	(5/26/86	*San Diego coast)*	
108	*(1/4/83*	*San Diego coast)*	
	7/31/83	San Onofre	
	(6/18/84	*San Diego coast)*	
	12/15/85	Bolsa Chica	2 yr 5 mo
116	*(10/23/81*	*San Diego coast)*	
	12/13/83	Newport Beach	
	12/15/85	Doheney Beach	2 yr
121	*(9/28/81*	*San Diego coast)*	
	4/22/84	Huntington Beach	
	2/23/85	San Onofre	10 mo
127	8/3/83	Bolsa Chica	
	8/7/83	Bolsa Chica	4 days
187	11/30/83	Huntington Beach	
	(11/2/84	*San Diego coast)*	
	10/6/85	Newport Beach	1 yr 10 mo
209	*(3/9/84*	*San Diego coast)*	
	4/18/84	Huntington Beach	
	4/22/84	Huntington Beach	4 days
	(3/16/85	*San Diego coast)*	
216	*(2/15/85*	*San Diego coast)*	
	2/23/85	San Onofre	
	10/6/85	Newport Beach	7.5 mo
217	7/1/83	Newport Beach	
	8/3/83	Bolsa Chica	1 mo
	9/8/83	Bolsa Chica	1 mo
	(2/15/85	*San Diego coast)*	
282	7/31/83	San Onofre	
	8/7/83	Bolsa Chica	1 wk
285	8/3/83	Bolsa Chica	
	10/6/85	Newport Beach	2 yr 2 mo
287	8/7/83	Bolsa Chica	
	10/28/84	Huntington Beach	1 yr 2 mo
291	4/18/84	Huntington Beach	
	9/8/85	Bolsa Chica	1 yr 4 mo
299	10/6/85	Newport Beach	
	12/15/85	Doheney Beach	2.3 mo

far away from the majority of dolphins, disappear for 30 to 40 minutes, and subsequently rejoin the larger group.

Distribution of the dolphins in the study area did not appear random; the dolphins showed a definite bias for specific locations. Dolphin pods were found more frequently in the northern part of the study area than in any other place; 64% of the sightings were between north Newport Beach and Bolsa Chica State Beach. Most of the remaining sightings, 25% of the total, occurred at the southern extreme in an area, significantly, with similar topography: shallow, sandy-bottomed, low relief beach with few or no rocky headlands, offshore rocky reefs, or offshore submarine canyons.

TABLE 3. *Tursiops truncatus* Stranding Data 1983 - 86.

ID No., Sex, Length, Weight	Date, Location, Decomposition	Necropsy Results	Tissue Analysis (ppm)	DDT	PCB
DK8318 male 266 cm, wt. na	5/5/83 Surfside Beach decomp. slight	stomach ulcer, parasites, emaciated[1]	blubber: muscle[2]:	1,933 20	128 0.8
DK8323 sex undeterm. 89 cm, wt. na	8/11/83 Newport Beach decomp. slight	na		na	na
DK8324 sex undeterm. 240 cm, wt. na	9/15/83 Newport Beach decomp. slight	na		na	na
DK8325 male 289 cm, wt. na	9/29/83 Newport Beach decomp. moderate	stomach parasite, emaciated[3]	muscle: liver[4]:	17.5 121	0.2 2.3
DK8329 female 259 cm, wt. na	12/27/83 Crystal Cove decomp. advanced	na		na	na
DK8411 male 285 cm, 222kg	10/25/85 Doheney Beach decomp. slight	chronic enteritis, emaciated[3]	blubber: liver[2]:	400 68	27 7
DK8503 female 128 cm, 17.2 kg	3/12/85 Crystal Cove decomp. slight	verminiferous pneumonia[5]	blubber: liver[2]:	150 144	3.1 15
DK8519 male 218 cm, 227 kg	10/5/85 Bolsa Chica decomp. slight	large forestomach ulcer, pneumonia[6]		na	na
DK8603 male 312 cm, 590 kg	3/30/86 Newport Beach decomp. slight	ulcer, gastritis, abcess[7]	blubber: kidney[2]:	910 117	265 38
DK8609 male 244 cm, wt. na	5/31/86 Huntington Beach decomp. advanced	na		na	na

[1]L.A. County Museum of Natural History
[2]So. Calif. Coastal Water Research Project
[3]Dr. Haight, Orange County Animal Shelter
[4]Orange County Sanitation District
[5]Dr. Dawson, Dept. of Psychobiology, UC Irvine
[6]D. Kelly, Orange Coast College
[7]Dr. Britt, L.A. County Veterinary Service
na = information not available

This general topography in both areas extends along the coast and off shore for several miles.

Within these areas dolphins often exhibited hunting behavior (swimming in echelon formation perpendicular to shore), or were actually observed chasing, catching and eating fish. Additionally, pods sighted between those locations were constantly moving either northerly or southerly towards the high-density areas. It is hypothesized that both the northern and far southern areas represent significant forage locations for dolphins.

The two possible dolphin births observed were within the middle area (south Newport Beach to San Clemente Beach), where, as indicated above, pods were infrequently observed. Also, both were in sheltered bays (Scotsman's Cove and Niguel Beach), not heavily used by humans and without high-density residences on the cliffs above. Such areas, uncommon now along the Orange County Coast, may also represent significant habitat to this species.

Site Fidelity

No evidence was found that identified any individual as a year-round or even seasonal resident of the study area.

Calf Percentages

Our finding of 6.9% calves is high compared to the percentages reported in most studies. However, only a fraction of calf percentages in the literature are based on year-round observations (Gruber, 1981; Leatherwood and Reeves, 1980). Data based on long-term observation have been reported by Wells and his colleagues in the Sarasota study area (Wells, Irvine and Scott, 1980); by Shane (1977, 1980); by Gruber (1981), along the Gulf Coast of Texas; and by Hansen (1983). Most of these researchers report calf proportions of approximately 7%.The low proportion reported in the Sarasota study (4%) probably reflects the maximum reproductive rate that can be maintained in that relatively isolated environment.

Population Statistics

The validity of our population figures rests on the following assumptions:

1) Identified and unidentified animals are randomly mixed.

2) Animals once identifed are always correctly identifiable thereafter. (We restricted ourselved to clear slides of distinctively notched dorsal fins. Further, we were often able to document alterations in the notch pattern of previously photographed animals.)

3) All identifiable (distinctively notched) individuals in a school are photographed. (The proportion of identifiable animals photographed probably approached 100% when the school size was small, and declined when it was large. The net effect of missing any animals would be to err on the conservative side in our estimates.)

4) Our correction factor is accurate.

Estimating the number of animals in a study area begins with a consideration of the proportion of photographically identifiable animals in samples. Hansen (1983) identified 118 individuals in his studies along the coast of north San Diego County, and estimated a population numbering between 173 and 240. The number of individuals we identified photographically can be used to make a similar estimate of the minimal number of individuals using the Orange County coast.

Since our population estimate from photo-identification refers only to those animals in the population with distinct dorsal fins, it must be corrected to account for the non-distinct fraction. Our estimates of the proportion of animals with distinct dorsal fins (i.e., possessing two or more notches) ranged from 60 to 70%, averaging 65%. Calves always had smooth fins, and the slightly larger animals, judged to be sub-adults, also had characteristically smooth or single-notched fins. Size/age distribution data presented by Wells (1978) from capture operations on 100 bottlenose dolphins in the Gulf of Mexico showed that 48% of their animals were either calves or sub-adults.

Even allowing for selection bias in the capture process, their data tend to support our estimate of the fraction of calves and subadults, or perhaps suggest that it may be conservative. Assuming that the fraction of indistinct animals was 35%, we obtain an adjusted estimate of 137 as the number of individuals seen in the Orange County study area between 1983 and 1985.

The role of contaminants

All tissue samples (including blubber, muscle, liver, kidney, and brain tissue) revealed high levels of the pesticide DDT (range 150 to 1,922 ppm; average for blubber 854 ppm) and of the industrial chemical PCB (range 3.1 to 265 ppm; average for blubber 105 ppm) (Table 2). These are extremely high levels of DDT and PCBs in all tissues examined compared to California Sea Lions previously examined (Britt and Howard, 1983), but not quite as high as some levels reported previously in bottlenose dolphins for the same area (O'Shea et al., 1980).

De Long et al. (1973) reported a significant correlation between premature sea lion births and DDT concentrations, but pointed out that the correlation did not indicate a cause-effect relationship and that other causes were possible. Halle et al. (1976) correlated PCB concentrations with increased uterine lesions and reduced reproductive success in ringed seals fom the Baltic Sea, but the PCB concentrations were higher than those found in California animals. Several investigators (Gaskin, 1982; Britt and Howard, 1983) have speculated that high organochlorine levels may impair the immune system of the marine mammals and therefore increase their susceptibility to infection and disease.

In studies of dead, beach-stranded bottlenose dolphins reported by O'Shea et al. (1985) from Southern California, tissue sampling revealed extraordinarily high body burdens of DDT and PCBs in all tissues examined.

Similar findings were reported after a disaster to the East Coast population of coastal bottlenose dolphins between the summer of 1987 and January 1988. Unprecedented numbers washed ashore at that time along the Atlantic Coast from New Jersey to Florida, with 740 bodies recovered and mortality estimated at up to 2,500 dolphins. Deaths exceeded 50% of the East Coast migratory stock. A comprehensive investigation of proximate and contributing factors unparalleled in cetological history (Geraci, 1989) revealed levels of contaminants (organochlorines) in the dolphins' blubber among the highest ever recorded for a cetacean; in addition, a host of bacterial and viral pathogens produced an array of clinical signs.

The dolphins were apparently poisoned by brevitoxin, a neurotoxin produced by the dinoflagellate *Ptychodiscus brevis*, Florida's red tide organism. But in his final report, Geraci (1989) stressed the urgency of learning what role contaminants play in dolphin mortality:

"The results from the beach-cast specimens obviously reflect the levels of contaminants in the nearshore environment, where the dolphins accumulate these substances... Free-ranging animals facing intermittent food supply, or mobilizing fat during lactation, migration or times of illness, release compounds from this depot (body fat) into vital, perhaps more critical organs such as the liver.

Geraci concluded:

"The overwhelming nature of some of the infections, which probably arose in the lung, may have been related to immunoincompetence, the cause of which cannot be established. The depletion of lymphoid follicles in spleen, lymph nodes, and the intestine supports this suggestion.

"Equally important is the need to resolve the growing question of whether contaminants at levels found in the dolphins might have affected their resistance and rendered them more susceptible either to the toxin or to the microortanisms that eventually brought them to their demise."

The present study cannot add evidence to support or disprove the hypothesis that contaminants render dolphins more susceptible to other toxins and microorganisms.

CONCLUSIONS

A much larger population of bottlenose dolphins (89 to 137) appears to use and visit the coast of Orange County than has been previously reported (Kelly, 1983). The dolphins seem very flexible and fluid in their use of the entire coast of Southern California. Pods of dolphins exhibit a preference for areas at the northern end of the coast (north Newport Beach, Huntington Beach, and Bolsa Chica State Beach) and the far southern end (San Onofre State Beach), areas we believe are significant for foraging.

Furthermore, it is hypothesized that certain coves within the middle portion of the coastline (Irvine Coast to Scotsman's Cove and south Lagunas Beach to Niguel Beach) represent important habitat for dolphins giving birth. The cause of this may be the area's relatively low human density – the lowest on the Orange County coast.

The population contains individuals from neonates to adults who carry burdens of DDT and PCBs among the highest recorded for any mammal worldwide. This does not bode well for the future health of the Orange County coastal bottlenose dolphin population, and indicates the importance of further and more comprehensive study if we wish to know what the future holds for these important members of our coastal marine community.

ACKNOWLEDGEMENTS

This work, carried out at Orange Coast College by the Dolphin Survey Project, was funded and supported by the Associated Students of Orange Coast College, the Marine Research Group (an OCC student club), and both the Marine Science Department and the Math and Science Division of the college.

Many individuals contributed their time and help over the years to keep the project afloat. Generous financial support came from the Orange County Chapter of the American Cetacean Society and from individuals. The author is most grateful for all their help.

Mike Couffer, Patty Leiberg, Larry Kepko, Lisa Flourney, Don Johnston, Marty Morales, Ted Bennett, Ron Jones, Dave Beeninga, and Robert (Rip) Profeta are only a few of the important contributors to this research effort. The author would also like to thank R.H. Defran, Cetacean Behavior Laboratory, San Diego State University, for his encouragement and support through the many trials and tribulations of the last three years.

Special appreciation is also extended to Henry Schafer and his fellow scientists at the Southern California Coastal Water Research Project, in Long Beach; Dr. Robert Haight and Dr. Nyla Kelly, of the Orange County Animal Shelter; Dana Seagars, Larry Hansen, Jim Lecky, and Sheridan Stone, of the National Marine Fisheries Service; and Dr. John Heyning and Dr. Dan Patten, of the Los Angeles County Museum of Natural History.

To all of those additional good spirits who lent a hand and helped make this happen: many thanks.

SPECIAL NOTE

An award-winning documentary film about these dolphins, entitled *Dolphins of the Orange Coast*, was written, photographed, produced and edited by George Gumbrecht, telemedia director for Orange Coast College. It is available for viewing, rental or purchase from Orange Coast College, 2701 Fairview Road, Costa Mesa, California 92626.

REFERENCES

Britt, J.O. and E.B. Howard. 1983. Tissue residues of selected environmental contaminants in marine mammals. *In* Pathobiology of Marine Mammal Diseases, E.B. Howard (ed.). CRC Press, Boca Raton, Florida.

Defran, R.H. and G.M. Schultz, 1988. A technique for the photographic identification and cataloging of dorsal fins of the bottlenose dolphin (*Tursiops truncatus*). International Whaling Commission Symposium on the use of non-lethal techniques, especially photo-identification techniques in the assessment of cetacean population parameters. La Jolla, California.

Defran, R.H., G.A. Shultz, M.A. Espinoza, and A.C. Weaver. 1985. The population biology of along the Southern California and northern Baja coastline. Sixth Biennial Conference on the Biology of Marine Mammals, Nov. 22-26, Vancouver, British Columbia, Canada.

Defran, R.H., D.L. Kelly, G.M. Shultz, A.C. Weaver, and M.A. Espinoza. 1989. The occurence and movements of the bottlenose dolphin in the Southern California bight. Manuscript accepted by Marine Mammal Science, J. Soc. for Marine Mammology.

DeLong, R.L., W.G. Gilmartin, and J.G. Simpson. 1973. Premature births in California sea lions: association with organochlorine pollutant residue levels. Science 181:1168-1170.

Dohl, T.P., K.S. Norris, R.C. Guess, J.D. Bryant, and M.W. Honig. 1978. Pinnipedia, Cetacea, and parasitology of the Southern California bight area. Vol. III., No. PB-295-932. National Technical Information Service, Springfield, Virginia. 473pp.

Gaskin, D.C. 1982. The Ecology of Whales and Dolphins. Heineman, Exeter, New Hampshire.

Geraci, J.R. 1989. Clinical Investigation of the 1987-88 Mass Mortality of Bottlenose Dolphin Along the U.S. Central and South Atlantic Coast. National Marine Fisheries Service, U.S.Navy, Office of Naval Research, & Marine Mammal Commission. April 1988.

Gruber, J.A. 1981. Ecology of the Atlantic bottlenose dolphin in the Pass Cavallo area of Madagorda Bay, Texas. M.Sc. thesis. Texas A & M Univ., College Station, Texas.

Hansen, L.J. 1983. Population biology of the coastal bottlenose dolphin of Southern California. M.A. thesis, Sacramento State Univ., Sacramento, California. 104 pages.

Helle, E., M. Olsson, and S. Jensen. 1976. PCB levels correlated with pathological changes in seal uteri. Ambio 5:261.

Kelly, D.L., 1983. Photo-identification of bottlenose dolphins in Southern California. Whalewatcher. J. Am. Cet. So. 17(2):6-8.

Leatherwood, J.S. and R.R. Reeves. 1982. Bottlenose dolphin and other toothed cetaceans. Pp. 369-414 *in* J.A. Chapman and G.A. Feldhamer (eds.). The John Hopkins University Press, Baltimore, Maryland. 1147 pp.

Norris, K.S. and J.H. Prescott. 1961. Observations on Pacific cetaceans of California and Mexican waters. Univ. Ca. Publ. Zool. 63:291-402.

Orr. R.T. 1963. A northern record for the Pacific Bottlenose dolphin. J. Mamm. 44(3):424.

Orr, J.M. 1976. A survey of *Tursiops* populations in the coastal United States, Hawaii, and territorial waters. Contract No. MM7AD-028. Marine Mammal Commission. Washington D.C. 13pp.

O'Shea, T.J., R.L. Brownell, D.R. Clark, W.A. Walker, M.L. Gay, and T.G. Lamont. 1980. Organochlorine pollutants in small cetaceans from the Pacific and South Atlantic Oceans. November 1966-June 1976. Pesticides Monitoring J. 14(2):35-36.

Sargent, D.E., D.K. Caldwell and M.C. Caldwell. 1973. Age, growth, and maturity of bottlenose dolphin from northeast Florida. J. Fisheries Res. Board Canada 30:1009-1011.

Scammon, C.M. 1874. The Marine Mammals of the Northwestern Coast of North America, described and illustrated; together with an account of the American whale-fishery. John H. Carmany and Co. San Francisco, California. 319pp.

Schafer, H.A., R.W. Gossett, C.F. Ward, and A.M. Westcott. 1985. Chlorinated hydrocarbons in marine mammals. *In* Southern California Coastal Water Research Project Biennial Report, 1983-1984, pp.109-114.

Scott, G.P., D.M. Burn, and L.J. Hansen, 1988. The dolphin die-off: long-term effects and recovery of the population. Proceedings of the Oceans '88 Conference. Baltimore, Maryland, October 31- November 2, 1988.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, in the Aransas Passarea of Texas. M.Sc. thesis, Texas A &M University, College Station, Texas. 239 pp.

Shane, S.H. 1980. Occurrence, movements and distribution of bottlenose dolphins in southern Texas Fishery Bulletin (U.S.) 78:593-601.

Shane, S.H., R.S. Wells, and B. Wursig. 1986. Ecology, behavior and social organization of the bottlenose dolphin: a review. 2:34-63.

Walker, W.A. 1981 Geographical variation in morphology and biology of bottlenose dolphins in the eastern North Pacific. National Marine Fisheries Service/Southwest Fisheries Center Administrative Report No. LJ-81-03C. La Jolla, California.

Wells, R.S. 1978. Home range characteristics and group composition of Atlantic bottlenose dolphins on the west coast of Florida. M.Sc. thesis, Univ. of Florida.

Well, R.S., A.B. Irvine and M.D. Scott. 1980. The social ecology of inshore odontocetes. Pp. 263-317 *in* L.M. Herman (ed.).

Wells, R.S., T.P. Dohl, L.J. Hansen, A.B. Baldridge, and D.L. Kelly. 1990. Extraordinary movements of bottlenose dolphins (*Tursiops* sp.) along the coast of California. *In* The Bottlenose Dolphin, Academic Press.

STATE OF CALIFORNIA — THE RESOURCES AGENCY
PETE WILSON, *Governor*

DEPARTMENT OF PARKS AND RECREATION

Orange Coast District
3030 Avenida del Presidente
San Clemente CA 92672
(714) 492-0802

Document #3

February 13, 1996

Dennis L. Kelly, Professor of Marine Biology
Marine Science Department
Orange Coast College
2701 Fairview Road
P.O. Box 5005
Costa Mesa CA 92628-5005

Dear Professor Kelly:

Thank you for writing and expressing your concerns regarding Pacific Coast Bottlenose Dolphin that utilize nearshore waters off Crystal Cove State Park. Their use of this "safe" haven to birth their young genuinely qualifies the location as significant to the local population.

The interplay between the Crystal Cove residents and yourself has no doubt been beneficial to the population as well as your work as Director of the Coastal Dolphin Survey Project. The additional data you have been able to collect from birthing episodes and strandings has no doubt helped your project work. We applaud the residents for being vigilant and caring by reporting harassment by jet skis, and warning visitors to keep away from the nearby dolphins.

The Crystal Cove Redevelopment Project is now in the process of selecting a contractor. They will fulfill a section of the approved General Plan in making this area available to all citizens. The people using these cottages in the future will no doubt be less informed than the current residents. However, one of our department's goals is interpreting park resources to our visitors. One of the permanent structures in the redevelopment plan includes an interpretive facility with information on both the Crystal Cove Underwater Park as well as terrestrial habitats. Dolphin concerns can be included into this permanent structure.

Document #3

We have lifeguard and/or ranger patrols every day of the year, and feel staff can fill the reporting void once Crystal Cove residents have moved. We have patrol radios that can speak directly with Orange County Harbor Patrol for boating violations. We have a Waverunner for rescue and enforcement work at Crystal Cove State Park, as well as two 30' patrol vessels available from Newport Harbor. The Department will require the operator of the Historic District to have an interpretive program to assist you with specific dolphin activity.

For marine mammal strandings, we follow protocols set up by the National Marine Fisheries Service. We would be glad to assist with this species' sensitivities and the Coastal Dolphin Survey Project, and in informing the public in the absence of our long-term, unofficial "wardens" of Crystal Cove. There are no doubt many ways to work together to help make our development project and your Dolphin Project mutually successful.

Thanks again for voicing your concerns. If you have any questions our local contact is David Pryor, Resource Ecologist at (714) 848-1566.

Sincerely,

Donald H. Ito

for Jack B. Roggenbuck
District Superintendent

cc: K. Jones
D. Troy
R. Rayburn
D. Pryor
M . Eaton

THE STATUS OF MARINE FISHES AND MAMMALS IN WATERS NEAR THE IRVINE COAST MARINE LIFE AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE AND IN RELATION TO OTHER SOUTHERN CALIFORNIA COASTLINE AREAS

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Prepared For
Irvine Community Development Corporation
Newport Beach, California

June 12, 2000

Comments to
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Cal. Coastal Commission
200 Oceangate 10th floor
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Document #4

THE STATUS OF MARINE FISHES AND MAMMALS IN WATERS NEAR THE IRVINE COAST MARINE LIFE AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE AND IN RELATION TO OTHER SOUTHERN CALIFORNIA COASTLINE AREAS

By

Jeffrey B Graham, Ph.D.

EXECUTIVE SUMMARY

A review of aspects of the diversity, distribution, natural history, and behavior of marine fishes and mammals living in the vicinity of the Irvine Coast Area of Special Biological Significance (ASBS) was carried out in response to concerns voiced about potential adverse environmental effects associated with the Crystal Cove Project. Specific among these concerns is the impact of storm runoff from Muddy and Los Trancos Canyon Creeks on the local conditions of salinity and turbidity in coastal waters and the effect this may have on the resident biota, including both fishes and marine mammals.

The Pre-Project condition is that runoff from the two watersheds continually enters the Irvine Coast at rates proportional to upstream irrigation and precipitation. Post-Project conditions will feature managed water flow in both creeks through a series of natural and structural sieves and detention basins that enhance water filtration and limit the outflow rate. In addition, sump pumps positioned just above sea level near the terminus of each creek, will capture net water flow and divert it to the sewer system during the dry season. In Post-Project there will be no daily water flow into the Irvine

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ASBS during the dry season which effectively eliminates these creeks as potential daily point sources for salinity and turbidity intrusion into the coastal waters.

The sump pumps at base of each creek will not, however, have the capacity to divert the entire creek outflows during wet season conditions or during storms and, at these times, sediment-bearing fresh water will be held for a time in detention basins and then released, at reduced flow rates, into the sea. Engineering studies of sediment transport during peak storm conditions, show that, because of the Runoff Management System incorporated into the Project, Post-Project sediment transport will be reduced from Pre-Project rates. This means that the potential turbidity effects of these outflows will be lessened in Post Project. While estimated maximum storm runoff volumes will be slightly greater in Post-Project, Post-Project runoff rates will be lower and will contain 76% less fine sediment, which will reduce outflow-associated coastal turbidity effects.

Analyses of coastal distributive properties affecting outflows indicate that a relatively smaller plume will form Post-Project compared to Pre-Project. The Pre-Project plume occurs at the surface and extends about 1.5 km offshore (to about the 50 m isobath) and extends about 3.7 km along the shore. The Post-Project plume will extend about 0.8 km offshore (30 m isobath) and will be about 2.9 km long.

Because less sediment will enter the coastal waters in Post Project, the plume's turbidity will be less. However, it must be emphasized that nearshore waters are often turbid, especially during storms and, in the case of Crystal Cove, sediment entering the water from the two creeks can be expected to have only a negligible effect on overall storm-generated coastal turbidity conditions in the vicinity of the plume.

small size of the supporting group and the tight positioning of the ring of the surrounding birthing circle dolphins remain undescribed in the scientific literature.

Accounts of the dolphin birth circle appear in an unpublished 1998 manuscript and have been given in the media. However, a description of this phenomenon has not yet entered the scientific literature. Other scientists experienced in the field observation of bottlenose dolphins at Pacific locations throughout California and Baja California have not observed this particular behavior, although allomaternal behaviors and cows swimming with newborn calves have been observed.

The scientific validity of the claim of dolphin birthing circles must await review of the data presented in support of its occurrence. However, as it concerns the Crystal Cove Project, media attention has centered on the "birthing circle" phenomenon, in spite of the paucity of scientific documentation. Based on the unpublished report, the birthing circle does appear to be an interesting bottlenose dolphin behavior that is probably allomaternal in nature. Because many of the observations of this behavior occur at locations that offer overviews of the near coastal area, the phenomenon - if it in fact is being interpreted correctly - may be more closely associated with the ease of viewing dolphins continuously from these promontories rather than a particular site specificity for dolphins exhibiting this behavior. The dolphin birthing circle observations do, in fact, indicate that this behavior is not unique to the Newport area; it has been seen both at Palos Verdes, about 40 km northwest of Newport, and at San Onofre, about 40 km southeast.

Conclusion

The issue with regard to birthing circles and the Crystal Cove Project reduces to the following point. Assuming that this behavior is in fact taking place and that young dolphins are born along the Newport Coast, then the Post-Project conditions established to 15 ppt, particularly when this is localized, primarily at the surface, and brief, and can be avoided. Bottlenose dolphins naturally encounter and tolerate broad ranges in environmental salinity and are thus going to be unaffected by localized changes in salinity of the magnitude predicted.

Water quality analyses and marine ecological studies show that outflows from the Los Trancos and Muddy Canyon watersheds are not sources for the entry of pollutants, toxins, or pathogens into Newport Coast waters. Also, these waters are not toxic to marine invertebrates tested in controlled experiments. Thus, the Pre-Project condition is that the outflow is clean and safe. Because of the Runoff Management System that will be put in place, Post-Project outflows will be even safer and pose no health threat to either the fishes or marine mammals living along the Newport Coast.

Another factor to be considered is the effect the Crystal Cove Project may have on bottlenose dolphins occurring along the Newport Coast. Critics of the Project raise the issue that special and unique behaviors are exhibited by Pacific bottlenose dolphins along the Newport Coast and suggest that the Crystal Cove Project will affect these. The particular behavior central to this issue is what has been referred to as the "dolphin birthing circle." This is described as a small aggregation of dolphins that form a circle around a pregnant cow during the final period before parturition, and remain close to her, assisting with birth and with the initial care of the neonate. The scientific literature contains numerous accounts of what is termed "allomaternal behavior" in which dolphins assist in facilitating parturition, in supporting the newborn calf, and helping it to nurse, and also protecting it and the mother from predatory attack by sharks. However, the

Turbidity is a normal condition experienced by nearshore fishes and marine mammals and is also an environmentally and ecologically relevant factor because of its effects on visual acuity and detection in both the near and far field. A fish in turbid water, for example, has less chance of finding food and more chance of being eaten. Marine mammals such as the bottlenose dolphins have acute vision and this would be affected by turbidity, but dolphins also have the capacity to use echolocation sonar to detect prey and this could conceivably give them an advantage over fishes in turbid conditions.

The peak storm flow conditions in which a salinity decline was measured at a Pre-Project point source showed reduction to about 15 parts per thousand (ppt, normal sea water salinity is 33 ppt). The scientific literature (summarized in reports to the Irvine Community Development Corporation by Professor R. Ford and co-workers) indicates that neither the extent of this localized salinity reduction nor the duration of its maximal effect (i.e., only during times of peak runoff) are of sufficient magnitude to physiologically or ecologically impact organisms living in the sand-bottom areas near the point source. Also, marine fishes are mobile and, a fish swimming in the vicinity of the source could, upon detecting a reduction in salinity, swim away from it.

Most marine fishes living in shallow water are very tolerant of short-term salinity reductions such as would occur within the outflow plume. This can be readily documented by pointing out that a number of the fish species living along the Newport Coast also live permanently in Newport Bay, a region having a much lower average salinity. If a species can reside permanently in waters ranging from 5-25 ppt salinity, then it is unlikely to be adversely affected by an occasional salinity reduction of from 33 there will improve overall water quality and the coastal environment and will therefore augment all bottlenose dolphin activities in the Crystal Cove area.

PROFESSIONAL PROFILE OF DR. JEFFREY B. GRAHAM

Dr. Graham received his B.A. in Zoology at San Diego State University (SDSU) in 1964 with an emphasis in anatomy, physiology, ecology, and evolution. His M.A. from SDSU (1967) emphasized the physiology of fish environmental adaptation. In 1970 he completed his Ph. D. in Marine Biology at Scripps Institution of Oceanography, specializing in the fields of tropical biology, marine physiology, and evolution. After a post doctoral fellowship and serving on the Research Staff of the Smithsonian Tropical Research Institute in Panama, Dr. Graham joined the faculty at SDSU where he was a Professor of Zoology from 1976-1978. In 1979 he joined the Scripps Institution of Oceanography, U.C.S.D. He divides his efforts between research and teaching graduate students either in the laboratory or in a small classroom setting. He has served as Chairman of eight doctoral student committees and held membership on several others.

Research conducted by Dr. Graham involves studies of the environmental adaptation of marine organisms, primarily fishes, and including sharks. A theme of his research is the mechanisms used by organisms adapting to environmental change. He has worked extensively on the physiological and other specializations of air-breathing fishes. In addition to his basic research, Dr. Graham has been actively involved in issues related to over-fishing and aquaculture in fisheries conservation and has studied the effects of El Niño and global environmental change on fish distributions and habitats. He has published over 120 papers, written one book, and edited another. His research has been supported primarily by the National Science Foundation. He serves as a reviewer for many scientific journals and evaluates grant proposals for the National Science Foundation and other agencies. His consulting experience includes evaluation of the effects of the San Onofre Nuclear Generating station on coastal fish abundance and ecology. He served as an advisor to the U. S. State Department during deliberations to expand the capacity of the Panama Canal by pumping seawater into Gatun Lake. He currently serves as an EPSCOR-US EPA advisor on environmental toxicology to the State of South Carolina. His academic awards include being the recipient of the distinguished alumni award from SDSU, a Guggenheim Fellowship, a fellowship from the Japanese Society for the Promotion of Science, and designation as the R.E. Carpenter lecturer for 2000 (SDSU).

INTRODUCTION

The status of fish and marine mammal populations in coastal waters is an obvious and easily evaluated indication of marine ecosystem health and viability. Not only is this indicator of scientific importance, the general public considers the presence of healthy fish and marine mammals in an area as sign that the coastal waters are safe for human activities. Healthy and stable marine fish and mammal populations are thus synonymous with excellent environmental quality. This is an important assurance for coastal-area residents and property owners, and especially important for communities dependent upon coastal recreation and tourism.

This report provides an assessment of the status of marine fishes and mammals in the vicinity of the Irvine Coast Marine Life Refuge Area of Special Biological Significance (ASBS) and in the adjacent waters of Southern California. Concerns have been expressed about the potential adverse environmental effects that the proposed Crystal Cove Project may have on the marine mammals and fishes occurring in the waters of the ASBS. Assertions have been made that storm runoff from the Crystal Cove Development will adversely affect water chemistry and turbidity and restrict the normal activities of marine mammals and fishes in the waters adjacent to the coastline. This report evaluates these and related concerns about the Crystal Cove Project's effect on marine fishes and mammals living along the coast, particularly along the corridor from Newport Beach to South Laguna Beach where there are three designated Marine Life Refuges and Areas of Special Biological Significance (ASBS).

However, to provide the appropriate context within which to review the question of coastal marine fish and mammal status, it is necessary to review the biological, oceanographic, and climatological factors that have historically influenced marine organisms in the southern California region, including the Newport Coast. This report also examines how human effects on the environment may have affected these populations.

THE IRVINE COAST MARINE LIFE REFUGE AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

The Orange County Coastline extends 71 km from Anaheim Bay (33°44'N) south to San Onofre Beach (32°20'N). The approximately 24 km (15 mile) area extending from Newport Beach to South Laguna Beach is situated near the center of the Orange County Coastline. The Newport-South Laguna coastal area is the site of three marine life refuges, as designated by the California Department of Fish and Game. These three sites are the Newport Beach Marine Life Refuge near Corona del Mar, the Heisler Marine Life Refuge at Laguna Beach, and the Irvine Coast Marine Life Refuge adjacent to the Crystal Cove State Park (CCSP). The latter of these encompasses the area where runoff from the Crystal Cove Development will enter coastal waters. These three areas have also been designated as Areas of Special Biological Significance (ASBS) by the California State Water Resources Control Board.

Coastal Topography and Habitat Conditions along the Newport Coast

The Newport Coastal Area is comprised of alternating stretches of sandy beach interspersed with rocky headlands containing tall cliffs and conspicuous offshore rocks, stacks, arches, and submerged reefs. For most of this region and particularly along the Crystal Cove ASBS, a sandstone bluff fronts the beach. Tidepools occur in lower intertidal rocky areas and the subtidal habitat is comprised of numerous rocky reefs that extend as far as 500 m offshore and to depths ranging from 12 to 18 m. These submerged rocks have a complex surface area and consist of many cracks, fissures, and caves.

Southwesterly swells generally influence the coastal zone. All coastal regions shallower than about 30 m are subject to current and wave surge, daily and seasonal temperature fluctuations, as well as variations in turbidity caused by sediment movements. Along the Newport Coast, the longshore flow is to the north on rising tides and to the south on falling tides. Tidal currents vary from about 0.2 m/sec during neap tides to 0.4 m/sec during spring tides (Dr. Scott Jenkins, personal communication; Jenkins and Wasyl, 2000).

Annual surface water temperatures in this area range from about 60-70°F (15-21°C). Subsurface waters are generally slightly cooler [55°F (13°C)] and a pronounced thermocline exists during most of the year. The salinity of these waters remains nearly unchanged at 33-34 parts per thousand (ppt) throughout the year.

THE SOUTHERN CALIFORNIA BIGHT

An understanding of the variables that potentially can affect the distribution and abundance of marine mammals and fishes along the Newport coast requires consideration of the large-scale factors affecting their populations. All of the marine organisms inhabiting the Newport-South Laguna coastal area have natural geographic distributions that extend far beyond this relatively small stretch of coastline. In fact, the geographic ranges of many of the species found in this area extend throughout and well beyond the Southern California Coast (SCC) region [i.e., the stretch of coastline extending from the intertidal rocky areas and the subtidal habitat is comprised of numerous rocky reefs that extend as far as 500 m offshore and to depths ranging from 12 to 18 m. These submerged rocks have a complex surface area and consist of many cracks, fissures, and caves.

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Mexican Border to Point Conception, CA (34°33'N, 120°28'W)]. For the purposes of considering such distribution patterns and their biological significance, it is more meaningful to think in terms of a slightly larger geographical reference area than the SCC. The appropriate reference region is the Southern California Bight (SCB), an open embayment extending 455 miles (732 km) from Pt. Conception, California in the north to Punta Colnett, Baja California, Mexico (30°57'N, 116° 20'W) (Figure 1).

The SCB encompasses about 61,000 square km, has an irregular submarine topography featuring northwest-southeast oriented basins, troughs, banks, and ridges, and a string of channel islands 20 to 110 km from the shoreline. The average depth is between 700 to 1000 m. Water circulation is generally counter-clockwise and there is a northward flow at most coastal locations (Jackson, 1986; Jenkins and Wasyl, 2000). Flow is influenced by topography and by the California Current which, although west of the Bight, sheds eddies that combine with north-flowing coastal and offshore waters to form the Southern California Countercurrent. The SCB has a high upwelling index between April and August, but geostrophic or wind-driven flows can occur year round (Carlucci et al., 1986). Seasonal surface temperatures are coolest in December - March and warmest in August - September with an annual range of 12 - 19°C. Salinity variations are minimal and the upper 100 m is well mixed and well oxygenated (50-100% saturated) (Jackson, 1986).

In terms of its flora and fauna, the SCB is defined as transitional environment, an ecotone, between the cooler-water habitat occurring to the north and the warmer-water habitat to the south. Accordingly, the SCB ecotone is comprised of a mix of species, some from the cooler, northern- and some from the warmer, southern-regions adjacent to it. Because SCB water temperatures are intermediate with respect to those to the north and to the south, the organisms living in the SCB have the capacity to adapt to a slightly warmer (if they are from the north) or cooler (if they are from the south) thermal environmental range.

Figure 1. The Southern California Bight (SCB) and the Newport Coast Region.

Because temperature exerts a major influence on marine-organism distribution, seasonal changes in water temperature, as well as the warming associated with an El Niño (a climate anomaly that transports warm surface waters north along the coast of Baja California and California, displacing the cool California Current to the west, Jenkins and Wasyl, 2000) will affect the species composition of the Bight and the geographic distribution of the warm and cool water constituents of this region. The warm surface waters associated with an El Niño are highly detrimental to the giant kelps which are adapted to cool water (MBC, 2000). El Niño warming can also eliminate the cool-water elements of the SCB fish fauna and permit warm-water adapted fishes to expand their distributions north into the coastal waters of Central California where it is normally too cool for them to reside (Fields et al., 1993). Marine mammals that prey on these fishes would follow them. Both seasonal warming and El Niño events can also bring more tropical species into the SCB from the south (Fields et al., 1993).

In addition to climatological influences, both biological and oceanographic factors directly influence organism distribution and abundance in the SCB and this must be kept in mind when the status of populations within a small area like the Newport Coast is being considered. Temperature-caused declines in the kelp habitat, resulting from nearly 20 years of continued ocean warming, have led to a decline in the associated marine animal populations and this lowers sportfishing success.

Similarly, coastal marine mammals (sea lions, seals, bottlenose dolphins) would find fewer fish to eat in the kelp bed and would search elsewhere. Marine mammals are highly mobile and move through areas primarily in search of prey (most often fishes). If prey are abundant in an area, then the numbers of mammals will increase (Defran and Weller, 1999). If El Niño conditions cause the prey of bottlenose dolphins to emigrate into the waters of central California, the dolphins will follow them (Wells et al., 1990). However, the fish species that are hunted by marine mammals are in turn searching for their own prey (small benthic invertebrates, smaller fishes, and zooplankton) and some may move from place to place.

In summary, a diverse and variable array of oceanographic, biological, and climatological factors strongly influence the relative abundance and activity of fishes and marine mammals in the SCB as well as along the Newport Coast.

THE STATUS OF MARINE FISHES IN THE OPEN COAST HABITATS OF THE NEWPORT AREA AND THE SOUTHERN CALIFORNIA BIGHT

It has been suggested that storm runoff and other aspects of the Crystal Cove Development may adversely affect marine fishes living along the Newport Coast. The scientific basis for these assertions is now examined. The present status of the fish population in the area and the environmental characteristics normally encountered by these species are described, and how environmental conditions affecting fishes will change with completion of the Crystal Cove Project is discussed.

Factors Affecting Fish Abundance and Diversity in the SCB

Over 120 fish species occur in the nearshore waters of the SCB (Allen et al., 1994; Stephens et al., 1994). The diversity and relative abundance of fish species is determined by a number of factors including recruitment success, habitat availability, and temperature (Horn and Allen, 1978; Patton et al., 1985; Stephens et al., 1994; Love et al. 1998; Bond et al., 1999).

Recruitment

Recruitment is defined as the arrival of young of the year fish to an area in which they can live to adulthood. The annual recruitment young of the year fish to the coastal habitats of the SCB is critical for sustaining diversity and this process is affected by temperature, sedimentation, primary production, drift mortality, substrate availability, and pollution (Stephens and Zerba, 1981; Pondella and Stephens, 1994; Love et al, 1998). Most of the fishes inhabiting both the SCB and the Newport Coast spent their early development as larvae that drifted in the currents [exceptions include sharks and rays and the family Embiotocidae (surfperch) which do not have a free-swimming larval life stage]. Success in first the egg and then the larval-life phase depends on the largely random processes of:

1) Encountering sufficient quantities of food (plankton) in the open water to sustain development and,
2) At the appropriate time in development, fortuitously encountering an appropriate habitat in which to settle from the plankton, metamorphose into a young fish and grow to adulthood.

Habitat Complexity and Characteristics

The four major habitat types found in coastal waters of the SCB are the sandy surf zone, the kelp forest and cobble bottom, the benthic soft bottom, and the midwater offshore habitat (Allen and DeMartini, 1983). Each of these occur in the Newport Coast area which also has many large submerged rocky reefs. In general, the complexity found within these habitats is predictable. In the kelp forest, plant density, the size of the kelp canopy and bottom relief all correlate with species diversity (Patton et al., 1985). The relative quality of different habitats having the same features is evaluated by comparing how finely its ecological resources are subdivided among the different fish species in the community (i.e., microhabitat, feeding mechanism and prey specialization, etc.)(Bond et al., 1999).

Temperature

The increased influence of El Niño conditions in recent decades has diminished SCB kelp beds (MBC, 2000) and depleted the associated fish fauna. This temperature change is also thought to be affecting the degree of upwelling and in turn, plankton biomass (Barber et al., 1985; Roemmich and McGowan,1995; Hayward et al.,1996) which affects fish recruitment. Warming has also eliminated some of the cooler adapted species that can exist in the SCB only during cooler times (Quast, 1968; Horn and Allen, 1978). Love et al. (1998) concluded that rising temperatures have led to the nearly complete disappearance of the blue, olive, brown, grass and bocaccio rockfishes (*Sebastes*) from nearshore rocky reefs of the SCB.

In summary, the diversity of fishes in the SCB and in particular habitats such as the Newport area is a complex probability function that begins with the reproductive effort of the adult fish population (this depends on their food supply and population size, etc.) and is contingent on the alignment of ~~many independent but critical factors. These~~ include sufficient levels of planktonic food resources in the water column to sustain the drifting fish larvae, water temperatures that are optimal for efficient feeding and growth, the presence of current patterns favorable for transporting developing larvae to habitable sites, and, at the critical time of settling out of the plankton, the presence of the appropriate substrate required by a species in an area that is sufficiently underpopulated with competitors and predators to allow the young fish to survive and grow.

Fish Species Present on the Newport Coast

The physiography of the Newport Coast is similar in many respects to that in other areas of the SCB and for this reason it can be expected that the species of fishes present and their relative abundance will resemble that in other areas. Both the abundance and high diversity of the inshore coastal fishes in the Orange County region was documented by Mearns (1979) who, over an eight-year long, systematic trawl survey of the deeper (18-200 m) waters of San Pedro Bay, compiled a list of 112 fish species.

Along the Newport Coast, Pequegnat (1964) examined the seasonal abundance and recruitment patterns of fishes associated with a subtidal reef and Wiley (1973, 1976) conducted field studies on two small gobies (*Lythrypnus dalli*, *Coryphopterus nicholsii*) abundant on subtidal reefs throughout the region. Brusca and associates (Brusca and Wicksten, 1979; Brusca and Winn, 1979; Brusca and Zimmerman, 1979) compiled fish-species lists as part of their biological surveys of the Newport, Irvine (Crystal Cove), and Heisler Park ASBS's. The collective opinion of these workers was that the coastal region encompassed by the three areas can be regarded as biologically healthy, relatively undisturbed, and free of any gross observable water pollution.

Table 1 lists the fish species known to occur along the Newport Coast, as compiled from the above-mentioned sources. While this list is not a complete accounting of all species living in the area, all of the species included in Table 1 are commonly found in most other nearshore locations in southern California.

Using SCUBA, Pequegnat (1964) documented the presence of 22 fish species on a sublittoral reef located 500 m offshore from Pelican Point. (This site is in 12-18 m deep water and known by the name 500 Meter or Whistler's Reef.) Among the most abundant species Pequegnat observed were: Gobies *Lythrypnus* and *Coryphopterus*, and the blenny *Hypsoblennius*, all of which are small and live on or among the rocks; the senorita (*Oxyjulis*) which swims near the reef edge; *Hypsopops*, the bright orange garibaldi; and *Chromis*, the blacksmith, a plankton feeder that swims over the reef.

The fish surveys done by Brusca and co-workers at Newport, Crystal Cove, and Heisler Park included the intertidal zone as well as SCUBA. Visual sampling was done along benthic transects parallel to the shoreline at various depths, and on vertical, pelagic transects (out to about 27 m depth). The total number of fish species observed at the three areas were: Newport, 19 species; Irvine, 25 species; and Heisler Park, 30 species (Brusca and Wicksten, 1979; Brusca and Winn, 1979; Brusca and Zimmerman, 1979). Brusca and co-workers could not always identify all of the species they observed (i.e., they use a few familial designations and, the rockfish species observed at the Newport ASBS were not identified). This and differences in transect-sampling depths may account for some of the site-to-site variability. In total, 36 species were counted at the three inventoried areas. Of these, 25 species (69%) occurred at two or more of the sites and 11 species (31%) occurred at all three sites. Combining these numbers with those of Pequegnat (1964) yields a list of 42 species (in 36 genera) occurring within a 14 km span of the Newport Coast (Table 1).

In a later study, Valencic (1987) used SCUBA to compare the relative abundances of 9 of the most common fish species on four subtidal reefs. His study sites included three reefs within the CCSP (Scotchman's Reef, Split Reef, and Hatchet Cut Reef) and 500 Meter Reef (where Pequegnat had worked.) Valencic found all 9 of his study species in each habitat surveyed; moreover, his data indicate that reef-specific habitat differences (i.e., depth, surface area and complexity, and its proximity to other reefs, sandy areas, and open water) as well as seasonal effects all appear to influence relative fish abundance.

It has, however, been well documented that visual surveys to determine fish-species presence in an area do not provide as complete of a data set as would be obtained by the application of fishing techniques specifically designed to target the variety of fishes present in an area (Allen and DeMartini, 1983; Valencic, 1987; Stephens et al., 1994). While diver observation has the advantage that fish only need to be seen, identification of the observed individuals to the species level cannot always been done. Also, species that are small, or cryptic, that burrow, or are only active at night, may be missed. Even in open water some species remain beyond visual range and, while SCUBA is needed for work at depth, it is less effective in shallow water because of wave surge and limited maneuverability and visibility. Despite these sampling limitations, visual inventories of species presence do allow a minimum estimate of species abundance for a particular location to be made.

The studies of Valencic (1987) are especially important is showing the validity of the visual inventories done at Newport. Even though Valencic's work followed that of Pequegnat by nearly 25 years, eight of the nine of the species he surveyed at 500 Meter Reef had also been recorded there by Pequegnat (1964). Moreover, all 9 of Valencic's study group [*Hypsopops, Semicossyphus (=Pimelometopon) Oxyjulis, Halichoeres, Medialuna, Chromis, Paralabrax clathratus, P. nebulifer, Girella*] are included in the cumulative species list for the area (Table 1).

In summary, fish observations along the Newport Coast provide an indication of the species present and indicate that the representative species there have persisted for the past two decades and probably much longer. With this information, it is now possible to determine how the fish fauna of the Newport Coast compares with that in other southern California areas.

Species Comparisons with Other Regions in the Southern California Bight

Because of the broad distribution of nearshore fish species within the SCB, it can be expected that most of the species occurring along the Newport Coast will also be found elsewhere. This is confirmed by Table 2 which compares the fish diversity at Newport with that at other southern California locations. The table emphasizes the results from fish surveys in which diver observation was the principal method of determining species abundance. Data from two other locations, San Pedro Bay and San Onofre, have also been included because, even though nets were used to capture fish, these sites are close to the Newport Coast.

It is emphasized that all of the species-abundance data reported in Table 2 are from surveys that had many more replicate samples and that were taken over much longer time spans than the Newport Coast inventories. Reflecting this, all but one site has a longer species list than that for Newport.

Because species number varies among the different sites, the degree of similarity between the species at Newport and at a particular site was assessed by the "species-overlap percentage" (i.e., the percentage of Newport species found at the site). Table 2 shows overlap percentages ranging from 43 to 98%. The highest overlap (98%) is with King Harbor, a habitat that has been systematically surveyed for nearly 25 years (Stephens et al., 1994). Although the King Harbor fish habitat is within a small boat harbor, the boulders forming the breakwater support a large benthic and rocky reef fish assemblage having about the same depth distribution as the reefs along the Newport Coast. A total of 121 species have been recorded at King Harbor; however, it is rare to encounter more than about 50 species on an annual basis (Stephens et al., 1994).

Visual sampling at several artificial reef sites along the 20 m isobath in Santa Monica Bay (Turner et al., 1969) also shows a high species overlap (80%) with the Newport Coast. Similar also are the data of Quast (1968) for kelp and sand-bottom areas in La Jolla. Even though Quast did not inventory intertidal fishes or elasmobranchs (sharks and rays), there is a 75% species overlap between La Jolla and the Newport Coast.

The sampling done at San Onofre involved the use of enclosing (Lampara) nets but, was done in fairly shallow waters over sandy and cobble-sand bottoms, and near kelp beds. Even though neither the small epibenthic nor intertidal fish species were surveyed, the percent overlap between San Onofre and the Newport coast is 60%. By contrast, and even though the Newport and San Pedro Bay habitats are in close proximity to one another, there is a marked reduction (43%) in species overlap at these two areas. This difference is directly attributable to differences in sampling-depth range and collection-methods: San Pedro Bay sampling involved otter trawls, was done from 18 to 170 m, on mainly silty sand and mud bottoms (Mearns, 1979).

In summary, this comparison shows that the fish species present along the Newport Coast are likely to be found in other nearshore coast habitats having comparable physiographic characteristics.

THE STATUS OF MARINE MAMMALS IN THE OPEN COAST HABITATS OF THE NEWPORT AREA AND THE SOUTHERN CALIFORNIA BIGHT

Several marine mammal species frequent the open waters along the Newport Coast. However, none of these are permanent residents of the area. Both the California sea lion (*Zalophus californianus*) and the harbor seal (*Phoca vitulina*) are often seen in the coastal beaches and coves. *Zalophus* is known to come ashore in this area (Brusca and Zimmerman, 1979). The California grey whale (*Eschrictius robustus*), which is common along the coast during its winter southward migration, may be seen off the Newport

Coast. Other marine mammals that occasionally approach the shoreline habitat include the Pacific white-sided dolphin (*Lagenorhynchus obliquedens*), the common dolphin (*Delphinus delphis*), and the pilot whale (*Globicephala macrorhynchus*). However, such occurrences are extremely rare (Hanson and Defran, 1993).

One of the most commonly observed marine mammals along the Newport Coast, and along much of the open coast of Southern California is the Pacific bottlenose dolphin (*Tursiops truncatus*). Specific concerns have been expressed that the Crystal Cove Project may impact the distribution, abundance, and natural behavior of the bottlenose dolphin on the Newport Coast. The following sections review the biology of this species in coastal Pacific waters and evaluate claims that it will be adversely affected by the Crystal Cove Project.

The Biology of the Coastal Bottlenose Dolphin

The bottlenose dolphin is the most usually observed just outside of the surf zone and is rarely more than 1 km from the shore. Solitary individuals are seldom seen; rather, dolphins usually occur in groups (termed pods, herds, schools, by various workers) that range in size from a few to as many as 100 or more animals.

Surveys over the past decade have significantly contributed to knowledge about the movements, population size, and behavior of the California coastal bottlenose dolphin. Aerial surveys have determined the spatial distribution of dolphin groups and estimated overall abundance. Boat-based surveys have determined dolphin presence and group size at different geographic locations and have enabled compilation of photographic identification records for individuals, based on the characteristic marking patterns on their dorsal fin (Würsig and Würsig, 1977; Kelly, 1983).

The photo-identification surveys of coastal *Tursiops* in California waters, which were done between 1981 and 1989, resulted in the registry of 404 individuals, as well as geographical distribution and abundance information. Combination of the identification and distribution data also allows estimation of the coastal bottlenose dolphin population size and description of movement patterns and rates.

Population Size

Censuses of the coastal bottlenose dolphin population have been conducted using aerial surveys and by applying different statistical methodologies to the "photo-identified" members of the population, based on the statistical principle of "mark and recapture" sampling (Hansen, 1990). In this application, the photo-identified dolphins are defined as "marked," and the percentage of these "recaptured" (i.e., re-sighted) on later survey trips is used to estimate total population number.

Between 1981-1983 Hansen (1990) photo-identified 123 dolphins in an approximately 30 km long study area in northern San Diego County and, based on photo recaptures, estimated the population size in this area at 240 dolphins (the 95% confidence intervals for the estimate are 120-477 dolphins). In surveys of approximately the same area between 1984-1989, Defran and Weller (1999) photo-identified 373 dolphins and, based on re-sightings, estimated population size for four successive years: 1985, 237 (214-262±95% confidence interval); 1986, 234 (205-263); 1987, 285 (265-306); 1988, 284 (274-294).

These estimates indicate that the relative numbers of bottlenose dolphins in the study area remained stable over the years 1981-1988. However, many of the identified dolphins were only observed once (i.e., from the first photograph) within the study area (Hansen, 1990; Defran and Weller, 1999). This means that the normal range of bottlenose dolphin movement likely extends well beyond the study area. Surveys conducted over the entire geographic range occupied by coastal bottlenose dolphins (i.e., from central California to southern Baja California) would provide a better estimate of total population numbers. Aerial surveys conducted from 1991 to 1994 estimated that 271 (240-306) bottlenose dolphins occupied the 450 km span between Point Conception, California and the U.S./Mexico border. This is approximately the same population number estimated based on the San Diego County survey; however, aerial surveys have been shown to usually under estimate the actual population number by a substantial amount (Hansen, 1990; Carretta et al., 1998). Also, as will now be discussed, the coastal bottlenose dolphins extend further north than Point Conception and further south than the U.S./Mexico Border. Thus, an aerial survey spanning this range would be required to obtain a meaningful population estimate.

Distribution and Movement Pattern

The bottlenose dolphins seen regularly along the southern California shoreline are members of the large coastal population that normally ranges from as far south as Ensenada, Baja California, Mexico (31°52'N) to Monterey Bay, California (37°00' N). Some members of this population have moved as far north as San Francisco Bay (37°40' N) and the northern most occurrence ever recorded is 100 km north of Seattle, Washington (Wells et al., 1990). Likewise, coastal bottlenose dolphins are known to extend all along the Baja California peninsula and into the waters of the Gulf of California, and some researchers are of the opinion that this population also extends south into the coastal waters of Central America (Defran et al., 1999).

A fact documented by the recent surveys was the northerly extension of coastal bottlenose dolphins to the central California coast as a result of oceanographic changes associated with the 1982-1983 El Niño. Wells et al. (1990) showed that bottlenose dolphins present in southern California waters in the early 1980s had migrated to the Central California coast during the 1982-1983 El Niño, and remained in that area for an extended period.

Defran et al. (1999) made a very important contribution to knowledge about the local movement patterns of the coastal bottlenose dolphins by conducting boat-based abundance surveys and photo-identifications at three locations, Santa Barbara, CA, Orange County, CA, and Ensenada, Baja California, over a relatively short time interval. Their results indicated that 88% of the dolphins photographed in Santa Barbara, 92% of those photographed in Orange County, and 88% of those photographed in Ensenada had also been documented during the earlier survey conducted between Torrey Pines State Park (northern San Diego) and Oceanside, California (Hansen, 1990; Defran and Weller, 1999). These findings show that coastal bottlenose dolphins are continuously moving between census regions and that there was little indication of site fidelity to a particular area.

The range of movements seen for the "photo identifiable" dolphins has allowed investigators to determine whether or not individuals showed fidelity to any particular area, either by remaining there, or by returning there after leaving. All observations indicate that coastal bottlenose dolphins are highly mobile, range over extensive long shore distances, and show little site fidelity to any particular coastal region. For example, only 10% of the "photo identified" individuals that were "observed again" were only seen at the same site where they were originally identified (i.e., they were never seen at another site). This indicates a high movement rate for the population. Moreover, for these same dolphins, the average time between their re-sighting at the original site was 203 days, which would be ample time for them to leave the area and return.

The movement data also show that bottlenose dolphin movements ranged from 50 to 470 km. In cases where a dolphin was seen at two different locations within a relatively short time span, its travel speed could be estimated. Specifically, a dolphin recorded in San Diego was found in Santa Barbara (286 km) 14 days later (20 km/day average travel speed). Another moved from San Diego to Orange County (93 km) in two days (47 km/day) and one went from San Diego to Ensenada in 12 days (11 km/day).

In summary, the overall conclusions reached by Defran et al. (1999) and several other workers are that coastal bottlenose dolphins move continuously between the study areas and because these movements are not correlated with season, and are occurring simultaneously in both directions along the coast, they do not constitute migrations. Many investigators suggest that these movements relate to bottlenose-dolphin feeding behavior (Norris and Dohl, 1980; Ballance, 1992).

Feeding Behavior and Prey

Coastal bottlenose dolphin groups appear to be continually foraging as they move along the coast (Kelly, 1990; Hanson and Defran, 1993). When prey are encountered they are dispatched, after which the dolphin group continues along the coast. The diet of the coastal bottlenose dolphin in the SCB consists mainly of fishes. A few macro-invertebrates (octopus, clams, shrimp, and seasonally abundant squid) are also taken. Hanson and Defran (1993) list 25 fish species that are consumed by bottlenose dolphins. These include turbot, halibut, queenfish, surf perch*, topsmelt*, anchovy, white croaker*, and midshipman (* species are in Table 1). The five top ranked prey, based on percentage of occurrence in dolphin stomachs are, in order of ranking: queenfish, white croaker, walleye surfperch, plainfin midshipman, and California corbina. Among these fishes, two groups, the sciaenids (croakers) and embiotocids (surf perch) account for 74% of the quantities ingested by the bottlenose dolphin. These primary prey fishes for the dolphin are non-migratory, year round residents of the open coast, sandy beach areas. Systematic surveys of the distribution patterns of the predominant prey fish species indicate they are widely distributed but are irregular in abundance and relative numbers, and are often concentrated in small, temporary aggregations.

Prey distribution has been demonstrated as a determining factor in the movement patterns of all marine mammals. Seasonal movements of the bottlenose dolphin population at Sarasota, Florida is, for example, closely correlated with seasonal shifts in mullet distribution (Irvine et al., 1981; Shane et al., 1986). The transient features of the California coastal bottlenose dolphin population, including high mobility, extensive long shore distance movements, the absence of site fidelity, and even the larger average group size, all appear to be the consequence of the patchy distribution of prey in the coastal waters of southern California and Baja California (Defran and Weller, 1999; Defran et al., 1999).

Reproduction and Demographics

Bottlenose dolphins reach reproductive maturity at about 7-10 years of age. Gestation requires about 12 months and calves are nearly 1 m long at birth. Neonates are readily differentiated from older calves by their very small size (less than half the length of the accompanying adult), a floppy dorsal fin, dark coloration, extreme buoyancy, a fetal swimming position relative to its mother, and fetal folds (Barco et al., 1999).

Maternal care of the calf begins with initiating nursing and continues through weaning and post-weaning. Mothers (cows) and calves, for example, maintain a closed echelon swimming formation for protection and calves feed with their mothers, who may assist this by activities such as herding prey. Mother dolphins may form groups with other mothers for the purposes of facilitating the protection, feeding, and nurturing of calves (Cockcroft and Ross, 1990). Close associations between mothers and calves can last for from 3 to 6 years and have lasted for as long as 8 years. Because of the care required by calves, females appear to have at least a two-year calving interval and often longer.

Breeding and calving are generally considered to occur year round in most populations. For the California coastal population, Hansen (1990) did not detect any seasonal peak in calving; however, based on a higher number of young dolphin strandings in October, suggested that calving may occur year round and peak in the fall. An annual survey of dolphins along the Orange County coastline indicated the presence of calves during all seasons (Kelly, 1990) and sightings of bottlenose dolphin parturition, compiled over 14 years, show this occurred over 6 contiguous months (November-May) as well as in July (Kelly, 1998, unpublished manuscript).

Field censuses distinguish two age classes of bottlenose dolphins; animals less than 1.5 m in length are defined as calves, and those longer than 1.5 m are defined as adults. The percentage of calves in the population provides an estimate of reproductive rate. Hansen (1990) found about 7.2% of the coastal San Diego population was comprised of calves and this agrees with Kelly's (1990) estimate of 6.9%. This estimate is very near the average number of calves found in most coastal U. S. bottlenose populations (mean 8%, range 3.7-15.7%). None of the California surveys to date report neonate numbers.

Hansen (1990) reported an average group size of 18 animals in the California population. During their 6 year survey, Defran and Weller (1999) found considerable year to year variation in mean group size (12.7-28.8); however, the overall mean group size for their study was 19.8. Thus, the group size reported for the both studies is larger than the 2-15 animals/group determined for most other bottlenose populations (Shane et al., 1986), a difference thought to be related to food supply and distribution in California waters (Defran and Weller, 1999).

How California Coastal Bottlenose Dolphins Compare With Other Populations

Tursiops truncatus occurs all around the world in warm-temperate waters of coastlines as well as in the open sea. Field studies of coastal bottlenose dolphins demonstrate their adaptability to variable habitat conditions. Gulf of Mexico and Atlantic coast dolphins differ in many respects from those in California largely because of habitat differences. The broader Gulf and Atlantic continental shelf increases coastal habitat area as well as complexity, with features such as broad, gently sloping, sandy beaches, large, shallow bays, river mouths, barrier islands and sounds being very abundant. Dolphins in these habitats move over shorter distances than do California dolphins and also appear to have home ranges that, while not defended like a territory, do represent limits to movement. Home range size is determined by population size, habitat quality, and food supply which, as in California dolphins, appears to be a determining factor in dolphin movement. Some dolphins remain in the same area for considerable time. Gulf and Atlantic coast dolphins also appear to divide their habitat more finely by aggregating in smaller groups. From 2-15 dolphins form most groups, however, some groups number 5-6 animals. Factors likely influencing group size include habitat structure, behavior, water depth, the proximity of the shoreline, bottom contour or area-specific foraging techniques, and the proximity of predators (sharks) and protection from predators (Norris and Dohl, 1980; Shane et al., 1986).

DOES A SPECIAL RELATIONSHIP EXIST BETWEEN THE NEWPORT COAST AND BOTTLENOSE DOLPHIN BEHAVIOR?

General Behavior and Movement Patterns

Professor Dennis Kelly heads the Marine Mammal Research Group at Orange Coast College (OCC) in Costa Mesa, CA. He is an authority on bottlenose dolphins in the Orange County region. He is a co-author of two previously mentioned studies: One documenting the El Niño-related translocation of members of the southern California bottlenose dolphin population to central California (Wells et al., 1990), and another demonstrating the relatively short-term movements of dolphins between locations as distant as Santa Barbara, CA and Ensenada, Baja California, Mexico (Defran et al., 1999).

A 1990 report by Kelly details a year-long survey of bottlenose dolphins within Orange County. Kelly monitored dolphin abundance and used photo identifications to evaluate site fidelity and determine patterns of seasonality in both abundance and reproduction (i.e., the relative abundance of calves). During the year, 581 bottlenose dolphins contained in 28 pods were sighted. Eighteen of the pods were north of Newport Bay, three were seen between Newport and San Onofre, and seven occurred at or near San Onofre. Eighty-nine dolphins were photo identified of which 59 (66%) were "recaputured" once, 21 were "recaptured" twice, and five were "recaptured" three or more times.

Kelly did not find seasonal differences in dolphin abundance or in the size of their pods (range 6-42, most common size range 20-30, median number of dolphins/pod 21), both of which are similar to other reports for bottlenose dolphins in the southern California region. His estimates for the relative calf population size (6.9%, about 2-4 calves/pod) also agree with observations for the southern California population.

In 1998-1999 two of Professor Kelly's OCC undergraduates conducted a land-based survey of coastal bottlenose dolphin abundance at 15 sites extending from Crystal Cove State Park (CCSP) south to Dana Point (16 km). In a student paper titled, "*The behavior and habitat usage of bottlenose dolphins along the Orange County Coast*," D. Figueroa and C. McClain reported carrying out 13 complete and 7 partial (i.e., not all sites were visited within one day) surveys between May 1998 and March 1999. Dolphins were seen during 3 of the partial and 4 of the complete surveys.

In the case of the 3 partial surveys in which dolphins were seen, a total of 20 dolphins were observed at only two locations (Shake Shack, Reef Point) both of which are within the CCSP. (**Note:** Data were reported only for sites where dolphins were observed and neither the number of sites visited during the partial survey nor their identity are indicated. This severely limits the utility of the partial survey data with respect to dolphin relative distribution and abundance in the study area.)

Critique of habitat paper

A total of 37 dolphins were sighted during the 4 complete surveys done by the two students. (**Note:** The students actually selected 18 sites, three of which were designated "optional." Data are reported only for sites where dolphins were observed. Thus, it is not clear which 15 sites were included in each of the complete surveys or if the site inclusions differed among the surveys.) Dolphins were seen at seven different locations, three of which (Pelican Point, Shake Shack, and Reef Point) are in the CCSP. However, only 6 of the 37 observed dolphins were at these sites; 31 of the dolphins observed were not within CCSP boundaries.

Although data presented in this report are not completely analyzed and difficult to interpret, the data table shows that 22 of the 57 dolphins observed (39%) were swimming "up coast," 25 (44%) were swimming "down coast," and 10 (17%) were alternately swimming in both directions. The pod sizes recorded by these workers (2-12, average 5.2) were smaller than published reports for the region (Kelly, 1983, 1990; Defran and Weller, 1999).

In summary, and although the data are not clear in all respects, the presence of 57 bottlenose dolphins was noted in this nearly year-long, land-based observation conducted by two OCC undergraduates. Of the 57 dolphin sightings, 20 (35%) are from one location, Reef Point. When the partial survey data are included, 26 of the 57 sightings (46%) occurred in the CCSP. However, when the partial survey data are excluded (this is appropriate because sites where dolphins were not present are not indicated), only 6 of 37 dolphin sightings (16%) occurred within the CCSP.

The ability to synoptically survey a large span of coastline could be an advantage for bottlenose dolphin population estimates, behavioral observations, and movement rate determinations. In this case, however, shore-based surveys of dolphin abundance, while expedient for student participation, are subject to numerous operational limits that restrict their validity. Principal among these were the low frequency of statistically useful survey data and the lack of proximity to the animals and, in turn, the inability to verify that individual dolphins observed at adjacent sites are not one in the same. Also, the data presentation was incomplete.

Critique of habitat paper

Nevertheless, and the observations of pod size aside, the major indications of the student report, that bottlenose dolphin relative abundance is not greater along the Newport Coast than at the other areas surveyed, and that dolphins are moving in both directions along the coast, agree with Kelly's (1990) conclusions for the Orange County bottlenose dolphins and further agree, in most respects, with observations made on coastal bottlenose dolphins at other southern California localities (Hansen, 1990; Defran and Weller, 1999; Defran et al., 1999).

Most of Kelly's (1990) sightings were in areas having a shallow sandy bottom that was low in relief with few or no rocky headlands or major topographic irregularites off shore which he suggests favor dolphin foraging. This agrees with the interpretation of other workers. Also, Kelly's (1990) findings for pod size, the percentage of calves in the population, the absence of site fidelity, and no seasonal differences in overal dolphin abundance all correspond with observations of other workers and conform to the general consensus view that coastal bottlenose dolphins are moving along the coast of Orange County and the Newport area and are neither residing at specific locations nor exhibiting a greater affinity for this region than for others. It is emphasized that this general behavioral pattern describes bottlenose dolphins all along the southern California coast and probably also applies to populations living in central California and in southern Baja California (Defran et al., 1999).

Nursery and Birthing Behavior of Coastal Bottlenose Dolphins at Crystal Cove State Park

Kelly (1990) reported two observations of what appeared to be the live births of bottlenose dolphins; one at "Scotsman's Beach" (**Note**: this exact location is not marked but it is likely the same as Scotchman's Cove mentioned by Brusca and Zimmerman, 1979 and must be near Scotchman's Reef, which was studied by Valencic, 1987), the other at Niguel Beach (exact location not certain). The OCC student paper, "*The behavior and habitat usage of bottlenose dolphins along the Orange County Coast*," also reported a dolphin "birthing circle" at El Morro Cove.

Birthing circle paper

In 1998 Professor Kelly wrote a manuscript "*Nursery birthing behavioral observations of coastal bottlenose dolphins at Crystal Cove State Park*," describing what he interpreted as unique behavior not previously reported for bottlenose dolphins. The behavior was first observed in the late afternoon of 21 December, 1982. It involved the attendance and perhaps assistance of several dolphins in parturition. Kelly observed seven dolphins that had formed a circle around one. Most often, the encircling animals had their beaks directed in towards the dolphin they surrounded. The group was close to shore, in water of less than 4 m depth. After about one hour, the central dolphin underwent convulsion-like body flexions. The surrounding dolphins also underwent some extreme and rapid body flexures and the group exhibited diving, surfacing, and rolling motions, displacing themselves about 3 meters in the process. Following all of this activity, Kelly observed nine dolphins; two of which were now in the center and ringed by theseven outer dolphins, which continued their close contact with the inner ones.

In his manuscript Kelly writes that his first thought was that he was witnessing what is termed epimeletic behavior, a well-documented action in which members of a school assist a distressed dolphin by holding it upright and preventing its sinking (Norris and Dohl, 1980). However, the apparent appearance of the additional dolphin indicated that a birth had occurred and Kelly termed the behavior he observed the "dolphin birthing circle." He concluded that the dolphin in the center of the ring had given birth and that the surrounding dolphins had been in attendance and perhaps assisted in some way. Shortly after birth had occurred, the group swam to the southeast.

Pitt

Ditt

A table in Kelly's unpublished manuscript details observations of a total of 11-bottlenose dolphin birthing circles made over a 14 year span. In every case that he observed, Kelly reports documenting the appearance of an additional dolphin in the center of the circle and in several cases he witnessed a birth. Nine of the 11 birth circles were observed in the CCSP and two were observed at San Onofre. The mean number of dolphins in the birth groups at CCSP was 9 (range 6-12) while 7-8 dolphins formed the birth groups seen at San Onofre. Kelly noted that the two areas where the observations were made are similar, in that beaches have low densities of people relative to other areas, and that the beaches are narrow with 10-30 m vertical cliffs. (**Note**: Three of the nine birthing-circle observations made at Crystal Cove were in July. Kelly did not remark how the number of people on the beach at that time compared to his winter and spring observations of circles in this area.) Crystal Cove has three long (100 m) rocky reefs projecting almost perpendicular from the beach and Kelly suggests that these features may minimize wave action and surge, thereby calming the water and facilitating parturition.

Kelly (1998 unpublished) lists another sighting of the dolphin birth ring formation made by workers at the Marine Mammal Care Center, Fort MacArthur, Palos Verdes Peninsula. This observation, which was reported in the Los Angeles Times (13 November. 1996), indicated that five dolphins formed the birthing group. Another observation was made on December 14, 1995 by Ms. P. Newman, who made a 2.5 hour video recording of bottlenose dolphin nursery behavior from her home which overlooks Three Arch Bay, South Laguna Beach. This involved twelve dolphins and there were two neonates, both of which had been born prior to time the video record began. Kelly observed the video and concluded that it showed the attending dolphins assisting the neonates with nursing.

Video

SCIENTIFIC EVALUATION OF REPORTS ON THE BIRTHING CIRCLE PHENOMENON

The observations reported in Professor Kelly's (1998) manuscript are summarized as follows: Thirteen events, occurring over 14 years, have been documented. Eleven of these were directly observed by Kelly; nine of his sightings occurred along the CCSP coast and the other two occurred 40 km to the south at San Onofre. Of the two events not directly observed by Kelly, the one at Three Arch Bay (11 km south of CCSP) was videotaped, while the one at Palos Verdes (about 40 km north of CCSP) was made by a person experienced with marine mammals. Thus, "the birthing circle or ring" phenomenon as described by Kelly appears to be:

1) Documented, but seen infrequently,
2) Occurring over a time span of at least six contiguous months: November, December, January, February, March, and April, and it was also observed in July, and
3) Not occurring exclusively at the Newport Coast, having been seen over an 80 km span of coast extending from Palos Verdes to San Onofre.

It appears that Professor Kelly may be correct in concluding that he was not witnessing an epimeletic behavior. Actually, the "birth-ring" behavior he described for these dolphins seems quite similar to the "allomaternal behavior" described for bottlenose and other dolphin species, and for other cetaceans by earlier workers. Herman and Tavolga (1980 pp. 192-193) review some of the earlier accounts of this behavior and wrote the following description:

Other investigat

> "Among "captive" bottlenose dolphins the birth of a calf may be closely attended by nonpregnant females, or 'aunts,' exhibiting allomaternal behavior (McBride and Kritzler, 1951; Tavolga and Essapian, 1957) Although Dudok van Heel (1977) believes that 'aunts' are not essential and may even be a 'nuisance,' in the wild they may protect the vulnerable mother from attacks by predators or harassment by mature males. In one observation of a birth in captivity to a dusky dolphin, an attending female of the same species apparently bit the umbilical cord in two (Allen, 1977). In bottlenosed dolphins, breaking of the cord by the mother herself through a sudden whirling maneuver is more commonly observed (Essapian, 1953; McBride and Kritzler, 1951)."

Based on captive Animal

> "Aunts show great interest in the calf after birth and typically school closely with the mother-calf pair. Although there are isolated cases of aunts temporarily taking the calf away from its mother, they more typically provide protection for the pair and may 'baby-sit' the calf while the mother is on a feeding foray."

There are a number of recent papers describing different examples of allomaternal care among bottlenose dolphins (Smolders, 1988; Kastelein et al., 1990; Mann and Smuts, 1998). However, there are no accounts of "dolphin birthing circles" in the scientific literature.

Authorities on cetacean and marine mammal behavior that were consulted about this behavior had either not heard of it before or knew of Professor Kelly's observations but were not familiar with the supporting data, and none had ever seen anything comparable during their field observations.

DeFran opinion

I spoke with Dr. R.H. Defran, Professor of Psychology at San Diego State University and Director of the University's Cetacean Behavior Laboratory. Dr. Defran is an authority on the behavior of coastal bottlenose dolphins in the waters off southern California and Mexico and several of his papers (including a work co-authored with Professor Kelly) are cited in this report [Hansen and Defran (1993); Defran and Weller (1999); Defran et al., (1999)]. Professor Defran is familiar with Professor Kelly's birthing circle observations and has discussed them with him. Defran stated,

> "Kelly's observations suggest that an interesting behavioral phenomenon may be occurring but details are lacking and the work needs to be published in the scientific literature in order to gain accreditation."

Defran further stated that neither he nor any of his students have observed such a behavior in over 15 years of observations in coastal waters ranging from Santa Barbara County to Baja California.

Ms. Rindy Anderson (MA), a Research Biologist at the Hubbs-Sea World Research Institute, San Diego, is an qualified professional in acoustic sensory perception by marine mammals and an experienced investigator in the areas of marine mammal behavior and the field and laboratory observation of marine-mammal behavioral responses. While acknowledging that she is not an expert on bottlenose dolphins she remarked,

> "I have never heard of any theories regarding a 'calving nursery' for Pacific coast bottlenose dolphin populations off the coast of Newport, CA, nor have I seen any published literature or data to support such a theory."

An authority on cetacean behavior who refused to be identified said that he/she was familiar with Professor Kelly's birthing circle descriptions and that he/she had seen the supporting data which he/she judged to be far from conclusive. He/she added that he/she had made no comparable observations on *Tursiops truncatus* in southern California waters.

Another world authority on cetaceans, who did not wish to be identified, said he/she would need to examine the supporting data before reaching conclusions.

Many aspects of the allomaternal behaviors described for the bottlenose and other dolphins are markedly similar to the birthing aggregation behaviors described in Kelly's manuscript. The scientific literature also supports Kelly's conclusion that full-term females favor calm, protected areas in which to give birth. Scott et al. (1990), for example, observed that bottlenose dolphins in Sarasota Bay used the shallow and largely enclosed Palma Sola Bay, as a nursery area. Cows with neonates occurred more frequently in this area than in either the open waters of Sarasota Bay or in the ocean. In addition to calm water and protection from predators, these areas also have a large availability of prey. A survey of coastal Atlantic bottlenose dolphins in the nearshore waters of Virginia also shows a greater abundance of females with neonates in the shallower, calmer waters of the southern Chesapeake Bay compared to the more open and deeper coastal Atlantic waters of Virginia Beach (Barco et al., 1999).

Kelly's (1998) summary table also points out birthing aggregations occurred at both Palos Verdes and San Onofre, which indicates that the Newport Coast is just one of several potential areas that a full-term pregnant dolphin may select for parturition. Barco et al. (1999) reported that the coastal bottlenose dolphin population they studied in Virginia also made use of another nursery area at Beaufort, North Carolina, about 300 km to the south. In view of the geographic separation of nursery areas used by Altantic bottlenose dolphins, it seems reasonable to suggest that other areas along the coasts of California and Baja California could also function as birthing sites for bottlenose dolphins. It is certainly the case that many other coastal areas have the same physical features of the Newport Coast that Kelly suggested as being important for selecting a birth site (i.e., somewhat enclose areas featuring cliffs, narrow beaches, and submerged rocky areas).

Considering the range and mobility of the coastal California bottlenose population, it is reasonable to expect that pregnant females are widely distributed and they are not always going to be in the vicinity of the Palos Verdes-Newport-San Onofre area when they reach term. This is supported by the movement data acquired for this population, which do not indicate directed movements. More importantly, there is not a shift in the relative numbers of calves in the populations occurring in Orange County. Nor are there any indications, among the surveys that have been done, of more frequent observations of neonate dolphins in the Orange County area. If the Newport Coast is the exclusive or a principal site for bottlenose dolphin parturition, then a greater number of neonates and cows would be expected there. Scott et al. (1990), for example, used the high abundance of cows and neonates in the Palma Sola back bay region of Sarasota Bay to support their conclusion that this was a preferred birthing area.

COASTAL HABITAT CONDITIONS POTENTIALLY AFFECTING MARINE FISHES, BOTTLENOSE DOLPHINS, AND OTHER MARINE MAMMALS

Water Quality

In the course of biological inventories of the Newport Coastline, Brusca and co-workers made a number of site-specific observations regarding potential pollution and other threats to environmental water quality. Brusca and Winn (1979) noted that, in the northern area of the Newport ASBS, several small drainages enter the beach zone and form a marshy region. They cite the threat of runoff from streets and developed areas in this region as well as the effect of outflow from the Newport Bay Channel.

With regard to the Irvine ASBS, Brusca and Zimmerman (1979) noted heavy erosion occurring at Scotchman's Cove (a high relief area west of Reef Point) but did not mention any effects of sediment deposition in the adjacent marine habitat. They noted the potential effects of storm runoff from Muddy Canyon Creek, which crosses the beach just east of Reef Point, and Los Trancos Creek, which connects to the sea at Crystal Cove. They also remarked about a small stream entering the beach at Abalone Point and several nearby drainages onto the beach in that area. They suggested that nutrient-rich effluents from the equestrian center east of Pacific Coast Highway (PCH) likely entered the coastal habitat at these points. While noting the need to protect the coastal habitat from excess drainages associated with future developments east of PCH, Brusca and Zimmerman voiced the opinion that the greatest threat to coastal water quality was outflow from Newport Bay Channel, about 6 km to the west, which is frequently transported into the ASBS's by prevailing nearshore currents. Figures 34-36 in Jenkins and Wasyl (2000) illustrate the potentially large effect that Newport Bay outflow will have on the Newport Coast and these workers emphasize the importance of this bay and other discharges (Buck Gully, Morro Creek) in contributing to average coastal water conditions. Professor Richard Ford (2000 and pers. comm.) similarly notes the larger potential impacts for the Newport Coast of rainy season discharges from both Newport Bay and the Santa Ana River.

Analyses of chemical constituents and bacterial levels in Los Trancos and Muddy Creeks, both at sites within the watersheds and offshore from their ocean entry points are reported by Richard Ford as associates (Ford, 2000; Ford et al., 2000). Parallel studies were also conducted in the adjacent Emerald Creek watershed for purposes of establishing control levels. Emerald Creek receives a large percentage of its runoff from the areas along PCH as well as from developed areas inland. Water samples were analyzed for total suspended solids and for the contents of trace metals and organophoshorus pesticide compounds and residues. Bacterial counts were made for coliforms, fecal coliforms, and enterococci. Salinity was also measured around the outfall sites of each creek.

The results show these three watersheds are largely free of trace metal contaminants attributable to anthropogenic activity. Also, the levels of organophosphorus compounds and bacteria are minimal. Storm condition runoff is characterized by the first-flush pulsing of these agents, however, their concentrations are quickly diluted in the surf and the bacteria do not survive in ocean salinity. Subsequent storm peak runoffs do not have the same high levels as the first runoff, which suggests that materials deposited during the dry months were carried down in the first rains of the season. The Emerald Canyon control sampling site near PCH had large fecal coliform and enterococci counts, which seems attributable to a greater presence of vertebrate animals (i.e., pets) within this drainage (Ford et al., 2000).

In summary, Pre-Project conditions in Newport Coastal waters pose no health threat to marine mammals and fishes in the vicinty of Los Trancos and Muddy Creeks. The outflows from these creeks contain no heavy metal, organic, or pathogenic pollutants. Post-Project Conditions, by diverting dry season nuisance runoff to the sewer system, will improve on an already favorable situation.

Turbidity Effects

Brusca and Winn (1979) observed that both surf conditions and seasonal increases in phytoplankton affect water turbidity and visibility. They reported ranges in visibility from a few inches to 10 m which is comparable to other areas in southern California (Quast, 1968; Turner et al., 1969). That surf action and surge contribute to a high turbidity and variable visibility is a fundamental fact for fishes living in the upper 30 m of the ocean. Seasonal cycles of winter and spring nutrient enrichment and resultant increased phytoplankton productivity also contribute to decreased water clarity.

Sedimentation and turbidity have both been found to decrease fish recruitment as well as to adversely affect the primary productivity of a habitat (Pondella and Stephens, 1994; Love et al. 1998), including kelp production (MBC, 2000; Jenkins and Wasyl, 2000). Species such as the garibaldi (*Hypsopops*) guard their substrate-attached eggs and thus require rocky areas for this. Increased sedimentation covers the substrate and reduces bottom relief. This lessens the size of areas open for larval settlement as well as grazing areas for adult fish (Pondella and Stephens, 1994; Patton et al., 1985) and also eliminates attachement sites for the kelp (MBC, 2000) thereby reducing local fish abundance.

Both sedimentation and turbidity occur naturally at areas of fresh water inflow and there are instances in which human activities have caused changes in benthic ecosystems and altered the local marine ecosystem in ways affecting fish abundance(Pondella and Stephens, 1994; Bond et al., 1999; MBC, 2000).

Pollution

Many studies have documented the ubiquitous occurrence of chemical contaminants in the sediments as well as in various marine organisms living in the SCB (D. A. Brown et al., 1986, Cross et al., 1987; D.W. Brown et al., 1998; McCain et al., 1988). An effect of some of these pollutants on the catch rate (Cross and Hose, 1988), reproductive success (Hansen et al., 1985; Cross and Hose, 1988; Pragar and MacCall, 1993), recruitment (Hansen et al., 1985; Cross et al., 1987; Cross and Hose, 1988), and health (Cross et al.,1987; McCain et al., 1988) of some marine fish species has been shown.

It is emphasized that the these chemicals are not present in the runoff waters of Los Trancos and Muddy Creeks (Ford et al., 2000). Also, the southern Orange County region (specifically Dana Point) was judged to have lower levels of sediment contamination than other areas within the SCB (McCain et al., 1988).

The Bottlenose Dolphin and Other Marine Mammals

Concerning marine mammals, the major environmental concerns expressed by Kelly (1990) and others include human encroachment into the area, a reduced prey abundance due to the depletion of naturally occurring fish stocks as a result of over-fishing and pollution, and the high levels of organic pesticide residues that chronically persist in coastal marine mammals (the bottlenose dolphin, seals, and sea lions). Extremely high amounts of chlorinated hydrocarbon residues have been found in the tissues of most marine mammals including the bottlenose dolphin (O'Shea et al. 1980; O'Shea, 1999). Organochlorides are now banned from use in most of the world but they are ubiquitous in the global marine ecosystem. They are not biodegradable, are concentrated in the "top of the food chain predators" such as the bottlenose dolphins and, because they are not subject to biochemical degradation, are passed from one generation to the next in mother's milk (O'Shea, 1999). Organophosphates, the residues of pesticides, pose another marine pollution problem, however, Ford et al. (2000) have shown these are not present in the runoff from Los Trancos and Muddy Creeks.

POST-PROJECT CONDITIONS AT CRYSTAL COVE: IMPLICATIONS FOR COASTAL HABITAT CONDITIONS AFFECTING FISHES AND MARINE MAMMALS

Post-Project Environmental Conditions

The extensive Runoff Management System to be used in the Crystal Cove Development Project will contain virtually all of the dry season daily runoff from Muddy and Los Trancos Creeks. A series of riparian filters, detention basins, traps, and other structures will reduce water flow from the two canyons (Hamilton, 2000a, b). Any dry season flow reaching the creek base near the PCH will be pumped from there into the sewer system. The net Post-Project effect therefore is that virtually no freshwater enters the Crystal Cove State Park (CCSP) from Muddy and Los Trancos Creeks during the dry season.

For the above reason the focus of freshwater runoff associated with the Project has been on flows occurring during the rainy period (Hamilton, 2000a, b). Storm-condition flow volumes and flow rates into coastal waters from Muddy and Los Trancos Creeks have been estimated by Hamilton (2000a and b) and are central to all subsequent considerations. This analysis shows that there will be more runoff because of the in presence of impervious surfaces, however, the planned Runoff Management System will reduce the water-flow rates (i.e., prolonging the flow durations and allowing more time for the drop of suspended sediments) (Hamilton, 2000a and b; Jenkins and Wasyl, 2000; Mangarella, et al., 2000).

Sediment Transport

Sediment yield studies for Muddy Canyon and Los Trancos Canyon discharges into the Irvine Coast (Crystal Cove) Marine Life Refuge and ASBS were conducted by Chang (2000). These show that the Runoff Management System in the Crystal Cove Development plan will lessen the annual rate of fine (<0.062 mm diameter) sediment transport into the ocean by 76%. Because suspended fine sediments cause turbidity, this reduction will lessen turbidity conditions along the shore line of Crystal Cove State Park.

Turbidity

Calculations of sediment reception and dispersal along the coastline have been made by Jenkins and Wasyl (2000). These show that a relatively smaller plume will form Post-Project compared to Pre-Project. The Pre-Project plume occurs at the surface and extends about 1.5 km offshore (to about the 50 m isobath) and extends about 3.7 km along shore. The Post-Project plume will also be at the surface and it will extend to only about 0.8 km offshore (to about the 30 m isobath) and will be about 2.9 km long. Thus, relative to Pre-Project conditions, the Post-Project storm-flow sediment load will be less as will be the outlfow rate. Lower amounts of sediment will therefore lessen the effect on ambient turbidity. Jenkins and Wasyl (2000) also point out, as was emphasized earlier, that there are many other factors contributing to coastal zone turbidity. Thus, under certain conditions, wave and turbulence generated ambient turbidity levels at the CCSP discharge sites could exceed runoff water turbidity.

Biological Effects of Storm Runoff

Thorough analyses by Ford (2000) and by Ford et al., (2000) evaluate every facet of the question of the potential effects of storm runoff on the shallow-water marine invertebrate biota. These findings are directly applicable to both marine fishes and marine mammals which, because of their larger size, mobility, and physiological capacities to precisely regulate their internal salt and water contents (Schmidt-Nielsen, 1993), will be unaffected by salinity reductions within the discharge plume.

Pre-Project studies of salinity fluctuation at the site of runoff impingement with the ocean indicate that, under extreme runoff conditions, salinity at the discharge site could be reduced to as low as 46% of normal (i.e., to about 15 ppt) (Ford, 2000, Table 5, Station LT-1 @ 1330 hrs on March 5, 2000). Applying the dispersal plume calculations of Jenkins and Wasyl (2000) and, depending upon wave energy and tide state, a plume of reduced salinity extending about 800 m out to sea and about 2.9 km along the coast would persist for as long as maximum outflow conditions were in effect. The expected salinity gradient at the discharge, about 18 ppt (i.e., 33 - 15 ppt) within the plume would rapidly decline away from the point source. This magnitude of the salinity change during peak runoff is not large and as shown by data in Ford (2000, Table 5), it would not persist very long. Ford (2000) also points out that the discharge sites of Los Trancos and Muddy Creek are onto sandy beaches and not directly into the rocky intertidal areas, about 100 m distant both up and down coast, where there is a much greater biotic diversity.

The ability to tolerate changes in ambient salinity is a fundamental fact of life for all shallow-dwelling sandy beach and rocky intertidal organisms and Ford (2000) has reviewed scientific literature documenting this. It is emphasized that, because of a lower flow rate, the Post-Project effect of salinity change for the organisms comprising the sandy beach community will be less than they are now, which is not extreme.

Moreover, Ford (2000) has also observed that many of the animals inhabiting the sandy beach zones near the Los Trancos and Muddy Creek outfalls, are broadly distributed and have some capacity to reposition themselves along the beach. This means that if a large infusion of low salinity water was to have the effect of reducing local population size, the resilience of these animals, that is their mobility as well as their capacity to recruit new members to the population into "open space," would quickly restore pre-storm densities.

Biological Responses: Pre- and Post-Project Effects on Fishes and Mammals

Fishes swimming near the Los Trancos and Muddy Creek storm outfall sites would encounter the salinity fluctuations described above. Ford (2000) has emphasized that these salinity changes will be both localized and brief in duration. Moreover, the plume of water will not extend into subsurface waters where most fishes occur.

A major advantage that fishes have relative to marine invertebrates [which are the the main focus of Ford's (2000) report], is that they are highly mobile and can avoid areas of low salinity simply by swimming away. Another advantage that marine fishes have over invertebrates is a more proficient mechanisms for compensating for salinity change. Marine fish "osmoregulate" which means that they have physiological and biochemical capacities to homeostatically maintain their body fluid solute contents in the face of enviromental salinity changes (Schmidt-Nielsen, 1993). Capacities for osmoregulation are particularly enhanced in shallow water marine fishes because they, like shallow-water marine invertebrates, naturally encounter variations in environmental salinity.

Probably the most convincing documentation of the intrinsic capacity of fishes living along the Newport Coast to tolerate the Post-Project storm runoff salinity conditions predicted for the Crystal Cove ASBS is to list the species in Table 1 that are known to live year round in Newport Bay, an enclosed region where annual salinities range from 5 to 25 ppt. Horn and Allen (1985) showed that the following species, all included in the Table 1 inventory, are permanent residents of the Newport Bay channel and inshore habitats: *Atherinops, Cymatogaster, Damalichthys, Embiotica, Hypsopsetta, Paralabrax* (both species), *Sygnathus, Urolophus.*

It is emphasized that these species are permanent residents of the low salinity habitat in Newport Bay. It is likely that a number of other fishes listed in Table 1 are able to tolerate the short exposure to salinity changes should these be encountered. However, as shown by the Jenkins and Wasyl (2000) calculations, the low salinity plume would be at the surface, should not extend more than 0.8 km offshore (to about the 30 m isobath), would be short lived, and the most extreme condition (15 ppt) would exist only at the point source.

Salinity, Bottlenose Dolphins, and Other Marine Mammals

Coastal bottlenose dolphins have osmoregulatory capabilities far superior to those of marine fishes. Because dolphins breathe air and do not have gills, their degree of "osmotic exposure" to ambient salt levels is much reduced. Also, dolphin skin is highly impermeable to ions and water, and having a highly efficient kidney, dolphins can regulate their salt and water balance with precision (Schmidt-Nielsen, 1993). This means dolphins are essentially insulated from the osmotic challenges that salinity reduction imposes on both marine invertebrates and fishes. Dolphins also naturally encounter variations in coastal salinity, each time they cross the mouth of a river or estuary, for example.

In summary, Pre-Project outflow salinity conditions do not present an environmental challenge for marine fishes or marine mammals in the coastal waters near Los Trancos and Muddy Creeks. Post-Project conditions of a reduced level of low salinity water outflow and the removal of most pollutants, toxins, and pathogens from the water will further reduce any threat to the health and well being of the region's marine fish and mammal species.

Fishes, Marine Mammals, and Turbidity

Coastal zone water turbidity is affected by several factors including wave action, currents, biological production, and sediment transfer from runoff (Jenkins and Wasyl, 2000). Variation in turbidity over a short time period is also a natural occurrence in the coastal ocean and this has biological importance for animals dependent upon vision. Turbidity affects both the near (acuity) and far (detection) visual fields. Increased turbidity may aid a stationary predator by making it less easily seen by a prey that might inadvertently swim too close. On the other hand, the stationary predator (e.g. a fish) cannot see as far in turbid conditions and may not see the close approach of an organism that could potentially eat it (e.g., sea lion or dolphin) until it is too late. Marine mammals have excellent vision and dolphins can echolocate which gives them an additional advantage over fishes in turbid water.

Post-Project conditions with respect to Los Trancos and Muddy Creek sediment transfer into Crystal Cove Waters will be improved relative to Pre-Project conditions. Sediment transfer will only take place during peak storm runoff conditions and due to entrapment measures designed into the watershed Runoff Management System, less sediment will enter coastal waters.

THE CRYSTAL COVE PROJECT AND BOTTLENOSE DOLPHIN BIRTHS

Conclusion

Post-Project environmental quality in the Crystal Cove area will be improved by regulation of the outflow from Los Trancos and Muddy Creeks, by deposition of dry season nuisance flow into the sewage system, and by reduction in fine sediments. Moreover, water quality measures will result in contaminant loads below critical thresholds. This will lessen the exposure of bottlenose dolphins transiting Newport Coast waters. Because of the Project's Runoff Management System, overflow from the two sites during storms will have less of an effect on turbidity than presently exists (Jenkins and Wasyl, 2000). Water quality analyses by Professor Ford and co-workers (Ford, 2000; Ford et al., 2000) indicate that there are no potential pollutants, marine mammal pathogens, or toxins entering from the watersheds and that salinity changes will be minimal and very localized. Thus, environmental quality in the vicinity of Crystal Cove will remain highly favorable for bottlenose dolphins that are born in the area's waters (Mangarella et al., 2000).

My strong opinion is that there is no scientific basis for arguing that the Crystal Cove Project will result in an unanticipated public use rate of the Crystal Cove State Park (CCSP) and that this, in turn, will thereby adversely affect bottlenose dolphin birthing behavior. The question of whether the Crystal Cove Development will result in additional use of the CCSP has been already been addressed in previous General Plan Environmental Impact Report (EIR), the findings of which include:

Final conclusion concerning dolphin birthing circles

> "While the project site is expected to contribute to the demand for use of Crystal Cove State Park, LCWP, and local parks and recreational facilities, because of comprehensive land use planning in the Newport Coast LCP, the regional and local parks and recreation facilities will not be adversely impacted by the proposed project."
>
> (EIR 4.11-11)

No impact statement

Also, and with respect to the CCSP itself,

> "The State Park would be filled to capacity only occasionally, in peak season, since visitor use normally is distributed throughout the day. It is typical for beach parks such as Crystal Cove State Park to experience visitor turn over of approximately 2.0 (i.e., 100 percent turnover per day). Therefore, a total of 14,960 visitors could be accomodated at the Park on a peak day."(EIR4.11-2)

Opponents of the project have stated that, through a cumulative effect on beach attendance or water quality issues, the Crystal Cove Project will interfere with the birthing behavior of bottlenose dolphins in CCSP. My opinion is that this claim is entirely unwarranted based on evidence available about the dolphin birthing process in the CCSP waters. As has been detailed above, this opinion is based on indications that birthing circles at CCSP have been observed in July (when beach attendance would have been near maximum) as well as in the winter and spring months. Also, Crystal Cove is

Overall conclusion

not the exclusive birthing site of the population. The overall indications supporting my view include:

- Birthing has been seen at other locations (San Onofre and Palos Verdes).
- Pregnant females moving continuously along a 700 km shoreline are likely to come to full term at locations far remote from the Newport Coast and thus use other birth sites.
- Other transient bottlenose dolphin populations use different birth sites.
- The frequency of birthing at Crystal Cove is very low:

  -The total number of "birthing circles" and apparent births observed at Crystal Cove by Professor Dennis Kelly amounts to only 9 in 14 years.

  -Of these, 6 occurred in the months of December to April, when the beach use would be minimal and 3 occurred in July when beach occupancy should have been near maximum.

REFERENCES CITED

Allen, J.F. 1977. Dolphin reproduction in oceanaria in Australasia and Indonesia. In: S. H. Ridgeway and K. Benirschke, (eds), *Breeding Dolphins: Present Status, Suggestions for the Future*. U.S. Marine Mammal Commision Report MMC-76/07.

Allen, L.G. and E. E. DeMartini, 1983. Temporal and spatial patterns of nearshore distribution and abundance of the pelagic fishes off San Onofre-Oceanside, California. U.S. Fishery Bulletin 81:569-586.

Allen, M. J. D. Diener, J. Mubarak, S. B. Weisberg, and S.L. Moore. 1994. Demersal fish assemblages of the mainland shelf of southern California in 1994. Southern California Coastal Water Research Project Annual Report. Westminster, CA.

Ballance, L. T. 1992. Habitat use patterns and ranges of the bottlenose dolphin in the Gulf of California, Mexico. Marine Mammal Science 8:262-274.

Barber, R. T., J. E. Kogelschatz, and F. P. Chavez. 1985. Origin of productivity anomalies during the 1982-1983 El Niño. CalCOFI Reports 26:65-71.

Barco, S. G., W. M. Swingle, W. A. McLellan, R. N. Harris, and D. A. Pabst. 1999. Local abundance and distribution of bottlenose dolphins (*Tursiops truncatus*) in the nearshore waters of Virginia Beach, Virginia. Marine Mammal Science 15:394-408.

Bond, A. B., J. S. Stephens Jr., D. J. Pondella, M. J. Allen, and M. Helvey. 1999. A method for estimating marine habitat values based on fish guilds, with comparisons between sites in the Southern California Bight. Bulletin of Marine Science 64:219-242.

Brown, D. A., R. W. Gossett, , P. G., Hershelman, C. F. Ward, A. M. Wescott, and J. N. Cross. 1986. Municipal wastewater contamination in the Southern California Bight: Part I- Metal and organic contaminants in sediments and organisms. Marine Environmental Research 18:291-310.

Brown, D. W., B. B.McCain, B. H Horness, C. A. Sloan, K. L.Tilbury, S. M., Pierce, D. G. Burrows, S. L. Chan, J. T. Landahl, and M. M. Krahn, 1998. Status, correlations and temporal trends of chemical contaminants in fish and sediment from selected sites on the Pacific coast of the USA. Marine Pollution Bulletin 37:67-85.

Brusca, R. C. and M. K. Wicksten. 1979. California Marine Waters Areas of Special Biological Significance Reconnaissance Survey Report: Heisler Park Ecological Reserve, Orange County. California State Water Resources Control Board Water Monitoring Report 79-2.

Brusca, R. C. and R. N. Winn. 1979. California Marine Waters Areas of Special Biological Significance Reconnaissance Survey Report: Newport Beach Marine Life Refuge, Orange County. California State Water Resources Control Board Water Monitoring Report 79-4.

Brusca, R. C. and R. Zimmerman. 1979. California Marine Waters Areas of Special Biological Significance Reconnaissance Survey Report: Irvine Coast Marine Life Refuge, Orange County. California State Water Resources Control Board Water Monitoring Report 79-3.

Carlucci, A.F., Eppley, R.W., and Beers, J.R. 1986. Introduction to the California Bight. pp. 1-12, In: R. W. Eppley (ed.), *Plankton Dynamics of the Southern California Bight. Lecture Notes on Coastal and Estuarine Studies*. Springer-Verlag.

Carretta, J.V., K. A. Forney, and J. L. Laake. 1998. Abundance of southern California coastal bottlenose dolphins estimated from tandem aerial surveys. Marine Mammal Science 14:655-675.

Chang, H.H. 2000. Sediment yield study for Muddy Canyon and Los Trancos Canyon. Report for the Irvine Community Development Center.

Cockcroft, V.G. and G.J.B. Ross. 1990. Observations on the early development of a captive bottlenose dolphin. pp. 461-478, In: S. Leatherwood and R.R. Reeves (eds.), *The Bottlenose Dolphin*. Academic Press.

Cross, J. N., J. T. Hardy, J. E. Hose, P. G. Hershelman, L. D. Antrim, R. W. Gossett and E. A. Crecelius. 1987. Contaminant concentrations and toxicity of sea-surface microlayer near Los Angeles, California. Marine Environmental Research 23:307-323.

Cross, J. N. and J. E. Hose. 1988. Evidence for impaired reproduction in white croaker (*Genyonemus lineatus*) from contaminated areas off southern California. Marine Environmental Research 24:185-188.

Defran, R. H. and D. W. Weller. 1999. The occurrence, distribution, site fidelity, and school size of bottlenose dolphins (*Tursiops truncatus*) off San Diego, California. Marine Mammal Science. 15:366-380.

Defran, R. H., D.W. Weller, D.L. Kelly, and M. A. Espinosa. 1999. Range characteristics of Pacific bottlenose dolphins (*Tursiops truncatus*) in the Southern California Bight. Marine Mammal Science 15:381-393.

Dudok van Heel, W.H. 1977. Dolphin reproduction in western Europe. In: Ridgeway, S. H., and K. Benirschke, Eds, *Breeding Dolphins: Present Status, Suggestions for the Future*. U.S. Marine Mammal Commision Report MMC-76/07.

Ebeling, A.W., R.J. Larson, W.S. Alevizon, and R.N. Bray. 1980. Annual variability of reef-fish assemblages in kelp forests off Santa Barbara, California. U.S. Fishery Bulletin 78:361-377.

Essapian, F. S. 1953. The birth and growth of porpoise. Natural History 58:385-392.

Fields, P. A., J. B. Graham, R. H. Rosenblatt, and G. N. Somero. 1993. Effects of expected global climate change on marine faunas. Trends in Ecology and Evolution. 8:361-367.

Figueroa, D. and C. McClain. 1999. The behavior and habitat usage of bottlenose dolphins along the Orange County Coast. Student Report, Orange Coast College.

Ford, R.F. 2000. Evaluation of water quality and marine ecological issues concerning freshwater runoff into the Irvine Coast Marine Life Refuge Area of Special Biological Significance. Report for the Irvine Community Development Company.

Ford, R.F., B.B. Hemmingsen, and M. A. Shane. 2000. Water quality and marine ecological monitoring studies for the Crystal Cove Development Project: First Quarterly Report for 2000. Report to the California Regional Water Control Board, Santa Ana Region, and the Irvine Community Development Company.

Hamilton, D.L. 2000a. Projected water balance for Los Trancos Canyon, Crystal Cove Area, California NB10187.000 Report to LSA Associates.

Hamilton, D.L. 2000b. Projected water balance for Muddy Canyon, Crystal Cove Area, California. NB10187.000 Report to LSA Associates.

Hansen, L. J. 1990. California coastal bottlenose dolphins. pp. 403-420. In: S. Leatherwood and R.R. Reeves (eds.), *The Bottlenose Dolphin*. Academic Press.

Hansen, P. D., H. V Westernhagen,. and H. Rosenthal. 1985. Chlorinated hydrocarbons and hatching success in Baltic herring spring spawners. Marine Environmental Research 15:59-76.

Hanson, M. T. and R. H. Defran. 1993. The behavior and feeding ecology of the Pacific coast bottlenose dolphin, *Tursiops truncatus*. Aquatic Mammals. 19:127-142.

Hayward, T. L., S. L Cummings., D. R Cayan, F. P. Chavez, R. J Lynn, A. W., Mantyla, P. P. Niiler, F. B. Schwing, R. R. Veit and E. L. Venrick, 1996. The state of the California current in 1986-1996: Continuing declines in macrozooplankton biomass during a period of almost normal circulation. CalCOFI Reports 37:22-37.

Herman. L. M. and W. N. Tavolga. 1980. The communication system of cetaceans. pp. 149-209. In: L. M. Herman (ed.), *Cetacean Behavior*. John Wiley and Sons.

Horn, M.H. and L. G. Allen. 1978. A distributional analysis of California coastal marine fishes. Journal of Biogeography 5:23-42.

Horn, M.H. and L. G. Allen. 1985. Fish community ecology in southern California bays and estuaries. In: Yáñez-Arancibia, A. (Ed). *Fish Community Ecology in Estuaries and Coastal Lagoons: Towards and Ecosystem Integration*. UNAM Press.

Irvine, A. B., M. D. Scott, R. S. Wells, and J. H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. U.S. Fishery Bulletin 79:671-688.

Jackson, G.A. 1986. Physical oceanography of the Southern California Bight. pp. 13-52. In: R. W. Eppley (ed.), *Plankton Dynamics of the Southern California Bight. Lecture Notes on Coastal and Estuarine Studies*. Springer-Verlag.

Jenkins, S. A. and J. Wasyl. 2000. Analysis of nearshore transport and shoreline change in the presence of the Crystal Cove Development Project. Report for the Irvine Community Development Company.

Kastelein, R.A. T. Dokter, and P. Zwart. 1990. The sucking of a bottlenose dolphin calf (*Tursiops truncatus*) by a foster mother, and information on transverse birth bands. Aquatic Mammals 16:134-138.

Kelly, D. L. 1983. Photo-identification of bottlenose dolphins in Southern California. Whalewatcher. Journal of the American Cetacean Society 17:6-8.

Kelly, D. L. 1990. The population biology of the bottlenose dolphin along the coast of Orange County, Southern California. pp. 85-89. In: P. Bryant and J. Remington (eds.), Memoirs of the Natural History Foundation of Orange County; Volume 3 Endangered Wildlife Habitats in Southern California.

Kelly, D. L. 1998. Observation of unusual "nursery" birthing behavior of coastal bottlenose dolphin (*Tursiops truncatus*) at Crystal Cove State Park, Orange County, California, U. S. A. unpublished manuscript.

Love, M. S., J. E. Casselle, and K. Herbinson. 1998. Declines in nearshore rockfish recruitment and populations in the southern California bight as impingement rates in coastal electrical power generating stations. U.S. Fishery Bulletin 96:492-501.

Mangarella, P., E. Strecker, and S. Gentzler. 2000. Newport Coast Planned Community, Crystal Cove Stormwater Quality Evaluation Report. (Draft) Report for the Irvine Community Development Company.

Mann, J. and B. B. Smuts. 1998. Natal attraction: allomaternal care and mother-infant separations in wild bottlenose dolphins. Animal Behaviour 55:1097-1113.

MBC Applied Environmental Sciences 2000. The status of kelp beds at Newport Coast and their relationshipt to the kelp beds along the Orange County Coast. Prepared for the Irvine Community Development Company.

McBride, A. F. and H. Kritzler. 1951. Observations on pregnancy, parturition, and post-natal behavior in bottlenose dolphins. Journal of Mammalogy 32:251-266.

McCain, B. B., D. W. Brown, M. M. Krahn, M. S. Myers, R. C. Clark, S. L. Chan, and D. C. Malins. 1988. Marine pollution problems, north American west coast. Aquatic Toxicology 11:143-162.

Mearns, A. J. 1979. Abundance, composition, and recruitment of nearshore fish assemblages on the Southern California mainland shelf. CalCOFI Reports 20:111-119.

O'Shea, T. J. 1999. Environmental contaminants and marine mammals. pp. 485-563. In. J.E. Reynolds III and S.A. Rommel (eds), Biology of Marine Mammals. Smithsonian Institution Press.

O'Shea, T.J., R.L. Brownell, Jr. D.R. Clark, Jr., W.A. Walker, M.L. Gay, and T.G. Lamont. 1980. Organochloride pollutants in small cetaceans from the Pacific and South Atlantic Oceans, November 1968-June 1976. Pesticides Monitoring Journal 14:35-46.

Norris, K. S. and T.P. Dohl, 1980). The structure and function of cetacean schools. pp. 211-261. In: L. M. Herman (ed.), *Cetacean Behavior*. John Wiley and Sons, New York.

Patton, M. L., R.S. Grove, and R. F. Harman, 1985. What do natural reefs tell us about designing artificial reefs in southern California. Bulletin of Marine Science 37:279-298.

Pequegnat, W. E. 1964. The epifauna of a California siltstone reef. Ecology 45:272-283.

Pondella, D.J. and J.S. Stephens. 1994. Factors affecting the abundance of juvenile fish species of a temperate artificial reef. Bulletin of Marine Science 55:1216-1223.

Prager, M. H. and A. D. MacCall. 1993. Detection of contaminant and climate effects on spawning success of three pelagic fish stocks off southern California: Northern anchovy *Engraulis mordax*, Pacific sardine *Sardinops sagax*, and chub mackerel *Scomber japonicus*. U.S. Fishery Bulletin 91:310-327.

Quast, J. C. 1968. Estimates of the populations and the standing crop of fishes. pp. 57-59, In North, W.J. and C.L. Hubbs, (eds.) Utilization of kelp-bed resources in southern California. Calif. Dept. Fish Game, Fish. Bull. 139:1-264.

Roemmich, D. and J. McGowan. 1995. Climatic warming and the decline of zooplankton in the California current. Science. 267:1321-1324.

Schmidt-Nielsen, K. 1993. *Animal Physiology: Adaptation and Environment*. Cambridge Press.

Scott. M.D., R.S. Wells, and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. In: S. Leatherwood and R.R. Reeves (eds.), *The Bottlenose Dolphin*. Academic Press.

Shane, S. H., R. S. Wells, and B. Würsig. 1986. Ecology, behavior, and social organization of the bottlenose dolphin: A review. Marine Mammal Science 2:34-63.

Smolders, J. 1988. Adoption behaviour in the bottlenose dolphin (*Tursiops truncatus*). Aquatic Mammals 14:78-81.

Stephens, J. S. Jr., P. A. Morris, D. J. Pondella, T. A. Koonce, and G. A. Jordan. 1994. Overview of the dynamics of an urban artificial reef fish assemblage at King Harbor, California USA, 1974-1991: A recruitment driven system. Bulletin of Marine Science 55:1224-1239

Stephens, J. S. Jr. and K. E. Zerba. 1981 Factors affecting diversity on a temperate reef. Environmental Biology of Fishes 6:111-121.

Tavolga, M. C. and F. S. Essapian. 1957. The behavior of the bottlenose dolphin (*Tursiops truncatus*): mating, pregnancy, parturition, and mother-infant behavior. Zoologica 42:11-31.

Turner, C.H., E.E. Ebert, and R. R. Given. 1969. Man-made reef ecology. California Department of Fish Game Fishery Bulletin 146:1-221.

Valencic, J. J. 1987. Crystal Cove underwater research project. Final report prepared for the California Department of Parks and Recreation.

Wells, R. S., L. J. Hansen, A. Baldridge, T. P. Dohl, D. L. Kelly, and R. H. Defran. 1990. Northward extension of the range of bottlenose dolphins along the California coast. pp. 421-431. In: S. Leatherwood and R.R. Reeves (eds.), *The Bottlenose Dolphin*. Academic Press.

Wiley, J.M. 1973. Life history of the western north American goby, *Coryphopterus nicholsii* (Bean). Transactions of the San Diego Society of Natural History 17:187-208.

Wiley, J.M. 1976. Life histories and systematics of the western North American gobies *Lythrypnus dalli* (Gilbert) and *Lythrynus zebra* (Gilbert). Transactions of the San Diego Society of Natural History 18:169-184.

Würsig, B. and M. Würsig, 1977. Behavior and ecology of the bottlenose dolphin, *Tursiops trucatus*. Science 198:755-756.

Table 1
Fish Species Found at Various Sites Along the Newport Coast

SPECIES	Common Name
Anistotremus davidsoni	Sargo
Atherinops sp	smelt
Brachyistius frenatus	kelp surfperch
Chromis punctipinnis	blacksmith
Citharicthys sp.	sanddab
Clinocottus sp	tidepool sculpin
Coryphopterus nicholsii	blackeye goby
Cymatogaster aggregata	shiner surfperch
Damalichthys vacca	pile surfperch
Embiotica sp	black/barred surfperch
Genyonemus lineatus	white croaker
Gibbonsia sp	kelpfish
Girella nigricans	opaleye
Gymnothorax mordax	moray eel
Halichoeres semicinctus	rock wrasse
Heterostichus rostratus	giant kelpfish
Heterodontus francisci	horn shark
Hypsoblennius sp	blenny
Hypsurus caryi	rainbow surfperch
Hypsopops rubicunda	garibaldi
Hypsopsetta guttulata	diamond turbot
Leiocottus hirundo	lavender sculpin
Lythrypnus dalli	bluebanded goby
L. zebra	zebra goby
Medialuna californiensis	halfmoon
Neoclinus sp.	fringehead
Oxyjulus californica	senorita
Oxylebius pictus	painted greenling
Paralabrax clathratus	kelpbass
P. nebulifer	sandbass
Phanerodon furcatus	white surfperch
Semicossyphus pulcher	California sheephead
Scorpaena guttata	scorpionfish
Scorpaenichthys marmoratus	Cabezon
Sebastes atrovirens	kelp rockfish
S. carnatus	gopher rockfish
S. chrysomelas	black and yellow rockfish
S. serriceps	treefish
Sebastes sp.	other rockfish
Sygnathus sp.	pipefish
Torpedo californica	Pacific electric ray
Urolophus halleri	round stingray

ORANGE COAST COLLEGE

2701 Fairview Rd., P.O. Box 5005, Costa Mesa, CA 92628-5005 Margaret A. Gratton, President

Document #5

Teresa Henry, District Manager
California Coastal Commission
200 Oceangate, 10th floor
Long Beach, CA 90802-4416

Dear Ms. Henry,

I am writing you in response to the contents of the report submitted to your office by the Irvine Community Development Corporation and written by Jeffrey B. Graham, Ph.D, Scripps Institution of Oceanography (June 12, 2000) titled:The Status of Marine Fishes and Mammals in waters near the Irvine Coast Marine Life Area of Special Biological Significance and in relation to other southern California coastline areas. I will confine my comments and response to those parts of his report dealing with the coastal bottlenose dolphin population of Orange County and their use of this unique coastal area and the birthing processes which I have observed and reported at Crystal Cove State Park.

I first became involved with the issues of this proposed development and plans for the creation of a beach-side resort at Crystal Cove back on January 2, 1996 when I wrote and sent a letter to Mr. Kenneth Mitchell of the California State Department of Parks and Recreation. In the later I stated that I was aware of plans for development in this area and that I was concerned for the "Pacific Coast Bottlenose Dolphin (Tursiops truncates) that utilize the nearshore waters off Crystal Cove in a very special way. In fact, the way they utilize this specific coastal area is for the most important thing that these dolphins do – namely reproduction. Crystal Cove is one of only two sites (note: now we know there is one more) along the Orange County coast that dolphins frequent when they are preparing to give birth to offspring. The other spot is far to the south at San Onofre State Park." I further stated that, "It is my belief that Crystal Cove represents a "safe" haven for these dolphins when they are performing this most important of behaviors. The dolphins are not molested at Crystal Cove or at San Onofre State Beach due to two different facts, in my opinion. One is that the human density at these two sites tends to be very low. Secondly, I believe, in the case of Crystal Cove, the long-term residents there are very aware of the dolphins and are careful not to bother them (swim out or paddle out on a surfboard) while this behavior is going on."

I received a response to that letter on February 13, 1996 from Jack B. Roggenbuck, District Superintendent of the Orange Coast District. In it he stated that, "Their (the dolphins) use of this "safe" haven to birth their young genuinely qualifies the location as

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significant to the local population." He went on to state that the lifeguards and ranger patrols were aware of the dolphin activity and would protect the animals from harassment during their visits to the park.

That was all good news to me and indeed, the developer (Mike Freed of Resort Design Associates) of the Crystal Cove Redevelopment Project met with me many times, discussed ways that impacts on the dolphins could be mitigated, and actually incorporated many of my proposals into his final plans for the Crystal Cove Cottage redevelopment project. I was very satisfied with his efforts and plans for that project alone. I said so in a letter to Mary Nichols (Secretary of Natural Resources) that I wrote and sent to her on May 27, 1999.

I must say that this is has not been the case with Irvine Community Development Corporation and their planning and preparation for their "massive" development on the east side of Pacific Coast Highway. At no time in the past have their representatives attempted to contact me to discuss the plans for their development and how impacts on the dolphins might be mitigated. When it came time, legally, for them to evaluate the potential impacts on these dolphins, they hired Jeffrey Graham. Jeffrey Grahams report to you of June 12, 2000 is a perfect example of their attitude toward my discoveries and warnings about impacts on the coastal dolphins.

First of all, Jeffrey Graham is not a marine mammalogist, nor has he published papers about marine mammals. He is a fish expert who specializes in "studies of the environmental adaptation of marine organisms, primarily fishes, and including sharks." He has no experience or expertise in marine mammal study and observation. The reason I mention this is due to the statements he makes in his report concerning the dolphins. They are extraordinary. Please let me share some of these with you.

He begins in the executive summary by describing (very accurately) my reports of dolphin "birthing circles" at Crystal Cove but ends by stating that the phenomena "remains undescribed in the scientific literature." This is absolutely true but needs clarification. I did submit a paper to the American Cetacean Society Whalewatcher Journal on July 12, 2000 (see included report). Between the time I wrote the "unpublished 1998 manuscript" and participated in the several newspaper articles that he mentions, I did what I think even fisheries biologists do when they make a discovery that seems new, unusual, and possibly unbelievable to their colleagues in that science. I met with "all" of my coastal dolphin research colleagues and spoke with them about my discovery, gave them copies of my manuscript and asked them to critique it, and even inquired of people doing coastal dolphin research in other parts of the United States, to find out if they had seen a behavior similar to this. It wasn't until I obtained a video tape of this behavior from a local citizen at a Orange County location that I felt confident to prepare the manuscript I recently submitted to the Whalewatcher journal. Long before that, I even arranged to show the video to my colleagues so that they could evaluate the nature of this unique behavior. All of them urged me to publish on this as soon as possible.

Jeffrey Graham goes on the state that, "other scientists experienced in the field observation of bottlenose dolphin at Pacific locations throughout California and Baja California have not observed this particular behavior, although allomaternal behaviors and cows swimming with newborn calves have been observed." My response to this statement is that these people were not looking in the same unique location I was and furthermore, I wonder where and how those newborn calves were born?

He furthermore states that, "The scientific validity of the claim of dolphin birthing circles must await review of the data presented in support of its occurrence. However, as it concerns the Crystal Cove Project, media attention has centered on the "birthing circle" phenomena, in spite of the paucity of scientific documentation." My response is (1.) I have already met with my marine mammal colleagues (several times) concerning this behavior phenomena, (2.) gone over the data and have asked for their input and critique, (3.) showed my colleagues the video of this behavior and asked their opinion; (4.) I have submitted a written report to the Whalewatcher Journal for publication; and (5.) I have submitted an abstract and asked to present a poster paper about my discovery at the American Cetacean Society Conference in November, 2000 in Monterey, California.. I believe this qualifies as scientific documentation in any field of marine biology.

He compounds the problems with his assessment of my discoveries in the body of his report (page 32) by making the extraordinary statement that, "An authority on cetacean behavior who refused to be identified said that he/she was familiar with Professor Kelly's birthing circle descriptions and that he/she has seen the supporting data which he/she judged to be far from conclusive. He/she added that he/she had made no comparable observations on Tursiops truncates in southern California waters." Now maybe this is the way fisheries biologists attack each others findings (anonymously) but it is not the way that it is done in marine mammal scientific circles. But that is not all, he follows this on the same page with the statement, "Another world authority on cetaceans, who did not wish to be identified, said he/she would need to examine the supporting data before reaching conclusions." One wonders, if there are any sources Jeffrey Graham would not stoop to use to dispute my findings.

Jeffrey Graham says in his executive summary that the behavior occurs in other locations in southern California which he then implies makes Crystal Cove of lesser importance to the dolphins for birthing. It does but has only been observed four times in other locations. In my report submitted to Whalewatcher Journal I suggest that the unusual beach, cliff, and isolated conditions available at Crystal Cove are what attract the dolphins to this area and result in over ten observations of this behavior at the state park.

He finishes his assessment by stating that, "The issue with regard to birthing circles and the Crystal Cove Project reduces to the following point. Assuming that this behavior is in fact taking place and that young dolphins are born along the Newport Coast, then the Post-Project conditions established there will improve overall water quality and the coastal environment and will therefore augment all bottlenose dolphin activity in the Crystal Cove area." My response to this is that Jeffrey Graham and the Irvine Community Development Corporation are practicing naïve and wishful thinking.

Since I first reported my findings and concerns to Mr. Kenneth Mitchell back in January 2, 1996 I have met with the ranger staff and managers at Crystal Cove and discussed my concerns about the dolphins; I have given talks about the dolphins to the park interpretive organization and naturalists; and I personally hand delivered a copy of an excellent newspaper article (from the Orange County Register) about the birthing phenomena to Ranger Manager Mike Eaton at the park headquarters. If you visit Crystal Cove State Park today, try to find any mention of the dolphins presence or use of the park waters, any photographs, or illustrative depictions on any interpretive sign about the dolphins throughout the park. You won't! Look for anything about the dolphins in the interpretive center at the park – there is nothing there! With all of that direct effort on my part and no results, imagine how interested the Irvine Company is in this issue taking into account Jeffrey Grahams report to you. He was hired by Irvine Community Development Corporation simply to dispute legitimate concerns I have about this development and its potential impact on the dolphins and to discredit my findings. He attempted to do so in the most unscientific manner I have ever observed.

I read all of Jeffrey Grahams' report, another by Dr. Richard F. Ford on Water Quality and Marine Ecological Monitoring Studies for the Crystal Cove Development Project; and their report by Larry E. Deysher on the Potential Effects of Coastal Development on subtidal kelp resources. I must say I am definitely not convinced that the Irvine Community Development Corporation will "improve overall water quality and the coastal environment and will therefore augment all bottlenose dolphin activities in the Crystal Cove area". I find that statement outrageous! I believe that this planned development by Irvine Community Development Corporation does not bode well for the future of these bottlenose dolphin when they try to use Crystal Cove for their birthing processes. Once you have had a chance to carefully read all of these reports, I hope you and your staff will reach the same conclusion.

Sincerely,

Dennis L Kelly

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Document #6

MARINE MAMMAL SCIENCE, 15(2):381–393 (April 1999)

RANGE CHARACTERISTICS OF PACIFIC COAST BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN THE SOUTHERN CALIFORNIA BIGHT

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ABSTRACT

Boat-based photoidentification surveys of bottlenose dolphins (*Tursiops truncatus*) were conducted from 1982 to 1989 in three discrete coastal study areas within the Southern California Bight: (1) Santa Barbara, California; (2) Orange County, California; (3) Ensenada, Baja California, Mexico. A total of 207 recognizable dolphins were identified in these three "secondary" study areas. These individuals were compared to 404 dolphins identified from 1981 to 1989 in our "primary" study area, San Diego, California, to examine the coastal movement patterns of bottlenose dolphins within the Southern California Bight. A high proportion of dolphins photographed in Santa Barbara (88%), Orange County (92%), and Ensenada (88%) were also photographed in San Diego. Fifty-eight percent (n = 120) of these 207 dolphins exhibited back-and-forth movements between study areas, with no evidence of site fidelity to any particular region. Minimum range estimates were 50 and 470 km. Minimum travel-speed estimates were 11–47 km/d, and all dolphin schools sighted during the study were within 1 km of the shore. These data

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suggest that bottlenose dolphins within the Southern California Bight are highly mobile within a relatively narrow coastal zone. Home-range dimensions and movement patterns for many vertebrate species are influenced, in part, by variation in food resources. The unique range characteristics documented during this study may reflect the highly dynamic nature of this coastal ecosystem and the associated patchy distribution of food resources available to these bottlenose dolphins.

Key words: bottlenose dolphins, *Tursiops truncatus*, Southern California Bight, photoidentification, distribution, home range, site fidelity, school size, movement patterns.

The concept of home range has traditionally been applied to distinct regions where animals live and perform biologically important activities, often throughout a lifetime (Burt 1943, Jewell 1966). Recent reviews of the behavioral ecology of bottlenose dolphin (*Tursiops truncatus*) populations have documented a high degree of variability in home range characteristics (Shane *et al.* 1986, Ballance 1992). The longitudinal research of Wells and colleagues (Wells *et al.* 1987) has provided strong evidence that bottlenose dolphins in Sarasota Bay, Florida, have utilized the same home range for at least 25 yr. Similarly, Connor and Smolker (1985) reported that bottlenose dolphins in Western Australia frequented the same coastal region for over 20 yr. In contrast, other populations of bottlenose dolphins have been shown to migrate seasonally or demonstrate temporary, seasonal, or semipermanent fidelity to a particular geographic region (see Shane *et al.* 1986 for a review). In addition, more than one type of residence pattern may occur in the same geographic area. Several studies, for example, have documented apparent site fidelity for bottlenose dolphins in a particular region but have also documented sightings of known individuals at significant distances from the original study area in which they were first identified (Würsig and Würsig 1979, Gruber 1981, Wells *et al.* 1990, Würsig and Harris 1990, Wilson 1995, Bearzi *et al.* 1997).

Bottlenose dolphins occur throughout the year in the nearshore waters of San Diego, California but display no long-term or seasonal site fidelity to the region (Defran and Weller 1999). Low sighting frequencies and long intervals between resightings of known individuals suggested that bottlenose dolphins utilized the 32-km San Diego area as only part of a more extensive range (Hansen 1990, Defran and Weller 1999). Defran and Weller (1999) hypothesized that movement patterns of this population occurred within a narrow coastal corridor, but the degree or extent of this longshore movement beyond San Diego was indeterminate.

Research presented here involved the systematic use of photoidentification techniques to examine the range characteristics of Pacific coast bottlenose dolphins within the Southern California Bight. By comparing dorsal fin photographs of individual dolphins identified in Santa Barbara, Orange County, and Ensenada to our nine-year photographic data set from San Diego (Fig. 1), we have been able to document this population's unique coastal-range characteristics.

Dennis L. Kelley Attachment

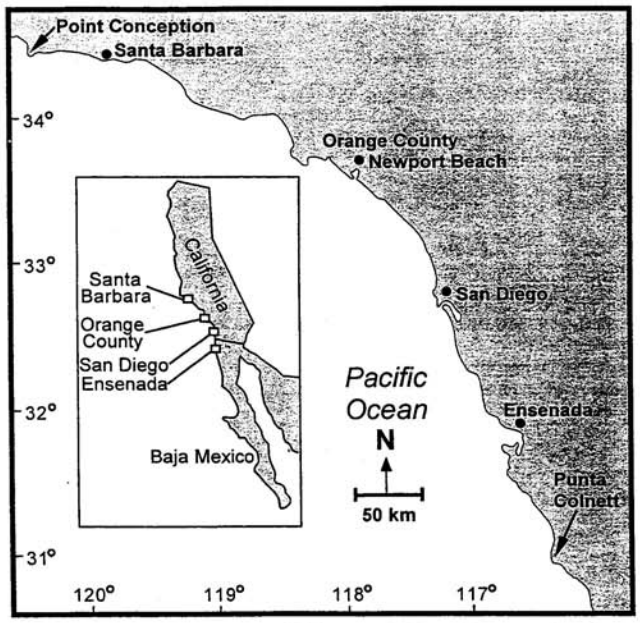

Figure 1. Map of the Southern California Bight. Inset shows coastal study area locations.

Methods

Study Areas

Four distinct coastal locations within the Southern California Bight served as study areas: San Diego, Orange County, and Santa Barbara, California, and Ensenada, Baja California, Mexico (Fig. 1, Table 1). While all the study areas differed from one another in subtle characteristics, the coastline, nearshore topography, and bathymetry were similar (Dailey *et al.* 1993) and consisted of beaches with gently sloping sand, steeply inclined cobblestone, estuary mouths, and rocky outcrops. Nearshore underwater topography ranged from submerged reefs, sea grass flats, and dense kelp canopies to relatively barren, sandy expanses.

The Southern California Bight extends 732 km from Point Conception (34°33′N, 120°28′W) in the north to Punta Colnett (30°57′N, 116°20′W)

Table 1. Summary information on survey effort, study period, and photographic data for Southern California Bight study areas.

Study area	Number of surveys	Study period	Number of dolphins	Calf percent	Number of schools	School size: Average	School size: Range	Number identified	Number resighted in San Diego
SD	174[a]	1981–1989	2,869[c]	11[c]	145[c]	19.8[c]	2–90[c]	404	—
OC[b]	44	1982–1989	534	8	27	19.8	5–42	133	123 (92%)
EN	11	1985–1986	168	14	8	21	2–45	68	60 (88%)
SB	12	1987 & 1989	129	9	7	18.4	10–30	49	43 (88%)

SD = San Diego, OC = Orange County, EN = Ensenada, SB = Santa Barbara.

[a] Includes data from Cetacean Behavior Laboratory (CBL), Hansen (1990), and 6 additional NMFS surveys.

[b] Includes data from 6 complete surveys, 25 partial surveys, and 13 opportunistic sightings.

[c] Based on CBL field estimates only, does not include data from Hansen (1990).

in the south. Figure 2 summarizes the location and length of the four study areas and the distances along the coastal contour between their boundaries.

Survey and Photoidentification Procedures

Survey methodology and photoidentification procedures employed in each of the secondary study areas paralleled those utilized in the San Diego study area (see Defran *et al.* 1990, Defran and Weller 1999). However, a brief description is also provided here. Photoidentification surveys involved travel in a 4.3- or 5.2-m boat parallel to the coast and 90–180 m outside the surf line. Two to four observers searched the area from the beach to 2 km offshore until a school of dolphins was sighted. The research vessel then maneuvered within

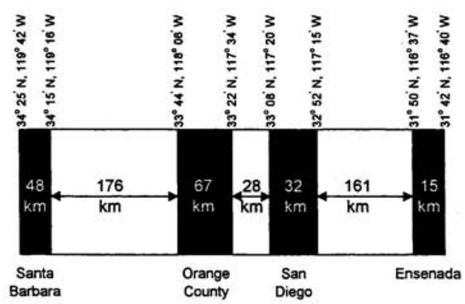

Figure 2. Southern California Bight study area dimensions, coordinates, and distances between study area boundaries.

3–12 m of the dolphin school, and individual dorsal-fin notch patterns were photographed. An attempt was made to photograph every dolphin within a school.

Initial estimates of the total numbers of dolphins and calves were revised as necessary, and contact with the school was maintained until photographic effort was completed. Both appearance and behavior were used to judge whether a dolphin was a calf: (1) constant and close affiliation over the observation period with an adult companion at least twice its size; (2) appearance of fetal folds; (3) awkward and immature swimming, submergence, and surfacing behaviors.

Our method for analyzing dorsal-fin photographs has been detailed elsewhere (Defran *et al.* 1990). Briefly summarized, only clear photographs of distinctive dorsal fins were used to establish a "type specimen" to which all other photographs were compared. Subsequently, only unambiguous matches with the "type specimen" were accepted as resightings. All dorsal-fin photographs from each study area were analyzed in the Cetacean Behavior Laboratory at San Diego State University. The initial San Diego photographic catalog consisted of 114 dolphins first identified from September 1981 to November 1983 by Hansen (1990) and his colleagues at the National Marine Fisheries Service (NMFS) (Hansen and Defran 1990, Defran and Weller 1999).

Results

Photographic Results and Sightings Across Study Areas

A total of 3,700 dolphins were observed and 424 individuals identified during surveys conducted from 1981 to 1989 in the four study areas (Table 1). Two hundred and seven dolphins were identified in the three secondary study areas. Twenty (10%) of these 207 dolphins were never photographed outside of the area in which they were first identified, while the remaining 187 dolphins (90%) were sighted in at least two of the four study areas. Finally, 185 (89%) of the 207 dolphins photographed in secondary study areas were also photographed in the San Diego study area. Additional information on survey effort and sighting frequencies is summarized in Table 1.

Resightings Within Secondary Study Areas

In each of the study areas most dolphins were sighted infrequently. Eighty percent (n = 16) of the 20 dolphins never sighted outside of their initial sighting location were sighted only a single time. The overall proportion of dolphins sighted only once was 71% in Orange County, 69% in Ensenada, and 53% in Santa Barbara. These "infrequent sighting" trends parallelled those already described for San Diego area dolphins (Defran and Weller 1999). The majority of resightings that occured within the Santa Barbara, Orange County, and Ensenada areas were attributable to individuals repeatedly photographed within a matter of days or weeks.

Dennis L. Kelley Attachment

Longshore Movement Reversals

Of the 207 dolphins identified in the three secondary study areas, 120 (58%) were documented to repeatedly move between study areas. These back-and-forth inter-study-area movements or "movement reversals" were scored when any of a number of patterns occurred. The most frequent example was when a dolphin first identified in San Diego was later resighted in another area (*e.g.*, Santa Barbara) and subsequently resighted again in one of the other three study areas. A "movement reversal" would also be scored for the following sighting sequence: San Diego → Ensenada → San Diego, → Orange County, or → Santa Barbara. Less common sequences beginning and ending with a sighting in Santa Barbara or Ensenada also occurred. Of the 120 dolphins which exhibited movement reversals, 48 (40%) did so between two and seven times.

Travel Distance and Travel Speed

For each of the 185 dolphins identified in at least two study areas, we calculated the distance between their two most widely separated sighting locations. The minimum distance traveled was 50–249 km for 68% (n = 126) of these 185 dolphins, while 55 dolphins (30%) traveled at least 250–349 km. At the extremes, one dolphin was documented to travel only 46 km from San Diego to Orange County, while three dolphins, first photographed together in Ensenada, traveled 470 km north, where they were again photographed together in Santa Barbara.

Surveys conducted in our different study areas but close in time provided an opportunity to evaluate the minimum travel speed between coastal locations. The most rapid travel times noted included the following: (1) three dolphins identified in the same school on 26 October 1984 in San Diego were also photographed together two days later, 93 km to the north in Orange County, resulting in a minimum travel speed of 47 km/d; (2) an individual identified in San Diego on 6 May 1989 was photographed 14 d later, 286 km to the north in Santa Barbara, resulting in a minimum travel speed of 20 km/d; (3) three dolphins photographed together in San Diego on 26 May 1986 were photographed together 12 days later, 172 km to the south in Ensenada, resulting in a minimum travel speed of 11 km/d.

Discussion

Photoidentification data collected within the Southern California Bight between 1981 and 1989 have provided evidence that coastal bottlenose dolphins in this area generally occur within 1 km of shore, are highly mobile, range over extensive longshore distances, and show little site fidelity to any particular coastal region. The minimum range estimates documented for most dolphins varied between 50 and 470 km. Movements between study areas were a common and repeated travel pattern for many dolphins and argue against an interpretation of this behavior as migratory, or mere emigration and immigration. When the low resighting rates of known individuals obtained in each respective study area were combined with the findings of regular inter-study-area movements, a pattern of limited site-specific fidelity was apparent. Only 20 (10%) of the 207 dolphins identified in the three secondary study areas were not sighted outside of the region in which they were first photographed. Based on the average 203-d interval between resightings for dolphins studied in San Diego (Defran and Weller 1999) we believe that given more time or effort many of these individuals would also have been photographed elsewhere.

Home-range dimensions in many vertebrate species are determined, in part, by the availability of food resources. The range characteristics of bottlenose dolphins reported here may be related to the unpredictable distribution and abundance of nearshore prey items within the highly dynamic coastal ecosystem of the Southern California Bight (SCCWRP 1973, Dailey *et al.* 1993). Red foxes (*Vulpes vulpes*) and Costa Rican squirrel monkeys (*Saimiri eorstedi*) utilized smaller home ranges and traveled less when food was abundant. However, once availability decreased, the time spent traveling and area covered increased (Ables 1969, Boinski 1987). Sea otter (*Enhydra lutris*) movements have been correlated with food availability (Loughlin 1980, Garshelis *et al.* 1986). Norris and Dohl (1980) suggested that movement patterns of many, and perhaps most, cetaceans schools seemed to be regulated by variable food resources. Würsig and Würsig (1980) related dusky dolphin (*Lagenorhynchus obscurus*) movements to seasonal and diurnal movements of their anchovy prey, and Hawaiian spinner dolphin (*Stenella longirostris*) movements were linked to the diel vertical migration of food items in the deep scattering layer (Norris and Dohl 1980). Seasonal shifts in the distribution of mullet (*Mugil cephalus*) have been associated with changes in habitat use by bottlenose dolphins in Sarasota, Florida (Wells *et al.* 1987).

Bottlenose dolphins in the Southern California Bight have exhibited range shifts in relation to changes in prey distribution (Hubbs 1960, Wells *et al.* 1990). This behavioral sensitivity to variability in food resources provides support for our hypothesis that the range characteristics documented during this study may be related to fluctuating prey availability. During the 1982–1983 El Niño event, southern fish species normally distributed within or south of the Southern California Bight were abundant in north-central California (McGowan 1985). During this same period, coastal bottlenose dolphins extended their northern range boundary back to historical limits in north-central California and were hypothesized to have followed the aforementioned changes in prey distribution (Wells *et al.* 1990). Interestingly, while the effects of the 1982–1983 El Niño dissipated within the following years, bottlenose dolphins continued to use the north-central California coastline. Between October 1990 and December 1992, T. Norris and D. Feinholz conducted 66 photoidentification surveys in Monterey Bay, California and identified 45 naturally marked bottlenose dolphins (Feinholz 1996). Twenty-eight of these 45 dolphins (62%) had previously been photographed in at least one of the Southern California

Bight study areas, representing travel distances ranging between 329 and 600 km.

The high mobility, extensive longshore distances traveled, and apparent lack of site fidelity all suggest that the movement patterns of coastal dolphins in California may be related to food resource availability. Information on the relative abundance and distribution of fish on the coastal shelf of the Southern California Bight indicates that most species occur either in temporary local concentrations or are widely but sparsely distributed across the Bight (SCCWRP 1973, Mearns 1979, DeMartini and Allen 1984, Ware and Thomson 1991, Cross and Allen 1993, Dailey *et al.* 1993). Systematic research trawling in nearshore waters found that few fish species captured were ranked high in both frequency of occurrence and abundance (SCCWRP 1973, Mearns 1979). Rather, the majority of species were higher in either abundance or frequency. For example, the white croaker (*Genyonemus lineatus*), one of the most frequently occurring prey items found in California coastal-bottlenose dolphin stomachs (Norris and Prescott 1961, Walker 1981), was ranked 5th in abundance but only 19th in frequency of occurrence. Such a difference in ranking (higher in abundance than frequency) indicates that white croaker are not equally distributed over the coastal shelf but rather occur in distinct concentrations. Other fish species showed similar wide but sparse distributions throughout the Bight (SCCWRP 1973, Mearns 1979).

Numerous studies on bottlenose dolphins have indicated that a limited number of fish species often constituted a high percentage of the total diet (Barros and Odell 1990, Cockroft and Ross 1990). Similar findings have been reported from stomach content analyses of California bottlenose dolphins (Norris and Prescott 1961, Walker 1981). Of the 25 fish species identified as bottlenose dolphin prey (Norris and Prescott 1961, Walker 1981), 74% were either surfperch (*Embiotocidae*) or croakers (*Sciaenidae*), and 54% of these consisted of only three species (Hanson and Defran 1993). This disproportionate dietary ration may be related to preferential prey choice. All of the fish species identified from stomach contents are non-migratory, year-round coastal inhabitants of the Southern California Bight (SCCWRP 1973, Cross and Allen 1993, Dailey *et al.* 1993). The significant daily, monthly, yearly, and decade-to-decade variability in California's coastal ecosystem, however, creates patchy and unpredictable patterns of abundance, distribution, and composition of nearshore marine organisms, including prey species of the bottlenose dolphin (SCCWRP 1973, Mearns 1979, Ware and Thomson 1991, Dailey *et al.* 1993). Patchy resources are often responsible for increases in mammalian home range dimensions, while abundant resources tend to work in an inverse manner (Krebs and Davies 1981). Optimal foraging models suggest that if high-quality prey species are available, there should be a preference for them regardless of the availability of other, less preferred, species (Krebs and Davies 1981). We hypothesize, therefore, that coastal bottlenose dolphins in the Southern California Bight are ranging over long distances to locate preferred but discontinuously distributed nearshore food resources. The predominantly nearshore distribution of prey items may play a significant role in shaping the nearshore affinity of

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dolphins in this region (Defran and Weller 1999) and help to explain the virtual absence of their movements greater than 1 km from shore.

Simonaitis (1991) found that bottlenose dolphins in San Diego spent considerable time occupying restricted portions (1–3 km) of the overall study area, a pattern she termed "localized movement." Localized movement has been observed in each of our Southern California Bight study areas and resembles the "patrolling" behavior of bottlenose dolphins in Argentina (Würsig 1978) and the "directed random walks" of minke whales (*Balaenoptera acutorostrata*) in the San Juan Islands (Stern 1998). Simonaitis (1991) observed a high proportion of feeding and socializing during localized movement bouts and hypothesized that this behavioral pattern was analogous to the behavior of other animals who utilize known core areas. We suggest that the localized movement patterns observed by Simonatis (1991) may be related to temporary concentrations of prey resources. For example, coastal dolphins may be moving great distances in search of preferred but patchy concentrations of nearshore prey, and once such conditions are located, longshore directional travel (movement between patches) ceases and localized movement (movement within patches) commences. As temporary local resources become depleted or are effectively "fished," dolphins relocate in search of more optimal conditions. This behavioral pattern suggests a win-stay → lose-shift foraging model and is supported by our findings of limited site fidelity and regular coastal travel interrupted by bouts of localized movements.

The range characteristics of Pacific coast bottlenose dolphins in the Southern California Bight differ from most other stocks of this species. Neither the relatively limited home-range size characteristic of many populations (Wells 1978, 1986; Shane 1980, 1987; Mate *et al.* 1995) nor the more migratory movement patterns of dolphins along the eastern seaboard of the United States and off the coast of Japan (Tanaka 1987, Scott *et al.* 1988, Kenney 1990) are directly comparable to the findings presented here.

The limited duration and geographically restricted nature of many studies on bottlenose dolphins in other areas may mask potential similarities to the movement patterns of California bottlenose dolphins. In many study sites, known individuals concentrate their activities in particular areas but are sometimes absent from those areas (*e.g.*, Würsig and Würsig 1977, 1979; Würsig 1978; Shane 1980, 1987; Gruber 1981; Odell and Asper 1990; Würsig and Harris, 1990; Ballance 1992; Bearzi *et al.* 1997; see also reviews by Wells *et al.* 1980, Leatherwood and Reeves 1982, and Shane *et al.* 1986). These cases indicate that the range sizes for some individuals exceeded the limits of the respective study area. For example, Würsig (1978) opportunistically sighted known individuals 300 km away from his study area in Argentina, and Gruber (1981) identified a Texas-coast dolphin in her study site that had previously been sighted 95 km to the southwest. Examples like these suggest that bottlenose dolphins outside the Southern California Bight may also range over significant distances.

In contrast, longitudinal and geographically broad research on bottlenose dolphins along the central-west coast of Florida has clearly documented long-term site fidelity and relatively small home-range dimensions (Wells 1978, 1986; Wells *et al.* 1980; Irvine *et al.* 1981; Wells *et al.* 1987; Scott *et al.* 1990). The mobility we have described for coastal bottlenose dolphins in the Southern California Bight and the site fidelity of dolphins along the central west coast of Florida probably represent two ends of a continuum for a number of populations. These intraspecific variations in behavior may be shaped, in part, by habitat differences.

The open California coastline differs significantly in oceanography and habitat structure from the protected primary bay ecosystems of west Florida. In both of these coastal regions dolphin food resources are likely to be patchy, as is true for fish distribution and abundance in most marine systems (Nybakken 1993). The concept of resource patchiness, however, is not directly comparable across habitats, because of differences in temporal and spatial scales. The dynamic coastal environment of the Southern California Bight probably influences the distribution of food patches on an oceanographic and biological scale quite different from that of the west Florida coast. Perhaps the primary bay systems of Florida maintain relatively predictable and spatially stable food resources which support resident populations of dolphins, while the California coastline maintains more unpredictable and spatially fluctuating food resources which promote movements over extensive coastal ranges.

Acknowledgments

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Literature Cited

Ables, E. D. 1969. Home-range studies of red foxes. Journal of Mammalogy 50:108–120.

Ballance, L. T. 1992. Habitat use patterns and ranges of the bottlenose dolphin in the Gulf of California, Mexico. Marine Mammal Science 8:262–274.

Barros, N. B., and D. K. Odell. 1990. Food habits of bottlenose dolphins in the southeastern United States. Pages 309–328 *in* S. Leatherwood and R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Bearzi, G., G. Notarbartolo-di-Sciara and E. Politi. 1997. Social ecology of bottlenose dolphins in Kvarnerić (northern Adriatic Sea). Marine Mammal Science 13:650–668.

Dennis L. Kelley Attachment

BOINSKI, S. 1987. Habitat use by squirrel monkeys (*Saimiri eorstedi*) in Costa Rica. Folia Primatologia 49:151–167.

BURT, W. H. 1943. Territoriality and home range concepts as applied to mammals. Journal of Mammalogy 24:364–352.

COCKCROFT, V. G., AND G. J. B. ROSS. 1990. Food and feeding of the Indian Ocean bottlenose dolphin off Southern Natal, South Africa. Pages 295–308 *in* S. Leatherwood and R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

CONNOR, R. C., AND R. S. SMOLKER. 1985. Habituated dolphins (*Tursiops* sp.) in Western Australia. Journal of Mammalogy 66:398–400.

CROSS J. N., AND L. G. ALLEN. 1993. Fishes. Pages 459–540 *in* M. D. Dailey, D. J. Reish and J. W. Anderson, eds. Ecology of the Southern California Bight: A synthesis and interpretation. University of California Press, Berkeley and Los Angeles, CA.

DAILEY, M. D., D. J. REISH AND J. W. ANDERSON. 1993. Ecology of the Southern California Bight: A synthesis and interpretation. University of California Press, Berkeley and Los Angeles, CA.

DEFRAN, R. H., AND D. W. WELLER. 1999. The occurrence, distribution, site fidelity, and school size of bottlenose dolphins (*Tursiops truncatus*) off San Diego, California. Marine Mammal Science 15:366–380.

DEFRAN, R. H., G. M. SHULTZ AND D. W. WELLER. 1990. A technique for the photographic identification and cataloging of dorsal fins of the bottlenose dolphin (*Tursiops truncatus*). Report of the International Whaling Commission (Special Issue 12):53–55.

DEMARTINI, E. E., AND L. G. ALLEN. 1984. Diel variation in catch parameters for fishes sampled by a 7.6 m otter trawl in southern California coastal waters. CalCOFI Report XXV:119–134.

FEINHOLZ, D. M. 1996. Pacific coast bottlenose dolphins (*Tursiops truncatus gilli*) in Monterey Bay, California. M.S. thesis, San Jose State University, San Jose, CA. 78 pp.

GARSHELIS, D. L., J. A. GARSHELIS AND A.T. KIMKER. 1986. Sea otter time budgets and prey relationships in Alaska. Journal of Wildlife Management 50:637–647.

GRUBER, J. A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Madagorda Bay, Texas. M.S. thesis, Texas A&M University, College Station, TX. 182 pp.

HANSEN, L. J. 1990. California coastal bottlenose dolphins. Pages 403–420 *in* S. Leatherwood and R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

HANSEN, L. J., AND R. H. DEFRAN. 1990. A comparison of photoidentification studies of California coastal bottlenose dolphins. Report of the International Whaling Commission (Special Issue 12):101–104.

HANSON, M. T., AND R. H. DEFRAN. 1993. The behaviour and feeding ecology of the Pacific coast bottlenose dolphin, *Tursiops truncatus*. Aquatic Mammals 19:127–142.

HUBBS, C. L. 1960. Marine vertebrates of the outer coast. Systematic Zoology 9:134–147.

IRVINE, A. B., M. D. SCOTT, R. S. WELLS AND J. H. KAUFMANN. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fishery Bulletin, U.S. 79:671–678.

JEWELL, P. A. 1966. The concept of home range in mammals. Symposium of the Zoological Society of London 18:85–109.

KENNEY, R. D. 1990. Bottlenose dolphins off the northeastern United States. Pages 369–386 *in* S. Leatherwood AND R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Dennis L. Kelley Attachment

KREBS, J. R., AND N. B. DAVIES. 1981. An introduction to behavioural ecology. Blackwell Scientific Publications, New York, NY.

LEATHERWOOD, S., AND R. R. REEVES. 1982. Bottlenose dolphin (*Tursiops truncatus*) and other toothed cetaceans. Pages 369–414 *in* J. A. Chapman and G. A. Feldhammer, eds. Wild mammals of North America: Biology, management, economics. The John Hopkins University Press, Baltimore, MD.

LOUGHLIN, T. R. 1980. Home range and territoriality of sea otters near Monterey, California. Journal of Wildlife Management 44:576–582.

MATE, B. R., K. A. ROSSBACH, S. L. NIEUKIRK, R. S. WELLS, A. B. IRVINE, M. D. SCOTT AND A. J. READ. 1995. Satellite-monitored movements and dive behavior of a bottlenose dolphin (*Tursiops truncatus*) in Tampa Bay, Florida. Marine Mammal Science 11:452–463.

MCGOWAN, J. A. 1985. El Niño 1983 in the Southern California Bight. Pages 166–184 *in* W.S. Wooster and D.L. Fluharty, eds. El Niño North: Effects in the eastern subarctic Pacific Ocean. Washington Sea Grant Program, University of Washington.

MEARNS, A. J. 1979. Abundance, composition, and recruitment of nearshore fish assemblages on the southern California mainland shelf. CalCOFI Report XX:111–119.

NORRIS, K. S., AND J. H. PRESCOTT. 1961. Observations on Pacific cetaceans of Californian and Mexican waters. University of California Publications of Zoology 63: 291–402.

NORRIS, K. S., AND T. P. DOHL. 1980. The structure and functions of cetacean schools. Pages 211–261 *in* L. M. Herman, ed. Cetacean behavior: Mechanisms and functions, John Wiley and Sons, New York, NY.

NYBAKKEN, J. W. 1993. Marine biology: An ecological approach. Harper Collins College Publishers, New York, NY.

ODELL, D. K., AND E. D. ASPER. 1990. Distribution and movements of freeze-branded bottlenose dolphins in the Indian and Banana Rivers, Florida. Pages 515–540 *in* S. Leatherwood and R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

SCOTT, G. P., D. M. BURN AND L. J. HANSEN. 1988. The dolphin die-off: Long-term effects and recovery of the population. Pages 819–823 *in* Proceedings of the Oceans '88 Conference, Baltimore, MD.

SCOTT, M. D., R. S. WELLS AND A. B. IRVINE. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235–244 *in* S. Leatherwood and R. R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

SHANE, S. H. 1980. Occurrence, movements, and distribution of bottlenose dolphin, *Tursiops truncatus*, in southern Texas. Fishery Bulletin, U.S. 78:593–601.

SHANE, S. H. 1987. The behavioral ecology of the bottlenose dolphin. Ph.D. dissertation. University of California, Santa Cruz, CA. 97 pp.

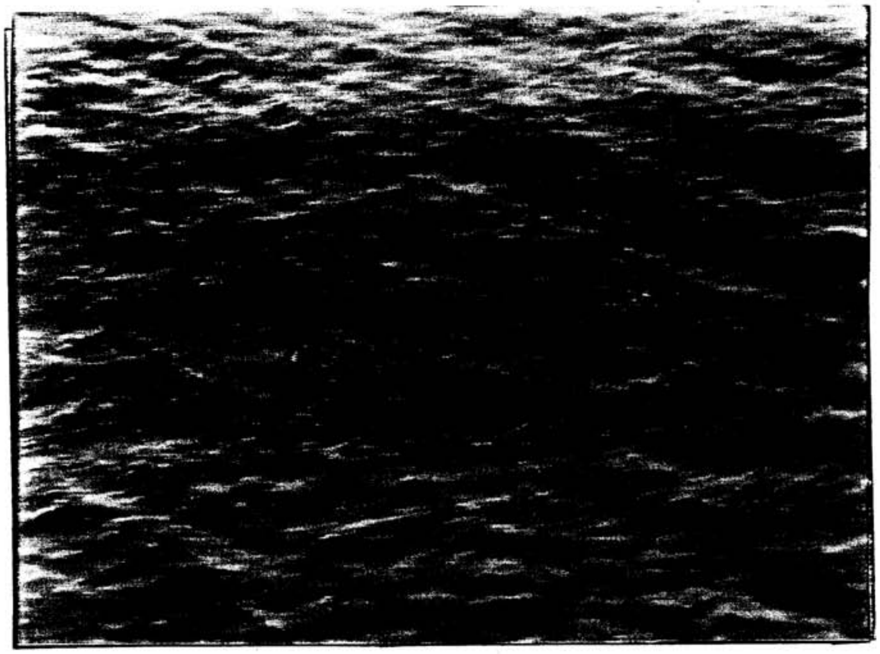
SHANE, S. H., R. S. WELLS AND B. WÜRSIG. 1986. Ecology, behavior and social organization of the bottlenose dolphin: A review. Marine Mammal Science 2:34–63.

SIMONAITIS, M. K. 1991. Daily movement patterns and behavior of the Pacific coast bottlenose dolphin *(Tursiops truncatus)*. M.S. thesis, San Diego State University, San Diego, CA. 79 pp.

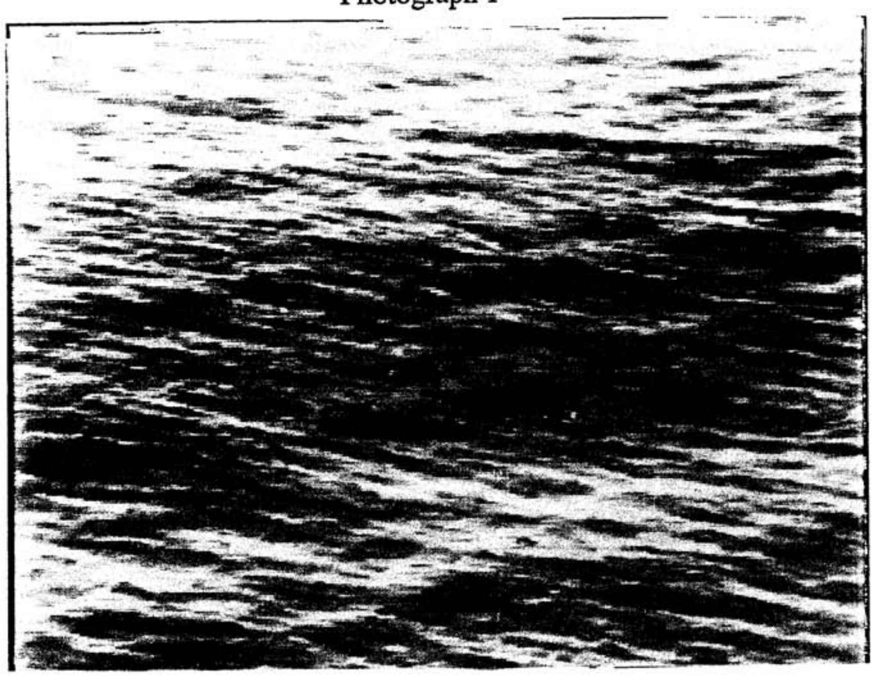
SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT. 1973. The ecology of the Southern California Bight: Implications for water quality management. TR-104. Available from Southern California Coastal Water Research Project, 7171 Fenwick Lane, Westminster, CA 92683.

STERN, S. J. 1998. Field studies of large mobile organisms: Scale, movement and habitat utilization. Pages 289–308 *in* D. L. Peterson and V. T. Parker, eds. Ecological scale: Theory and applications. Columbia University Press, New York, NY.

TANAKA, S. 1987. Satellite radio tracking of bottlenose dolphins *Tursiops truncatus*. Nippon Suisan Gakkaishi 53:1327–1338.



Photograph 1



Photograph 2

Figure 3

November 2000
Document #7

First Report on Unusual "Nursery" Behavior and Accompanying "Birthing Circle" Formation by Coastal Bottlenose Dolphin in Southern California.

By Dennis Kelly

Beginning in December of 1982 an unusual behavior, never before reported in the literature, was observed exhibited by coastal bottlenose dolphin (Tursiops truncates) during a survey at Crystal Cove State Park in southern California by the Coastal Dolphin Survey Project (CDSP) of Orange Coast College. The behavior has since been designated by the author as "nursery" behavior and the actual configuration of the dolphin group performing the behavior has been named "a birthing circle" (figure 1). The author theorizes that this behavior and configuration was assistance by other dolphins to a pregnant female involved in the process of birthing of a neonate. This behavior has been observed and recorded an additional nine times at the first location (Crystal Cove State Park) and four times at three other locations (figure 2). Images of the behavior and formation were captured on video tape and shared with other coastal dolphin researchers in southern California (figure 3).

It is well documented in the scientific literature that both inshore or coastal and offshore bottlenose dolphin inhabit the southern California Bight (figure 2). Coastal bottlenose dolphin are found from the surf zone to within one nautical mile from shore from as far south as San Quintine, Baja California, Mexico along the coast north through San Diego, Orange, Los Angeles, Ventura, Santa Barbara, and Monterey counties. The dolphins occur in pods of one to over fifty individuals, typically about twenty, foraging along the beaches for food, traveling up and down the coast, playing in the waves, and

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occasionally interacting with human inhabitants (surfers and swimmers). Estimates of their population size vary from as few as three-hundred and fifty (National Marine Fisheries Service, Southwest Fisheries Center) to over eight-hundred (Cetacean Behavior Lab (CBL), San Diego State University). CBL, directed by Dr. R.H. DeFran, has carried out the concentrated, long-term studies of population biology and behavior of these dolphins.

As a result of the CBL research (and that of other organizations and individuals as well) much has been reported about the behaviors displayed by the coastal bottlenose dolphin of southern California. Prior to this discovery, only one other dolphin behavior researcher (Ann Weaver, CBL, 1987 masters thesis) reported a behavior similar to the nursery behavior and birthing circle formation now being proposed. Her description was named "spoke" formation and was described as follows: "a number of animals oriented toward the middle form a circle that may surround an individual". Weaver goes on to include this further description of "spoke" formation: "conference: When Tursiops held a conference, a group of dolphins hung at the surface with their fins, and others, their melons and backs exposed for several seconds. They were oriented with their rostrums toward one another in a tight circle or semi-circle. Occasionally, one dolphin was seen lying prone in the center of the circle with all the conferees touching it." Weaver reports that this behavior was rarely observed and she does not report observing the birth of a baby dolphin.

Apparently, according to Weaver's paper, a behavior similar to Weavers "spoke" formation was also observed and reported along the coast of Texas in the 1970's by another dolphin researcher – Dr. Susan Shane.

The author proposes that "spoke" formation, describe by Weaver was the precursor to or an actual incidence of the formation of a "birthing circle" and the "nursery" behavior that is describe in this report.

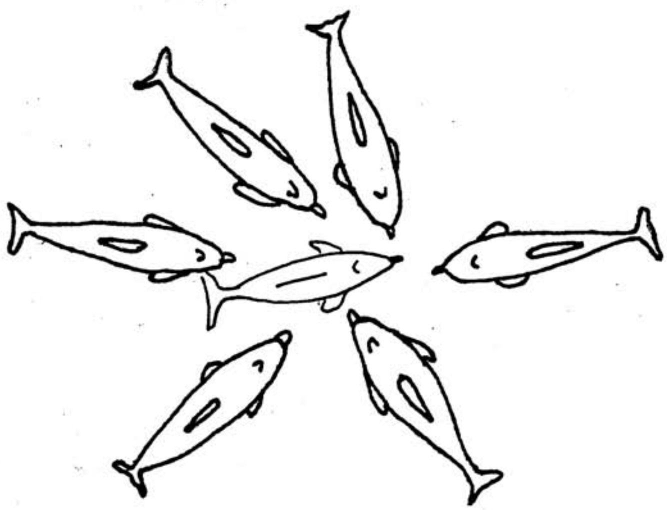
The following is an account of this new behavior based on the initial observations made on December 21, 1982 by the author. The additional nine observations made subsequently, between then and January 6, 1997, at Crystal Cove State Park, were similar enough not to warrant additional description. The number of dolphins involved was initially eight and the observations were made by the author between 15:21 to 17:00 from a cliff-top vantage point (less than one-hundred meters above the beach in front of which the behavior took place). The group of dolphins was noticed, and initially drew the authors attention, as they were very close to shore (less than twenty meters) during a high tide and were in water less than four meters deep. What made the behavior unusual and of particular interest was the fact that the pod of dolphins was clustered together, in roughly a tight oval (figure 1) with seven of the dolphins pointing their rostrums into the center of the oval. The eighth dolphin was in the center of the oval and the beaks of the other seven dolphins were either very close to the central dolphin or were actually touching that dolphin. During four years of previous observation and study of these same coastal dolphins the author had never observed or even heard about any behavior sightings similar to the one exhibited by the dolphins on this day. This, combined with the proximity of the dolphin pod to shore, prompted the author to continue observing and recording the dolphins or an extended period of time (two hours and twenty-one minutes). The author's initial hypothesis was that this behavior was a form of epimeletic (care-giving) behavior being administered by the other dolphins to a sick, injured, dying, or dead comrade. The author made ten individual counts of this group as they drifted close to shore over a one hour period and the centrally positioned dolphin was observed to move – primarily bending vertically at regular intervals – thus eliminating the possibility that this was a dead comrade. At 16:30 (one hour and nine minutes into the observations) all of the dolphins in the circle, including the dolphin at the center, were seen to suddenly convulse, dive, resurface, roll, and then slowly move about three meters down coast. At this time a neonate dolphin (less than twenty-five inches long) was observed at the center of the oval, next to and touching the flank of the dolphin that the author believes was the mother and the dolphin that had been at the center of the oval. At this time all of the other dolphin present began to touch the neonate with their beaks, flanks, and pectoral fins. At 17:00 all of the dolphins began swimming together down coast and all disappeared from view by 17:10.

In addition to nine other subsequent sightings of this behavior and formation at Crystal Cove State Park, the behavior has been seen and reported to the author occurring at three other sites along the southern California coast (figure 2). The three sites are: Three Arch Bay, Laguna Beach (one sighting); South San Onofre State Beach (two sightings); and White's Point, Palos Verdes Peninsula (one sighting). The author has noted, after visiting all three locations, that the other sites have significant similarities to the initial site (Crystal Cove State Park). These areas all have narrow beaches (approximately 30 meters wide at low tide) and abrupt nearly vertical cliffs (approximately fifteen to thirty meters high) immediately adjacent to the beach. At all but one location (San Onofre State Beach) there are rocky reefs projecting out almost perpendicular from the shore – thus creating sheltered, partially wave-blocked, quieter water areas. Finally, at all four locations where the behavior has been observed, the average daily human beach usage appears to be far less than at other city, county, and state beaches in the vicinity (i.e. Huntington Beach, Newport Beach, and Bolsa Chica State Beach). The author hypothesizes that all of these factors may combine, or be a prerequisite, in determining where or not the dolphins choose a location to exhibit this new behavior. The author believes that this behavior has not been reported by others, prior to now, due to the few isolated locations along the coast of southern California where all of the conditions described above occur.

In conclusion, the author wishes first to thank Mrs. Patty Newman of Three Arch Bay, Laguna Beach for providing him with a copy of the very clear and well-focused video (2.5 hours long, beta format) of this behavior that she recorded on December 14, 1985. Mrs. Newman made the recording from the deck of her patio overlooking Three arch Bay. The video excellently captures several elements of this unusual behavior and formation and was used to obtain the photographs that accompany this article (they were "captured" from the video). The author has already shown the video to researchers at the CBL and would be pleased to allow other interested dolphin researchers to view it as well. Furthermore, the author invites readers of this article to report sightings of dolphin behavior similar to that described in this article directly to him at the telephone number at the end of the article.

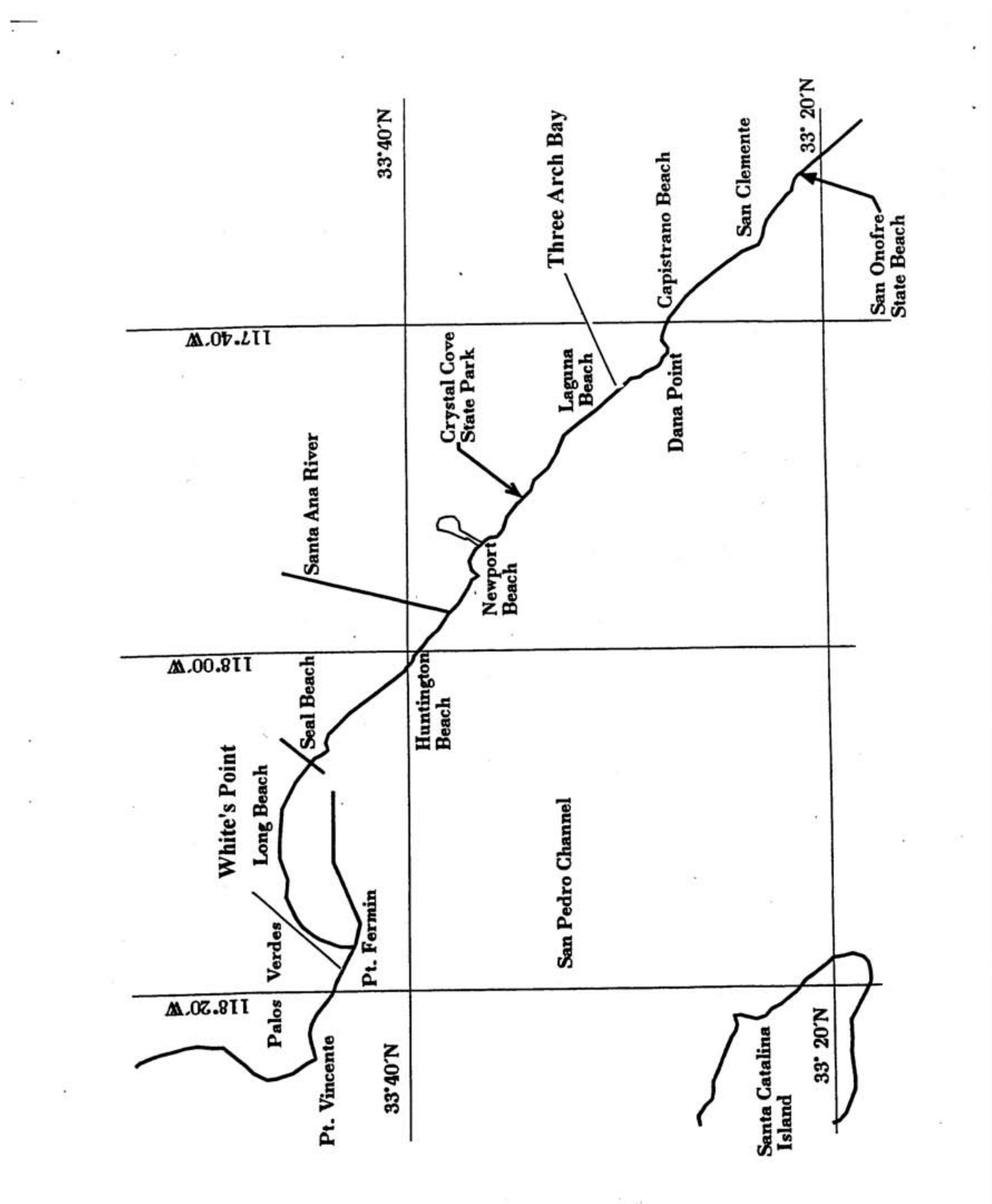
Based on the above information and descriptions, the author proposes that this behavior is yet another component in the behavioral repertory of the amazing coastal bottlenose dolphin and is a method by which these dolphins have adapted to living along the crowded coast of southern California. This may be why the coastal bottlenose dolphin appear to be thriving here while many other species of local marine life have either been significantly reduced or have been eliminated all together.

Dennis Kelly has been a Professor at the Marine Science Department, Orange Coast College, Costa Mesa, California since 1974 and has been the director of the Coastal Dolphin Survey Project since 1978. His research focus is principally the ecology and population biology of coastal bottlenose dolphin and other sea life. He has a website at http://www.occ.cccd.edu/departments/dolphin and can be reached at dkelly@occ.cccd.edu



BIRTHING CIRCLE PATTERN

Figure 1



33°40'N
33° 20'N
117°40'W
118°00'W
118°20'W
Three Arch Bay
Capistrano Beach
San Clemente
San Onofre State Beach
Crystal Cove State Park
Laguna Beach
Dana Point
Santa Ana River
Newport Beach
Seal Beach
Huntington Beach
White's Point
Long Beach
San Pedro Channel
Palos Verdes
Pt. Fermin
Pt. Vincente
Santa Catalina Island

Figure 2