

**HUMPBACK WHALES AND OTHER MARINE MAMMALS OFF COSTA RICA AND
SURROUNDING WATERS, 1996-2003**

**REPORT OF THE OCEANIC SOCIETY 2003 FIELD SEASON
IN COOPERATION WITH ELDERHOSTEL VOLUNTEERS**

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April 2004

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INTRODUCTION

Since 1996, Cascadia Research has been conducting research on humpback whales and other marine mammals off the Pacific coast of Costa Rica and surrounding areas of Central America. In February 2003, we continued this research for the eighth field season in collaboration with the Oceanic Society and with Elderhostel volunteer support. This report summarizes the research conducted on humpback whales and other marine mammals off southern Costa Rica as part of the Oceanic Society trips in 2003, and also includes some of the closely related effort we conducted after these trips in northern Costa Rica and Panama in both February and March. To make this report of broadest possible value, we also summarize the results from all eight years of research in this region and consider the significance of the findings in relation to our research off the west coast of the United States.

The primary effort in conjunction with Oceanic Society Expeditions, and Elderhostel volunteer support, consisted of boat surveys based from Drake Bay, Costa Rica for one week in 2003 (effort in 1996 to 2002 have ranged from one to four week-long programs each year). All of these have been conducted in January and February. Until these studies began in 1996, little information was available on humpback whales and other marine mammals that inhabit the waters off the west coast of Costa Rica.

Humpback whales make seasonal migrations between high-latitude feeding areas and low latitude wintering areas where they mate and give birth to calves. Their populations were depleted by commercial whaling and, in the North Pacific, have recently been estimated to number about 8,000 (Calambokidis *et al.* 1997, 2001). Humpback whales return annually to defined feeding areas in coastal waters, including the waters off California where about 700-1000 humpback whales return annually to feed (Calambokidis *et al.* 1996, 1999, 2002).

In the North Pacific, humpback whales were thought to use three primary wintering areas: the waters near Mexico, Hawaii, and Japan (Calambokidis *et al.* 2001). It was not until research was conducted in the 1990s that it became clear that some humpback whales from the North Pacific were also using Costa Rican waters as a wintering ground (Calambokidis *et al.* 1997, 2000, Steiger *et al.* 1991, Rasmussen *et al.* 1995, Acevedo and Smultea 1995). This research has provided some of the first information available about the number and behavior of humpback whales using Costa Rican waters.

The project has several scientific objectives:

1. Determine the number of whales using Costa Rican waters as a wintering area.
2. Examine for evidence of whale preference for specific areas and habitats within the region.
3. Determine the movement patterns and migratory destinations of these whales.
4. Evaluate the annual return rate of animals to Costa Rican waters.
5. Further evaluate if humpback whales seen in Costa Rican waters are engaged in breeding behaviors similar to other North Pacific wintering grounds.
6. Document the occurrence of other marine mammals in Pacific waters off Costa Rica including the habitats and regions that they inhabit.

METHODS

Small boat surveys

The primary small boat surveys in all eight years (1996-2003) were conducted from Drake Bay on the north side of the Osa Peninsula, Costa Rica, located in the southwestern section of the Pacific coast (Figure 1). Surveys were also conducted off of Northern Costa Rica in 1999-2003, and off Panama in 2001-2003. The boats used off of Drake's Bay were 24 ft fiberglass boats equipped with twin 40-60 hp outboard motors and driven by experienced boat captains familiar with the local area. In other areas, small (less than 30 feet) fishing or tour boats were chartered from locals. A total of 9 dedicated boat surveys were conducted on 5 days in 2003 between 29 January and 7 February (Tables 1 and 2). Additionally, 4 days of surveys were conducted in the Gulf of Papagayo in northern Costa Rica on 11-14 March, and 4 days of surveys were conducted in the Golfo Chiriqui Panama on 25-28 February (Table 1). The Drake Bay surveys covered 618 nmi and all surveys total covered 1,123 nmi of effort and encompassed much of the southwest coast of Costa Rica, western Panama and part of Northern Costa Rica. Surveys out of Drake Bay predominately covered the area offshore from Drake Bay to Isla del Caño, north to Dominical, and southeast into Golfo Dulce (Figure 1). Although survey effort was considerably less in Drake's Bay in 2003, the area covered was consistent with previous years.

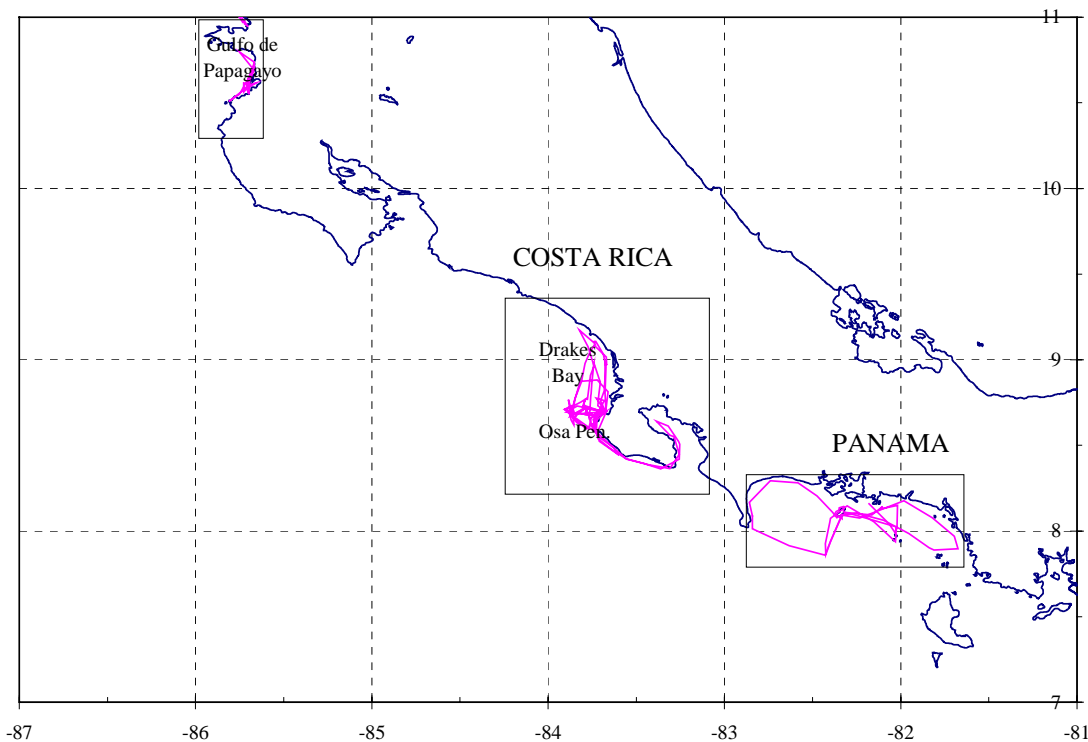


Figure 1. Detail of survey effort in 2003 in Costa Rica and Panama.

One team of Elderhostel volunteers assisted in observing and collecting data on marine mammals for one week in 2003. Two boats were used each day with 6-8 observers each (including a team leader). Observation points to the front, sides, and back were divided among observers. Position information was based on a hand-held GPS (Global Positioning System) kept

aboard each boat. Positions were generally recorded every 30-60 minutes as well as with each sighting. Weather conditions, including sea state, cloud cover, swell height, wind speed, and water temperature were recorded at intervals throughout the survey. Observers recorded information on each surfacing and the behavior of whales during each encounter. One boat would generally attempt to survey more locally and the other more distant regions, such as Dominical to the north, Golfo Dulce to the south, and a number of offshore areas to the northwest and west.

Surveys conducted without Elderhostel volunteers, (surveys in Northern Costa Rica and Panama) were conducted using small charter vessels, typically fishing vessels. One observer was on board in addition to the boat captain, and the same data were collected as described above.

Photographic identification

All humpback whales seen were approached to obtain identification photographs of individual animals. We used photographic identification procedures that have been developed by us and other researchers in studies of humpback whales around the world. Whales were approached slowly from behind and followed until they made a deep dive and typically raised their flukes in the air. If the whale did not raise its flukes, dorsal fin photographs were taken for within season identification purposes. We used *Nikon* 35mm cameras equipped with a motor drive, databacks to print the date on each frame of film, 300mm telephoto lenses, and *Ilford* HP5+, a high-speed black-and-white film.

Acoustic monitoring

Acoustic monitoring and recording has been conducted as part of our surveys, although there have been some changes over the years. Survey boats from 1998 to 2003 each had a hydrophone to listen for and record vocalizations of humpback whales while in 1996 and 1997 only a single hydrophone was available. The primary hydrophones used over the last few years (incl. 2003) were those designed by Bev Ford (Offshore Acoustics). These hydrophones from Offshore Acoustics had a sensitivity of $-154 \text{ dBV/uPa} \pm 4 \text{ dB}$ at 100 Hz, and frequency response from 6 Hz to 14 kHz of $\pm 3 \text{ dB}$. One system was used with a 10m cable and the other with a 20m cable. When humpback whale songs were heard clearly, recordings of 30-60 minutes of song were generally made onto either Digital Audio Tape (DAT) with a *Sony* TCD-D7 or D8 DAT recorder (frequency response 20-14,000 Hz, 32 Hz sampling rate). A few recordings in past years were made on cassette tape with an *Aiwa* Super Bass HS-JS135W stereo cassette recorder.

Hydrophones were also used to help find and locate whales. Hydrophones were usually deployed every 30 minutes. If whales were heard, a more intensive search of the area was made to try and locate the whale. The relative intensity of the song was used to judge the approximate range to the singing whale. Whales were heard at distances up to 5-10 nmi.

The use of hydrophones on both boats since 1998 has allowed us to locate whales based on the time of arrival of the song to each boat. This was accomplished by having one boat transmit the song over the VHF radio to the other boat. The boat hearing the song later was farther from the source of the song (the whale) and would reposition ahead of the other boat. This process was continued in a series of leapfrog movements until both boats were equally

close to the whale and the song could be heard clearly through the boat without the hydrophone. We would then remain in position until the whale was seen.

RESULTS AND DISCUSSION

Humpback whale sightings

Our reduced effort off of Drakes Bay in 2003 resulted in fewer sightings than in previous years. 2003 was one of our lowest years in terms of whales sighted per survey (0.89) and whales sighted per nautical mile surveyed (0.013) in this area (Table 1). However, the percent of days whales were seen (80%) was higher than average, and the percent of surveys whale were seen (56%) was just below average for all the years combined (Table 1). We were consistently seeing whales, but not in great numbers. Because surveys were done over a short period of time, it is difficult to use these data as an indicator of any trends. Tour operators, fishermen, and other locals in the area did not report any noted decrease of whale sightings in 2003 from previous years.

The distribution of whale sightings was similar to past years. Sightings were concentrated between Drake's Bay and Isla Canos, and north along the mainland near Isla Ballena. Our survey into the Golfo Dulce did not yield any sightings and sighting rates have been low in past years in this area (Figure 2).

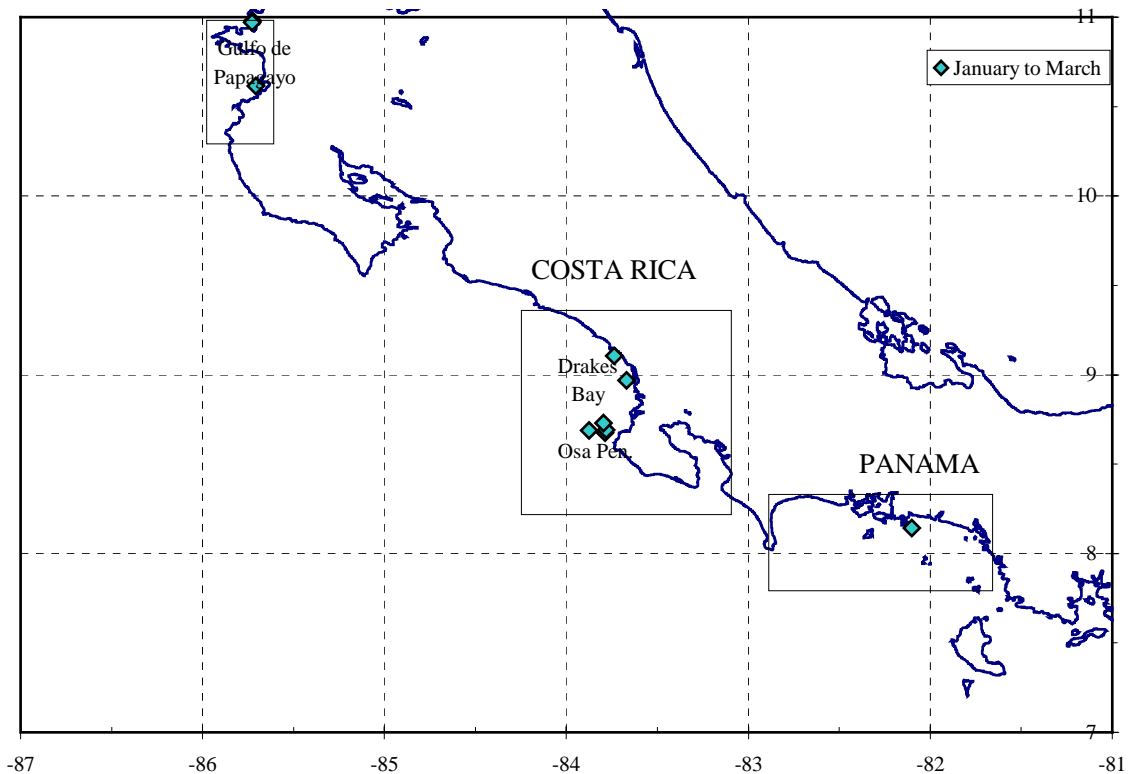


Figure 2. Locations of humpback whale sightings in 2003.

Consistent with previous years results, sighting rates off of Panama were not as high as what we typically find off of Costa Rica. (0.005 whales per nautical mile off Panama). Despite the low number of sightings during these surveys, discussions with the local Panamanians and fishermen in the area indicate that it is not uncommon to see whales there this time of year. Because Panama is farther away from their feeding area than Costa Rica, it is not surprising that we typically find fewer whales there. It appears that Panama is an area with patchy and sporadic distribution of whales.

In contrast to Panama, Northern Costa Rica had a higher sighting rate (0.023 whales per nautical mile) than southern Costa Rica (0.013 whales per nautical mile) in 2003 (Table 1). This sighting rate for Northern Costa Rica is nearly the same as our overall sighting rate for all areas and all years combined (Table 1). We have had consistent success in this area, despite the difficulty surveying because of the strong winds that typically blow during this season.

The overall group composition for humpback whales off Costa Rica is not very different than has been reported in other wintering areas, which is further evidence that Costa Rica is a typical wintering ground for humpback whales (Table 3). The proportion of single animals (singers and non-singers) in our study through 2003 has been 45%. In the North Atlantic, 42% of sightings on Samana Bank (Mattila *et al.* 1994) and 49% of sightings on Virgin Bank were singletons (Mattila and Clapham 1989). Along the Hawaiian Island chain, only 30% of animals were reported to be single whales (Mizroch *et al.* 1996). In all wintering areas it has generally been found that more males are present than females.

We do not see all of the group types represented in 2003, which could be due to our lower overall sightings. Most of our sightings (44%) were of singers, and we had no sightings of non-singer singles, or any groups larger than two whales. One third of our sightings were of mother/calf pairs, which was higher than the overall average (18%).

Photo-identification

Humpback whales were identified on 7 occasions representing 6 unique whales in 2003 (Table 2). Three whales were identified off of Drake's Bay, one in Northern Costa Rica, and one in Panama (Table 4). Of these 6 whales, all 6 have been previously identified off of California. This is a higher matching rate than our overall average, which is 86% of whales match California (Table 4). Four of these whales had been seen off of Costa Rica in previous years (Table 5). This high rate of resighting whales off of Costa Rica could be an indication that we have photographed the majority of whales that winter in this area.

Photo-identification of individual whales has given us some interesting data on transit times between Costa Rica and California. Of whales identified in 2003, one (10523) was seen on July 20, 2003 in Monterey Bay, seven months before it was seen off Costa Rica. The farthest north these Costa Rica whales have been seen (ID#10583 and 12001) is near Newport, Oregon, 5,524 km north of where they were seen in Costa Rica. The longest documented transit distance (same season) for a whale seen in Costa Rica was ID#11243 seen on 6 October 1998 off Pt. St. George at the Oregon/California border and resighted in Costa Rica on 6 February 1999, a minimum straight-line distance of 5,427 km in 4 months. This is more impressive given that the distance traveled was likely much greater and the interval probably much shorter than we documented. The shortest transit time

we have documented in any year was a whale we saw off northern California on 1 December 1995 (one of our last surveys of the season) that we saw a mere 56 days later on 26 January 1996 during our first survey off Costa Rica (Calambokidis *et al.* 2000). The straight-line distance between these two points is 5,200 km. Even in this case the actual transit was probably shorter in time and longer in distance than this indicates; this whale likely stayed longer off California, arrived earlier off Costa Rica, and may have traveled other areas than revealed by our observations. As coincidental as this pair of sightings seems, we have had several other resightings of the same whale thousands of miles away just a few months apart.

The total number of different individuals that has been identified off Central America (primarily S Costa Rica but including some from S. Mexico to Panama) in winter months now is 83 (Table 4). The rate with which we have matched these whales to those we know from our research off California remains high (Table 4). Of the total of 83 different humpback whales off Costa Rica, 72 (87%) have been seen off California. Because we have not identified all California whales (we typically find that 15-20% of whales we see off California have not been identified previously) the match rate of Costa Rica whales to California indicates Costa Rican waters are almost exclusively used by humpback whales that migrate to California. This overall rate is higher than has been documented between any other winter and feeding regions that scientists have examined. The exclusive use of a wintering area by animals from a single feeding area is different than has been documented for other humpback whale wintering areas that have been studied in the North Pacific and North Atlantic. At other wintering areas, humpback whales have been documented traveling to multiple different feeding areas. This may be the result of Costa Rica being the farthest south wintering area for North Pacific humpback whales and California being the most southern feeding area.

Even though whales along the U.S. West Coast are part of a single feeding area with fairly high rates within-region movements, there were clear patterns between areas whales were seen feeding and where they migrated in winter. The whales we have identified off southern California were far more likely to have been identified in the Central America wintering area with about 12% of the 300 whales identified in two different regions of S California having also been seen in Central America. Only 6-7% of whales identified off central and northern California and 2% of those seen in Oregon and S Washington had been seen off Central America (Figure 3). The exact opposite pattern was seen for whales known to have gone to wintering areas off mainland Mexico; whales seen off Oregon and Washington had the highest chance and whales seen feeding off southern California the lowest chance (6-7%) and those off N California and Oregon-S WA. the highest chance (13-14%) of having also been seen in mainland Mexico. The whales seen off N Washington and S British Columbia are a different feeding aggregation with low rates of interchange with Central America. This is consistent with the pattern we reported previously that whales feeding in the southern feeding areas tended to migrate to Central America and those using more northern feeding areas tended to go to the more northern wintering areas off mainland Mexico (Calambokidis *et al.* 2001).

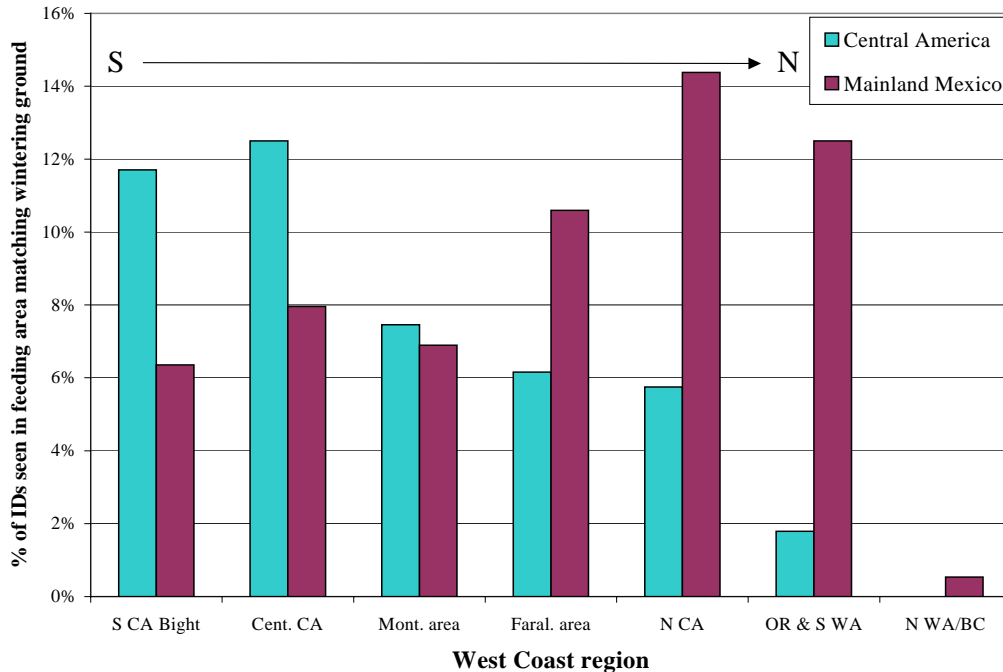


Figure 3. Percent of identified humpback whales from different feeding areas matching to Central America and mainland Mexico.

Humpback whale song and gender differences

The hydrophone was deployed 106 times off of Southern Costa Rica, 27 times off Panama, and 15 times off Northern Costa Rica (Table 6). Song was heard 18% of the deployments in southern Costa Rica, 27% in Northern Costa Rica, and no song was heard in Panama. Recordings were made on two occasions, one time in Southern Costa Rica (ID# 10557 on 29 Feb 2003), and one time in Northern Costa Rica (ID# 10173 on 14 March 2003).

There is a considerable amount of variability throughout the years in the percentage of times we hear song, and we have ranged between 16% and 42% of the time off of Southern Costa Rica (Table 6). Our most successful season for song was in Northern Costa Rica in 2001, where we heard song 57% of hydrophone deployments.

Our research off of Costa Rica has added to a growing database of known sexes for individual humpback whales. We know that male humpback whales are the only ones who sing. Since we started this research in 1996, we have been able to positively identify nine individual whales as singers, (and therefore as males) one of which was newly identified as a singer this year. In addition, females have been positively identified on three occasions because they have been seen with calves off Costa Rica .

Southern Hemisphere surveys

Since 2001, we have also begun to study the presence of humpback whales off of Costa Rica and Panama during the southern hemisphere wintering season. In the Southern hemisphere, humpback whales feed in Antarctic waters during their summertime (December-April), and travel north to warmer waters during their wintertime (July-October). Since we started doing research in Costa Rica we were aware that whales were seen year round, with peaks during the two wintering seasons for both hemispheres. We conducted dedicated surveys off Costa Rica in 2001, and off both Costa Rica and Panama in 2002 and 2003. These have provided us with new insights into the migration of these whales (Figure 4).

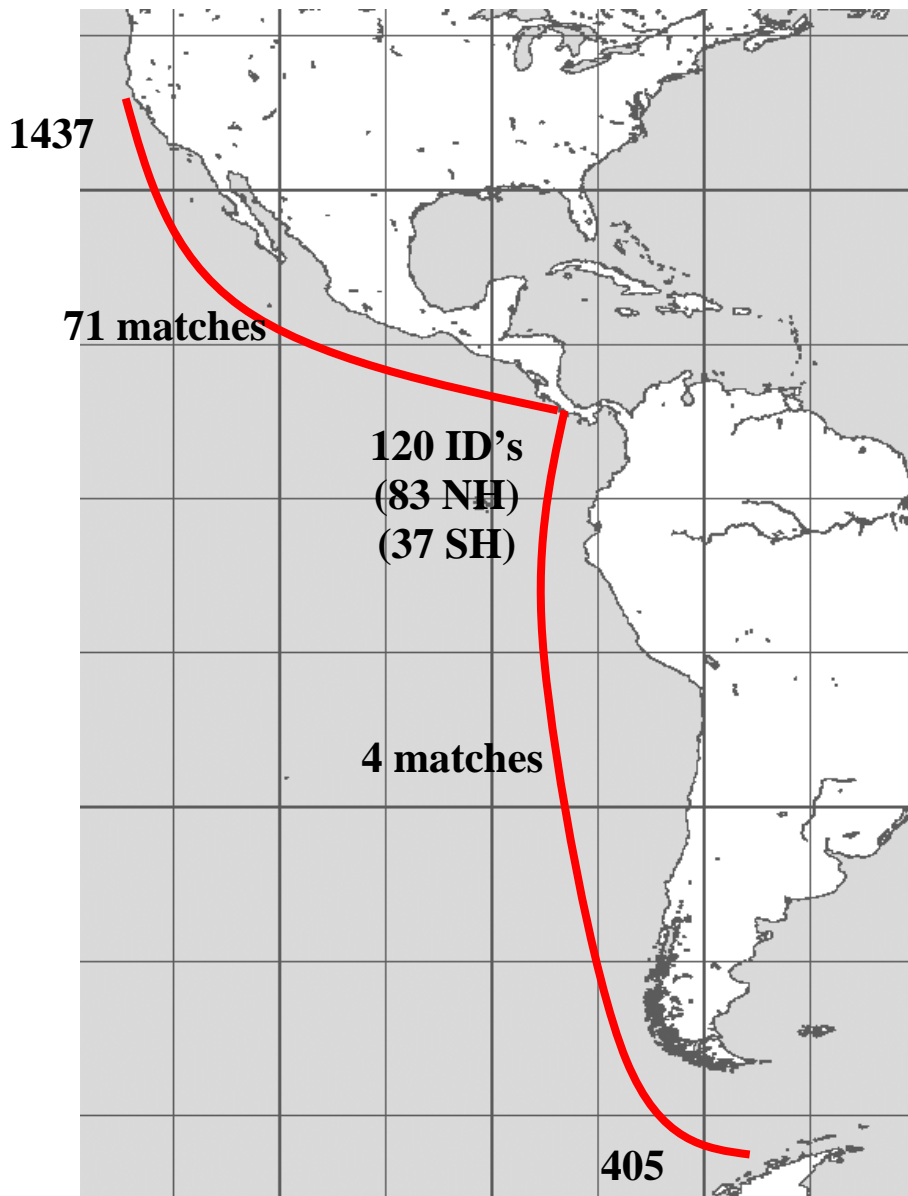


Figure 4. Migrations of N & S Hemisphere humpback whales from Central America. Numbers show sample sizes in regions and number of matches between regions.

We now have 37 individuals identified off of Costa Rica and Panama during this season. Marco Saborio collected five of these photographs before 2001. Of these 37, four have also been identified feeding off the Antarctic Peninsula (Antarctic Humpback Whale Catalog, College of the Atlantic). This firmly establishes that whales seen during this season off of Costa Rica are migrating from Antarctica, but it also sets a new record for the longest migration by an individual mammal. The one-way migration between these two places is approximately 8,400 kilometers.

We have also been able to describe the geographic area of overlap that whales from both hemispheres are using as a wintering area off of Central America. Along with our collaborators, we have documented whales from both hemispheres throughout the coasts of Costa Rica and Panama (Rasmussen *et al.* 2001). This area of overlap is much bigger than was previously thought, and is the only area known in the world where whales from both hemispheres inhabit the same area during their wintering season.

Although there are two distinct peaks of sightings that correspond with the two different wintering seasons, sightings of humpback whales have been reported year round off of Costa Rica. Although the chances are slim, it is possible that whales from the two hemispheres could encounter each other. Genetic research has shown that there has been some interchange between these two populations sometime in the past, and it's likely that this wintering area off of Costa Rica is where this genetic interchange occurred.

Other marine mammals

Since the start of the study, we have documented 11 different species of marine mammals in our study area from 1996 to 2003 (Table 7). In addition to humpback whales four other species of marine mammal were seen in 2003; multiple sightings of spotted dolphins and bottlenose dolphins and single sightings groups of killer whales and false killer whales. A brief summary from the data from all years for each species is provided below.

Large baleen whales

Although no large baleen whales other than humpback whales were seen in 2003 there have been sightings in past years. A single Bryde's whale was seen on 26 January 1998. It was observed along the south side of the Osa Peninsula and was swimming south. This medium-size whale is in the same family (Balaenopteridae) as humpback whales. Unlike most other baleen whales, it is generally confined to warmer tropical and temperate waters. It was identified by its streamlined shape, smaller size (30-40 ft), and three head ridges. The occurrence in this region is not surprising. The only other species of baleen whale, besides humpback and Bryde's whales, seen in our research, was a single sighting of a possible fin or sei whale in 1997.

Toothed whales

False killer whales are the most commonly seen species of the toothed whales in our study. This species was seen in 2003, and has been seen in past years in 1996, 1998, 2000, and

2001. During one of the sightings in 1998, one whale dove down out of our sight, and then resurfaced with a red rockfish in its mouth. It carried the fish around in its mouth and passed it to another animal nearby. Two of the sightings (one in 1996 and one in 1998) were made on the west side of Isla del Caño while the other sightings (in 1998 and 2003) were off Drake Bay. This species has been reported frequently in Golfo Dulce and off Isla de Coco in Costa Rica (Acevedo-Gutierrez *et al.* 1997). Local naturalists reported frequently sighting pilot whales in the study area. We never encountered pilot whales in our surveys and suspect at least some sightings of false killer whales may be mistakenly identified as pilot whales.

Sperm whales were seen in 1996. Sperm whales primarily inhabit deeper offshore waters, where we saw them in 1996. Our surveys are usually in shallower waters with the exception of a few segments just barely off the shelf edge so the infrequent sightings of this species are to be expected.

Killer whales were sighted in 1997 and 2003. In 1997, a group of four animals, including two adult males was observed on the same day in both the morning and afternoon. During one encounter, we observed the whales pursuing an adult humpback whale, which was able to escape them. In 2003, a group of seven killer whales (including one calf) passed through an area where a humpback whale was singing. We observed chunks of flesh in the water near them, which we were unable to identify. Recently there has been controversy regarding the reason why baleen whales migrate to lower latitudes during the winter months. Some researchers suggest that this is to escape predation by killer whales in the higher latitudes (Corkeron and Connor 1999). These observations would suggest that humpback whales off Costa Rica are subject to predation by killer whales.

Dolphin species

Five dolphin species have been seen during the study (not including the false killer whale or killer whale which are in the delphinid family). Spotted dolphins remained by far the most frequently seen marine mammal species in our surveys accounting for half of all of our sightings. The distribution of spotted dolphin sightings reveals they were seen throughout the area we surveyed.

Bottlenose dolphins were seen 5 times (total of 89 animals) in 2003 and have been seen all years of the study and throughout the study area. Many of our sightings of this species over the years have come from more peripheral areas of our effort suggesting they are not as common around Isla del Caño as in some other areas. Bottlenose dolphins were often sighted during our few surveys out to the shelf edge northwest of our primary study area suggesting this is a better habitat for this species than the principal areas we surveyed. Bottlenose dolphins were also seen in Golfo Dulce during some of the trips we made there. Group sizes were generally smaller than for other dolphin species (about 15 animals).

Three other species of dolphin have only been sighted in single years but not in 2003. Rough-toothed dolphins were seen in 1998, 2000, and 2002. These dolphins do not have a crease between the melon and beak, which distinguishes them from other species. Rough-toothed dolphins are considered relatively uncommon throughout most of their tropical range (Leatherwood and

Reeves 1983). Spinner dolphins, were seen for the first time in our study in 1999. This is a fairly common dolphin known to occur in this region but we had been unable to positively identify it in past surveys. A group of approximately 50 common dolphins were seen during one of our few surveys off the continental shelf edge at the northwest tip of our survey coverage on 12 February 1998. This species is relatively common in offshore waters of the eastern tropical Pacific but had not been seen in the areas of our surveys.

CONCLUSIONS

Principal findings of the research over the years have included:

- Humpback whales regularly use Costa Rican waters as a calving and breeding area with sightings of mother-calf pairs, pregnant females, singing males and surface active groups.
- North Pacific humpback whales inhabit a broad region of Central America extending south from the wintering grounds previously described in Mexico all the way to Panama. There is also some evidence of site preferences with some whales returning in multiple years to the Drake Bay area.
- Humpback whales from this region are almost exclusively animals that use the California, Oregon, and Washington feeding area with some tendency for animals from Central America to feed in the more southern portions of this feeding area.
- A total of 11 marine mammal species were documented in Costa Rican coastal waters and provided some of the first details of these species in these waters.

This information will be valuable in protecting managing marine mammals in Costa Rica. Tourism in Costa Rica has increased dramatically over the last 20 years, especially with visitors interested in terrestrial and marine wildlife. An expansion of resorts and tourist activities in Drake Bay has occurred over the five years of this research. With these increasing activities and interest in whales and marine mammals, it is important we learn more about the populations of many of these species to be better to protect them and educate people.

ACKNOWLEDGMENTS

This research was supported by Oceanic Society Expeditions and Elderhostel; Birgit Winning, Joel Litwin, Mary-Jane Schramm, Silke Schroeder, Randi Reiremo, and Sherri Shannon at Oceanic Society arranged many of the logistics for the field base. Izzy Szczepaniak, Frank Garita, and Heather Harding all assisted as leaders of some trips. We are grateful to those who made this research possible, especially the dedicated volunteers and everyone at Drake Bay Wilderness Camp. Herbert, Marleny, and Fernando of Drake Bay Wilderness Camp provided logistical help and support. Boat captains with Drake Bay provided skillful driving as well as assistance with sightings, especially Roger, Alex, and Omar. Marco Tulio Saborío provided sighting information and photographs from his encounters with humpback whales going back many years. Laura May-Collado provided photographs and conducted surveys in northern Costa Rica. John Tresemer provided sighting information. Sierra Sequera provided sighting information and logistical help (boat surveys). Carol Henderson, Andre Koenig, Herbert Michaud, Bill Muraco, and Jack Swenson provided photographs from past years. Carolina Garcia provided photographs and sighting information. George Ravenscroft, Linda Klein, and Doug Bell provided assistance in Panama. Lisa Schlender assisted in data analysis and matching. We thank these people and organizations.

We especially thank the Elderhostel Volunteers in 2003: Judy Palmer, Reid Earls, Betty Risley, Tom Telder, Richard Updegraff, Virginia Updegraff, and Rita Benear.

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Table 1. Summary of survey effort and humpback whale sightings Costa Rica and Panama

	Year									2003 breakdown		
	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL	Drakes	NCR	Panama
Survey effort												
Start date	26-Jan	31-Jan	24-Jan	27-Jan	25-Jan	19-Jan	6-Feb	29-Jan		29-Jan	11-Mar	25-Feb
End date	16-Feb	14-Feb	18-Feb	7-Feb	13-Feb	17-Feb	14-Mar	14-Mar		7-Feb	14-Mar	28-Feb
Days with surveys	15	10	15	10	16	20	16	13	115	5	4	4
Total boat surveys	26	18	27	18	30	32	20	17	188	9	4	4
Survey nmi	1,581	1,205	1,734	1,249	1,738	2,374	1,312	1,123	12,315	618	130	375
Humpback sightings												
Sightings	15	27	18	32	29	33	14	9	177	6	2	1
Animals	19	45	25	60	46	67	25	13	300	8	3	2
Days whales seen	10	10	8	10	15	12	6	7	78	4	2	1
Surveys whales seen	13	14	12	15	22	18	9	8	111	5	2	1
Sighting rates												
Percent of days whales seen	67%	100%	53%	100%	94%	60%	38%	54%	68%	80%	50%	25%
Percent of surveys whales see	50%	78%	44%	83%	73%	56%	45%	47%	59%	56%	50%	25%
Whales/survey	0.73	2.50	0.93	3.33	1.53	2.09	1.25	0.76	1.60	0.89	0.75	0.50
Whales per nmi	0.012	0.037	0.014	0.048	0.026	0.028	0.019	0.012	0.024	0.013	0.023	0.005

In 2000, 6 hours of effort on 23-24 January covering 31 nmi was conducted off N Costa Rica

2001 includes 3 days of effort in northern Costa Rica (19-21 January) and 4 days in Panama (14-17 February)

2002 includes 3 days effort in Northern Costa Rica (8-10 March) and 6 days in Panama (22-27 February).

Table 2. Summary of survey effort, sightings, and identifications in Costa Rica and Panama in 2003.

Date	Leader	Time		Dura- tion	Humpbacks			ID's	Other species	Comments
		Start	End		sight.	#	#ID			
Drake's Bay										
29-Jan	KR	7:53	15:24	7:31	1	1	1	10557	Oo, Sa	Killer whales pass near where a humpback whale is singing
29-Jan	FG	7:55	15:10	7:15	1	1	0		Oo, Sa	Killer whales pass near where a humpback whale is singing
30-Jan	KR	7:42	16:06	8:24	0	0	0		Sa	
30-Jan	FG	7:42	14:54	7:12	1	1	1	10557	Sa	singer, same as whale from 29-Jan
1-Feb	KR	7:53	15:01	7:08	1	2	2	10523, 11378	Sa	2 adult humpbacks
1-Feb	FG	7:05	15:12	8:07	0	0			Tt	
2-Feb	KR	7:41	15:08	7:27	1	2	0		Sa	cow/calf pair, several other whale watching boats in area
2-Feb	FG	7:42	12:23	4:41	0	0	0		Sa	
7-Feb	KR	8:10	12:25	4:15	0	0	0		Pc	Large group of false killer whales
Panama										
25-Feb	KR	7:38	14:46	7:08	1	2	1	10570	Sag	Shred with calf
26-Feb	KR	7:37	13:36	5:59	0	0	0		Sa	
27-Feb	KR	7:44	14:20	6:36	0	0	0		Sa, Sag, Tt	
28-Feb	KR	8:06	15:15	7:09	0	0	0			
Northern Costa Rica										
11-Mar	KR	7:53	11:36	3:43	0	0	0		Sa	High winds
12-Mar	KR	7:15	12:20	5:05	0	0	0			High winds
13-Mar	KR	8:44	11:16	2:32	1	2	2	10547	Sa	cow/calf pair, fishing boats, jet skis, and dive boats in area, cow seen feeding
14-Mar	KR	8:28	12:46	4:18	1	1	1	10173		Singer

Sa-spotted dolphin (*Stenella attenuata*), Sag- coastal spotted dolphin subspecies (*S. attenuata graffmani*), Tt-bottlenose dolphin (*Tursiops truncatus*)

Sb-rough toothed dolphin, (*Steno bredanensis*),

Table 3. Group composition of humpback whale sightings in study area off Costa Rica, 1996-2003.

	1996		1997		1998		1999		2000		2001		2002		2003		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Lone singers	5	33%	2	7%	7	39%	5	16%	14	48%	8	24%	4	29%	4	44%	49	28%
Singles	5	33%	6	22%	4	22%	4	13%	6	21%	3	9%	2	14%	0	0%	30	17%
Pairs (not including m/c pairs)	3	20%	15	56%	5	28%	4	13%	2	7%	7	21%	3	21%	1	11%	40	23%
Mother/calf	0	0%	3	11%	2	11%	14	44%	1	3%	4	12%	4	29%	3	33%	31	18%
Mother/calf/escort	0	0%	0	0%	0	0%	5	16%	5	17%	10	30%	0	0%	0	0%	20	11%
Groups >2 (excl. comp. grps)	2	13%	0	0%	0	0%	0	0%	1	3%	1	3%	0	0%	0	0%	4	2%
Competitive Groups	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1	7%	0	0%	1	1%
Undetermined	0	0%	1	4%	0	0%	0	0%	0	0%	0	0%	0	0%	1	11%	2	1%
Total groups with calf	0		3		2		19		6		14		4		3	33%	51	29%
Total	15		27		18		32		29		33		14		9		177	

Table 4. Results of photographic identification research of humpback whales in Costa Rica and Panama

	ID's	Unique whales	New whales	No. matching California	% matching California	Comments
pre-1996	5	5	5	4	80%	2 IDs by Richard Sears, 2 by Carol Henderson, 2 by Marco Saborío
1996	16	13	12	11	85%	2 IDs by Herbert Michaud of Drake Bay Wilderness Camp, 1 ID by Bill Muraco, and 1 ID from Panama by Jack Swenson
1997	19	11	10	8	73%	
1998	12	7	4	6	86%	
1999	28	27	26	23	85%	19 IDs from <i>Russamee</i> Central American survey, 2 IDs each from Laura May and Andre Koenig, both in N Costa Rica
2000	26	12	7	11	92%	1 ID by John Calambokidis from N Costa Rica
2001	25	16	11	14	88%	2 IDs by Kristin Rasmussen from Panama, Includes 2 matches (mom/calf) that match 2001 California (11445 and 11446)
2002	11	7	6	6	86%	One identification from Carolina Garcia in Bahia Honda, Panama, two from Kristin (one from Drake's Bay, one from Golfo Papagayo)
2003	7	6	2	6	100%	
All Years	142	83		72	87%	

Table 5. Humpback whales identified between January and March 2003 in Costa Rica with summary of sighting histories.

ID	Sightings in Costa Rica			Times seen	Locations seen in California	Sightings in California																Comments
	Date	Location	Role			87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	
10173	03/14/03	N Costa Rica	Singer	22	FB, GF, MB, PSG	x	x	x		x				x	x		x				Singer in 1996 CR	
10523	02/01/03	Isla Canos	1 of Pair	15	GF, HM, MB, SB, SL					x	x			x	x				x		Singer in 2000	
10547	03/13/03	Golfo Papagayo	Cow	12	GF, HM, MB, SL					x	x			x	x				x		cow in 01, 10557 escort	
10557	01/29/03 01/30/03	Drake Bay "	Singer "	12	SL, GF					x	x	x	x	x			x			x	escort of 10547 in 01 off CR	
10570	02/25/03	Panama	Cow	32	GF,MB,SB,SL					x	x		x	x		x	x	x	x		cow in 96,99,02, Shred	
11378	02/01/03	Isla Canos	1 of Pair	4	MB, SL														x	x	possible cow in 99	

California locations: GF-Gulf of Farallones, HM-Half Moon Bay, MB-Monterey Bay, NC-Northern California, PA-Point Arena, SB-Santa Barbara Channel, SL-San Luis Obispo

Table 6. Proportion of hydrophone deployments in which humpback whales were heard. Results are biased upwards by more frequent deployments when locating a singing whale.

Year	Hydrophone deployments		
	number of times deployed	Song heard	%
1996	79	19	24%
1997	82	13	16%
1998	255	54	21%
1999	238	52	22%
2000	455	193	42%
2001 N CR	30	17	57%
2001 S CR ¹	368	48	13%
2001 Panama ¹	57	18	32%
2002 N CR	17	0	0%
2002 S CR	146	51	35%
2002 Panama	53	7	13%
2003 S CR	106	19	18%
2003 N CR	15	4	27%
2003 Panama	27	0	0%
All Years	1928	495	26%
Mean	157	35	25%
SD	142	49	16%

Table 7. Summary of sightings of marine mammals in 1996-2003.

Species	96	97	98	99	00	01	02	03	TOTAL
Baleen whales									
Humpback whale	15	27	18	32	29	33	14	13	181
Bryde's whale			1						1
Unidentified Baleen whale		1				1			2
Toothed whales									
Sperm whale	1								1
Killer whale		2						1	3
False Killer whale	1		2		1	3		1	8
Dolphin Species									
Spotted dolphin	20	36	35	63	83	74	42	28	381
Bottlenose dolphin	8	2	7	2	3	17	5	5	49
Rough Toothed dolphin			1		1		1		3
Common Dolphin			1						1
Spinner dolphin				1					1
Unidentified dolphin	26	8	12	1	2	10		3	62
Total	71	76	77	99	119	138	62	51	693