

**HUMPBACK WHALES AND OTHER MARINE MAMMALS OFF COSTA RICA AND  
SURROUNDING WATERS, 1996-2002**

**REPORT OF THE OCEANIC SOCIETY 2002 FIELD SEASON  
IN COOPERATION WITH ELDERHOSTEL VOLUNTEERS**

Prepared by

Kristin Rasmussen  
John Calambokidis  
Gretchen H. Steiger  
*Cascadia Research*  
*218½ W Fourth Ave.*  
*Olympia, WA 98501*  
*www.CascadiaResearch.org*  
*(360) 943-7325*

Sponsored by  
Oceanic Society Expeditions  
*Fort Mason Center, Bldg. E*  
*San Francisco, CA 94123*  
*http://www.oceanic-society.org*  
*(415) 441-1106*

December 2002

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## EXECUTIVE SUMMARY

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. The principal objectives are to examine aspects of humpback whale use of Central America including, the number, habitat preference, timing, behavior and migrations of humpback whales as well as document the occurrence of other marine mammals species.

The research has been conducted in collaboration with the Oceanic Society and with Elderhostel volunteer support. Small boat surveys from 1996-2002 were conducted primarily from Drake Bay on the north side of the Osa Peninsula, Costa Rica. Surveys were also conducted off of northern Costa Rica in 1999-2002, and off Panama in 2001-2002. All humpback whales seen were approached to obtain identification photographs of individual animals. Acoustic monitoring and recording for humpback song was conducted as an integral part of the visual surveys. Four aerial surveys were conducted in 2002 covering the entire Pacific coast of Costa Rica, and the western Pacific coast of Panama.

Humpback whales were consistently sighted in all years off southern Costa Rica, most whales found between the mainland and Canos Island where our principal survey effort was concentrated. Our success in finding whales in surveys off northern Costa Rica and Panama was more variable. The overall group composition for humpback whales off Costa Rica is not very different than has been reported in other wintering areas and included singles, cows with calves, and occasionally larger surface-active groups.

With the effort in 2002, 81 different individual humpback whales that has been identified off Central America (including S. Mexico to Panama) in winter months. Of these, 69 (85%) have been also seen off California, a match rate that indicates these whales exclusively migrate from the California feeding aggregation. This overall rate is higher than has been documented between any other winter and feeding regions that scientists have examined. Whales feeding off southern California were more likely to migrate to Central America than those feeding off northern California, Oregon, and Washington. The longest migration documented was from Newport, Oregon, to Costa Rica (5,524 km) and the shortest documented transit was 56 days.

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 (Northern Hemisphere summer). Of the 25 individuals identified off of Costa Rica and Panama during this season, three have also been identified feeding off the Antarctic Peninsula. This is the first documented migration between hemispheres and sets a new record for the longest migration by an individual mammal (8,400 km each way).

We documented sightings of 10 other marine mammals species besides humpback whales in our surveys. Spotted and bottlenose dolphins were the most common other species encountered. The increased tourism and other development in these regions makes it critical to document the occurrence of marine mammals and identify potential threats.

## 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 2002, we continued this research for the seventh 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 2002, 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 seven 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 2002 (effort in 1996 to 2001 have ranged from two 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). Humpback whales migrate annually to defined feeding areas in coastal waters, including the waters off California where about 700-1000 humpback whales return each year 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 (Steiger *et al.* 1991, Rasmussen *et al.* 1995, Acevedo and Smultea 1995, Calambokidis *et al.* 1997, 2000). 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 Central American 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 Central American waters.
5. Further evaluate if humpback whales seen off Central America 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 six years (1996-2002) 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 1999-2002, and off Panama in 2001-2002. Off of Drakes Bay, the boats used were 24 ft fiberglass boats equipped with twin 40-60 hp outboard motors and driven by experienced boat captains familiar with the local area. A total of 8 dedicated boat surveys were conducted on 4 days in 2002 between 6 February and 10 February (Tables 1,2 and 3). Additional effort in 2002 included, three days of surveys between 12 and 14 March (after our regular trips) off southern Costa Rica, 3 days of surveys in the Gulf of Papagayo in northern Costa Rica on 8-10 March, and 6 days of surveys were conducted in the Golfo Chiriqui Panama on 22-27 February (Figure 1). The Drake Bay surveys covered 840 nmi and all surveys total covered 1,312 nmi of effort (Table 2) and encompassed much of the southwest coast of Costa Rica in addition to coverage in northern Costa Rica and western Panama (Figure 1). Surveys out of Drake Bay predominately covered the coastal waters from Drake Bay to Isla del Caño, north to Dominical, and southeast into Golfo Dulce (Figure 2). Although survey effort was considerably less in Drake's Bay in 2002, the area covered was consistent with previous years.

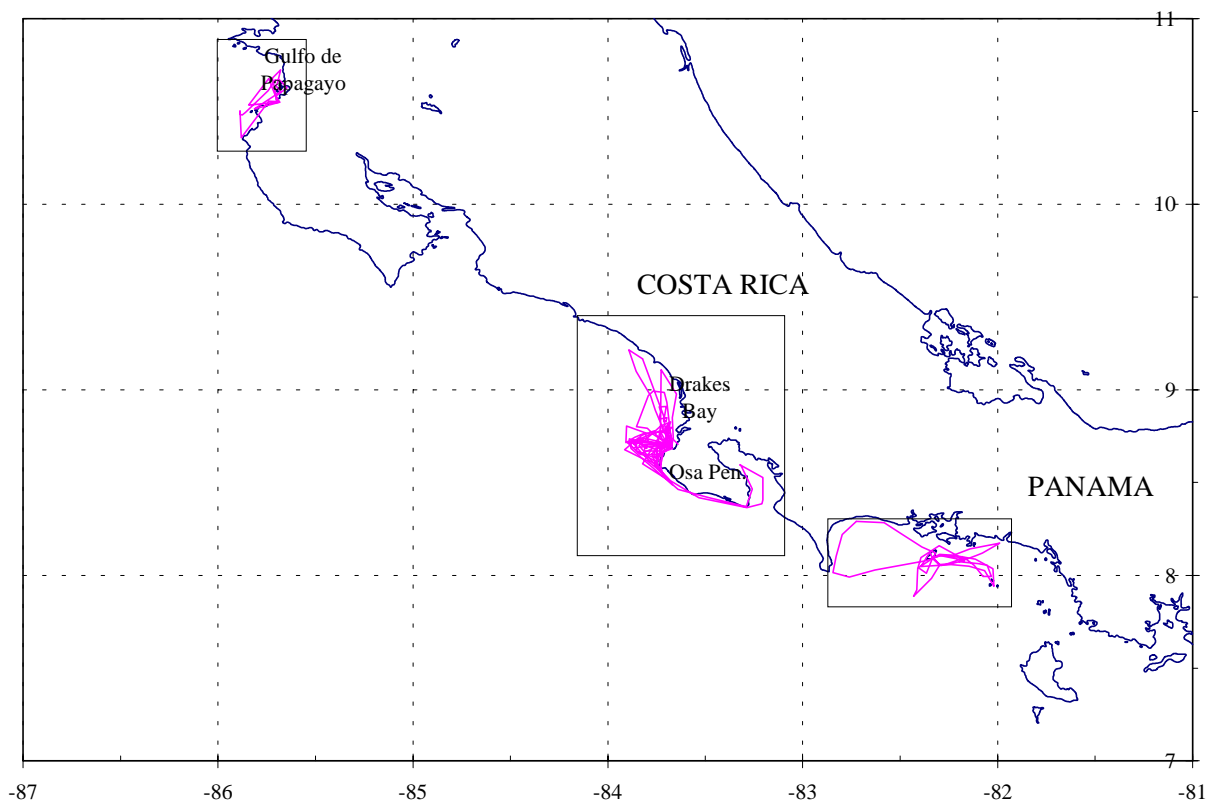


Figure 1. Study areas (boxes) and survey effort in 2002 in Costa Rica and Panama.

One team of Elderhostel volunteers assisted in observing and collecting data on marine mammals for one week in 2002. 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.

Surveys conducted without Elderhostel volunteers (in northern Costa Rica, Panama, and in Drake's Bay in March 2002) were conducted using small charter vessels, typically fishing vessels, except with two observers were on board (in addition to the boat captain)..

### **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 a whale did not raise its flukes, dorsal fin photographs were taken for within season identification purposes. We used *Nikon* 35mm cameras equipped with motor drives, 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 2002 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. 2002) were those designed by Bev Ford (Offshore Acoustics). These hydrophones 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. We also occasionally used hydrophones on both boats 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 and using the time of arrival to determine the direction to the whale.

### Aerial Surveys

We conducted four aerial surveys in 2002 covering the entire Pacific coast of Costa Rica, and the western Pacific coast of Panama (Figure 2). Surveys were conducted in collaboration with Lighthawk, a non-profit organization pairing private pilots with environmental organizations (Table 4). Surveys were conducted using a single-engine *Cessna Turbo 206*. Surveys were conducted at an altitude of 1000 feet, and at a speed of 100 knots. Two observers searched from the right and left sides of the plane respectively, and a data recorder was in the co-pilot seat and observed when possible. When sightings of marine mammals were made, time, location, group size, behaviors, and horizontal angle to the sighting using a *Suunto* clinometer were recorded.

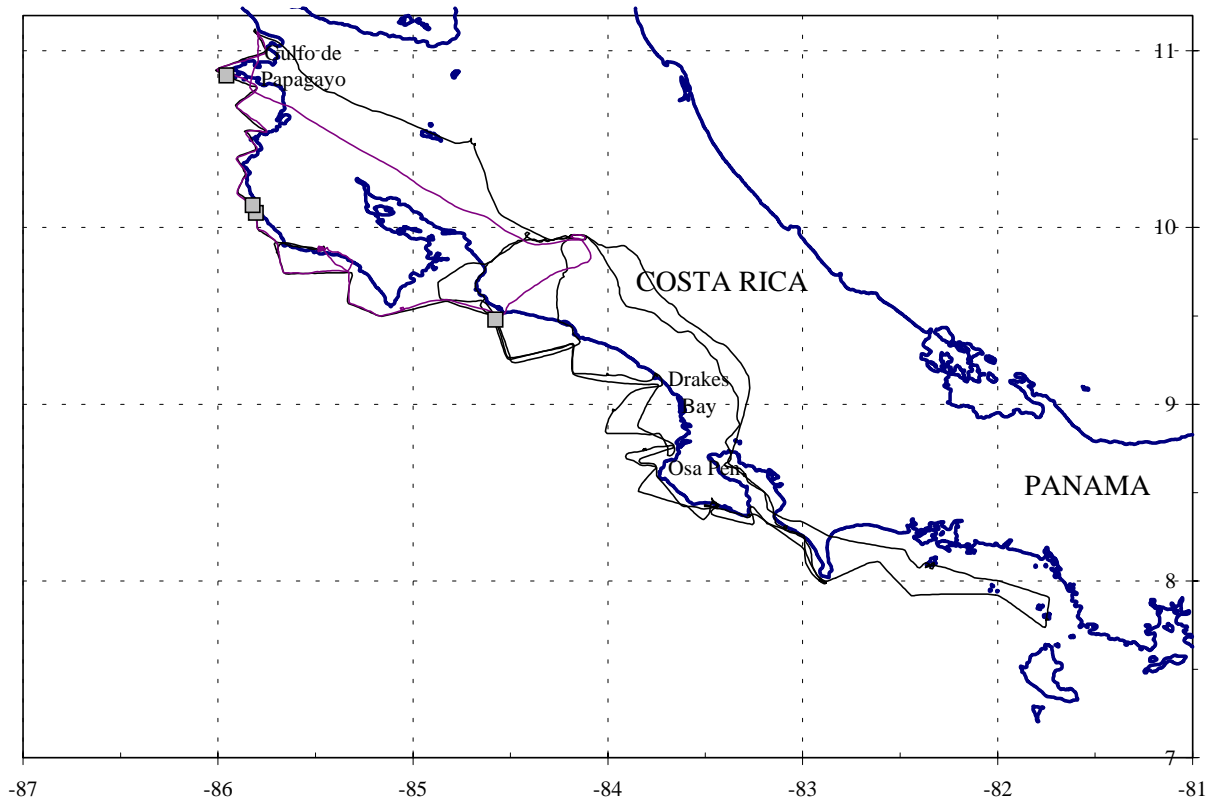


Figure 2. Aerial survey trackline along Pacific coast of Costa Rica and the western Pacific, Panama. Locations of humpback whale sightings are shown as shaded squares.

## RESULTS AND DISCUSSION

### Humpback whale sightings

Although our effort off of Drake's Bay in February was less than it had been in other years, we were still successful in sighting and identifying whales in 2002 (Tables 1 and 2). The number of sightings during the surveys out of Drake Bay (10 sightings of 20 animals) in 2002 was reasonable considering the fewer number of surveys done. The percentage of days whales were seen (75%), the number of whales seen per survey (2.5 whales per survey) and whales seen per nautical mile (0.03) were all higher than average for all the years combined (Table 1). Whale sightings off Drake's Bay during the three surveys in March were not as high as during February. We had only one sighting during the three surveys. March is near the end of the period when we would expect northern hemisphere humpback whales to be on their breeding grounds and some may have already left the region.

The distribution of whale sightings in 2002 was similar to past years. Whales were primarily sighted between the mainland and Canos Island where our principal survey effort was concentrated (Figure 3). Surveys into the Golfo Dulce and further north along the coast did not yield any sightings and sighting rates have been lower in past years in these areas.

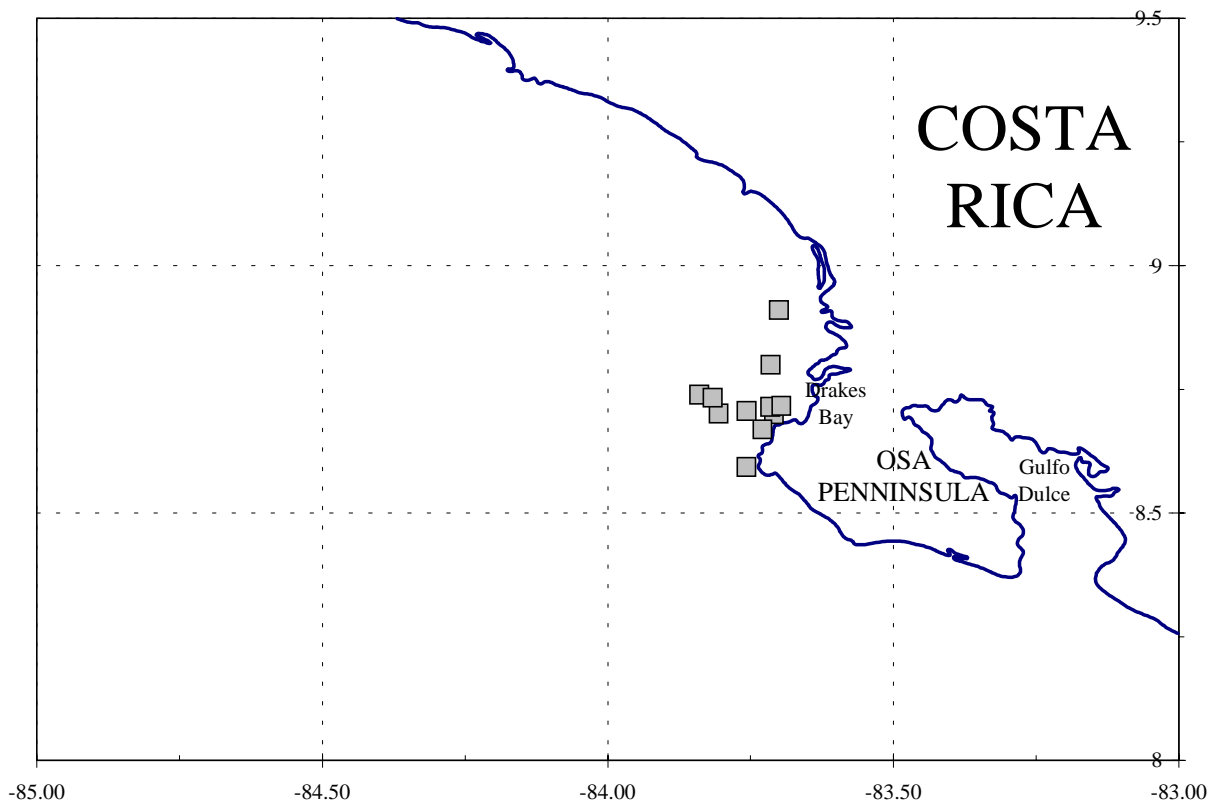


Figure 3. Locations that humpback whales were sighted off southern Costa Rica during the surveys in January 2002.



Our success in finding whales in our separate surveys off northern Costa Rica and Panama in 2002 was not as high as off Drake Bay or what we had found in these regions previously (Table 2). In Panama in 2002, only a single humpback whale was seen on one of six days surveyed; a sighting rate (0.003 whales per nmi) considerably lower than in all other areas. Despite the low number of sightings during these surveys, discussions with the local Panamanians and fishermen in the area indicated that it was common to see whales there this time of year. In 2001 in Panama, we had two sightings of four whales during three days of surveys. It is possible that Panama is an area with patchy and sporadic distribution of whales. Off northern Costa Rica, there were two sightings during the three surveys in 2002 (Table 1). The highest number of whales we sighted off northern Costa Rica was in 1999 when we had 7 sightings of 11 humpback whales in one day. Weather conditions in northern Costa Rica this time of year are often not optimal for sighting whales, and during these three days of surveys, all surveys were shortened due to high winds. More than half of the time these surveys were conducted, the Beaufort sea state was higher than 4 (winds higher than 17 knots), which are difficult conditions for sighting whales.

The overall group composition for humpback whales off Costa Rica is similar to what has been reported in other wintering areas (Table 5). The overall proportion of single animals (singers and non-singers for all five years) in our study through 2002 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 saw a higher proportion of cows with calves and a larger group of animals than typical in 2002 (Table 5). We saw the second highest proportion of cow calf pairs for all years surveyed (4 of 14 sightings were of cow/calf pairs). Singers were sighted in the same proportion as cow-calf pairs, which is similar to other years. Pairs of adult animals and single adult animals were also similar to what we have been seeing in previous years. The smallest portion of our sightings is made up of groups larger than 2 animals, and this year was no exception. This year did differ however, in that we had one sighting of 5-7 animals, our largest sighting off of Costa Rica to date. This sighting was the first time we had witnessed surface-active behavior, also known as rowdy behavior. Groups of rowdy animals are associated with breeding grounds, and are often made up of mostly males competing to mate with a single female. We were able to photoidentify three animals from this rowdy group.

### **Photo-identification**

Humpback whales were identified on 11 occasions representing 7 unique whales in 2002. These include one whale identified off of northern Costa Rica, and one whale identified off of Panama. The rest were all identified off of southern Costa Rica during survey conducted off of Drake Bay. One whale (ID 10411) was seen on two different days off of southern Costa Rica (6 and 7 February). This same whale was identified 10 days later (17 February) off of Bahia Honda, Panama, by our collaborator Carolina Garcia. In all three of these sightings, this whale was seen with another unidentified adult.

Of the seven unique individuals identified in 2002, six have also been identified off of California (Table 6). The one whale that was not identified off California has been seen previously in 1999 off northern Costa Rica. This whale was part of the rowdy group seen in 2002. All six of the whales that were also seen off California had long sighting histories with 4 to 34 sightings between 1987 and 2001 (Table 7). Three of the animals had been seen in 2001, the feeding season immediately preceding their sighting in Central America. Most had been seen off central California with the most frequent sightings in the Gulf of the Farallones (5) and Monterey Bay (6).

For all years, 81 different individual humpback whales have been identified off Central America (S. Mexico to Panama) in winter months (Table 6). The rate with which we have matched these whales to those we know from our research off California remains high with 69 (85%) having been also documented 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 rate of matches to Central America indicates these waters are almost exclusively used by humpback whales that migrate to the U.S. West Coast (California, Oregon, and Washington). 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.

The proportion of whales from different feeding areas along the West Coast that matched Central America varied by region (Table 8). The whales we have identified off southern California had the highest rate of matching to Central America (11% having also been identified off Central America). The rate of matching dropped for feeding areas farther north going to about 6% to 7% off central and northern California, 2.3% off Oregon and southern Washington, and none from off northern Washington and southern British Columbia. This opposite pattern was noted for matches between mainland Mexico and feeding areas indicating 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).

The 2002 field season also provided additional data on migratory transits of these whales. Two of the six whales that had been sighted off of Costa Rica in 2002 were sighted in May of 2001 off of California. These transits add to a growing set of data on migration distances and timing. 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 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 about 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.

### **Humpback whale song and gender differences**

The hydrophone was deployed 146 times off of Southern Costa Rica, 53 times off Panama, and 17 times off northern Costa Rica (Table 9). Song was heard 35% of these deployments in southern Costa Rica, 13% of the deployments in Panama, and no song was heard in northern Costa Rica. Recordings were made on six occasions, including one time in Panama. Our results from northern Costa Rica differ greatly from our surveys there in 2001, in which we heard song 57% of the time. However, that survey was done in January, and in 2002 our survey was done in March. The seasonal difference could be a factor in not hearing any song in March. Also, our surveys in 2002 did not cover a very large area, which could also account for not hearing any song. 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 9).

This year we were not as successful in obtaining identification photographs of singing whales as we have been in years past (Table 10). We identified the same singer on two occasions, February 7 and February 10. Recordings were made of this whale on both of these sightings. All recordings made this year will be analyzed and compared to past years and other breeding grounds in the North Pacific.

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 animals to sing. Since we started this research in 1996, we have been able to positively identify seven individual whales as singers, and therefore as males. Skin samples collected in California of another 10 of the whales identified off Central America have indicated they are males bringing us to 17 known males in our Central America sample. We also know that 10 of the animals we have identified are females because they were accompanied by a calf either in Central America or California.

We also know the ages of four animals we have seen in Central America that were first identified when they were calves in either California or Central America. These data provide us with unique insights into at what age humpback whales begin engaging in mating and reproductive behavior. One (ID #10731) was first identified off California in 1993 and thought to be a calf born that year or possibly the year previous. He was seen singing off Costa Rica in 1996 when he was likely only 3-4 years-old and was seen again there as an escort of a cow-calf pair in 2001. Another whale (10825) was first seen as a calf in California in 1995 and was seen

escorting a mother and calf (with one other whale) in Costa Rica in 2001 when it would have been six years-old.

## **Aerial Surveys**

Four sightings of 5 humpback whales were made during the aerial surveys (Table 4). Three sightings were in northern Costa Rica, and one sighting off of central Costa Rica (Figure 1). Two sightings of a single animal were very close to each other geographically, although were made 20 days apart. It is not surprising that we had only four sightings of humpback whales. Because the airplane is traveling at a speed of 100 knots, and because whales spend the majority of their time below the surface of the water, the chances of sighting a whale are particularly low in areas of low abundance. However, despite the low number of sightings during these surveys, three of the sightings occurred in areas where we have not conducted any boat surveys. These surveys increase our understanding of the distribution of humpback whales along the Costa Rican and Panama coasts by allowing us to go where to areas where we have not been able to survey by boat.

In addition, 34 sightings of dolphins were made during aerial surveys, most of these were not identified to species. The distribution of these sightings was consistent along most of our survey area, although few were sighted in northern Costa Rica and in Panama. The few sightings in northern Costa Rica could be accounted for by the high winds in this area, which would decrease the ability to sight smaller animals. One unidentified whale was also sighted off of the Burica Peninsula, an area which we have never before surveyed by boat. This whale was estimated to be between 20-25 feet, had a visible blow, and a tan colored sleek body. It was possibly a sighting of a Bryde's whale, or a beaked whale species.

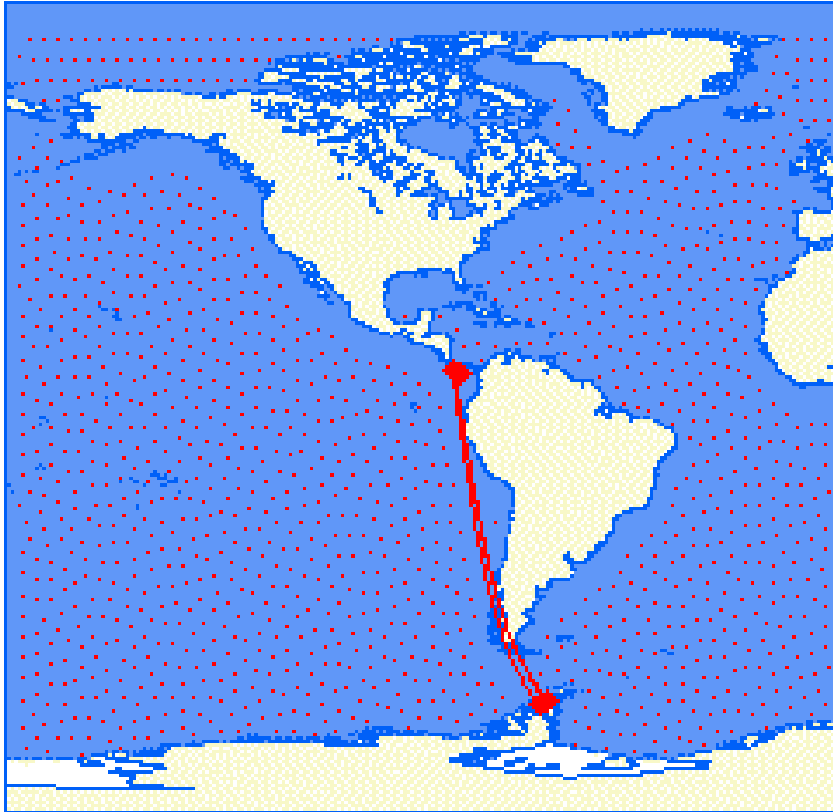
## **Southern Hemisphere surveys**

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 (Northern Hemisphere summer). In the Southern Hemisphere, humpback whales feed in Antarctic waters during their summer (December-April), and travel north to warmer waters during their winter (July-October). Since we started doing research in Costa Rica, we received reports that whales were seen year round, with peaks during the two wintering seasons for both hemispheres.

In August-October of 2001 and 2002, we conducted surveys off of northern and southern Costa Rica and Panama. We now have over 25 individuals identified off of Costa Rica and Panama during this season. Five of these photographs were collected by Marco Saborio before 2001. Of these 25, three have also been identified feeding off the Antarctic Peninsula. This firmly establishes that whales seen during this season off Central America are migrating from Antarctica. 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. 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 region during their respective wintering seasons.



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 low, 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 (Baker *et al.* 1993), and Central America would be one of the most likely areas where interbreeding could occur.

Figure 4. Locations of whales matched between Costa Rica and Antarctica.

### Other marine mammals

Sightings of other species besides humpback whales were not as varied in 2002 as most past years. Only three other species were confirmed during our surveys in 2002, spotted dolphins, bottlenose dolphins, and rough toothed dolphins (Table 11). These sightings contribute to the limited information available on marine mammals off Costa Rica. In total, we have documented 11 different species of marine mammals in our study area from 1996 to 2002 and a brief summary from the data from all years for each species is provided below.

#### *Large baleen whale sighting*

Although no large baleen whales other than humpback whales were seen in 2002 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 Brydes 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 has been seen in past years with sightings 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 sighting (in 1998) was off Drake Bay. This species has been reported frequently in Golfo Dulce and off Isla de Coco off 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 would be expected.

Killer whales were sighted 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. 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). This observation 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), three of them in 2002. Spotted dolphins remained by far the most frequently seen marine mammal species in our surveys accounting for 42 sightings of 825 animals in 2002. This is similar to most past years. The distribution of spotted dolphin sightings reveals they were seen throughout the area we surveyed.

Bottlenose dolphins were seen 2 times (total of 171 animals) in 2002 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).

One sighting of Rough-toothed dolphins were seen in 2002 in the mouth of the Golfo Dulce. Sightings of these dolphins also occurred in 1998 and 2000. 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).

Two other species of dolphin have only been sighted in single years but not in 2002. 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, and singing males.
- We had our first sighting of a rowdy group in 2002, which is very typical on other humpback whale wintering grounds.
- 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 this region.

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. As a part of our research we have provided information on our findings and also ways to avoid disturbing whales to boat drivers, guides, and resort operators in the region.



## 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. Lighthawk, Michele Gangaware Dean and Lana Smith helped with aerial surveys. Marcus Rhineland, Frank Garita, and Marco Saborio were aerial observers. Marcus Rhineland assisted with boat surveys and logistics in the field. Lisa Schlender assisted in data analysis and matching. We especially thank the Elderhostel volunteers for 2002: Jean Baker, George Coon, Gerry Coon, Judy Goodwin, Jim Goodwin, Chris Morris, Jeanne Squires, Eugene Childers, Gerry Friedman, Jerry Friedman, Dace McLaughlin, Bob McLaughlin, Charles Odom, and Bud Wright.

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

	Year							Total
	1996	1997	1998	1999	2000	2001	2002	
<b>Survey effort</b>								
Start date	26-Jan	31-Jan	24-Jan	27-Jan	25-Jan	19-Jan	6-Feb	
End date	16-Feb	14-Feb	18-Feb	7-Feb	13-Feb	17-Feb	14-Mar	
Days with surveys	15	10	15	10	16	20	16	<b>102</b>
Total boat surveys	26	18	27	18	30	32	20	<b>171</b>
Survey nmi	1,581	1,205	1,734	1,249	1,738	2,374	1,312	<b>11,192</b>
<b>Humpback sightings</b>								
Sightings	15	27	18	32	29	33	14	<b>168</b>
Animals	19	45	25	60	46	67	25	<b>287</b>
Days whales seen	10	10	8	10	15	12	6	<b>71</b>
Surveys whales seen	13	14	12	15	22	18	9	<b>103</b>
<b>Sighting rates</b>								
Percent of days whales seen	67%	100%	53%	100%	94%	60%	38%	<b>70%</b>
Percent of surveys whales seen	50%	78%	44%	83%	73%	56%	45%	<b>60%</b>
Whales/survey	0.73	2.50	0.93	3.33	1.53	2.09	1.25	<b>1.68</b>
Whales per nmi	0.012	0.037	0.014	0.048	0.026	0.028	0.019	<b>0.026</b>

1999 does not incl. Russamee survey from S Mexico to N Costa Rica

2000 incl. 6 h effort on 23-24 January covering 31 nmi off N Costa Rica

2001 incl. 3 d effort off N Costa Rica (19-21 January) and 4 d off Panama (14-17 February)

2002 incl. 3 d effort off N Costa Rica (8-10 March) and 6 d off Panama (22-27 February)

Table 2. Summary of survey effort and humpback whale sightings off Costa Rica and Panama 2002.

	<b>2002</b>				<b>Total</b>
	<b>Drakes Feb</b>	<b>Drakes Mar</b>	<b>N Costa Rica</b>	<b>Panama</b>	
<b>Survey effort</b>					
Start date	6-Feb	12-Mar	8-Mar	22-Feb	<b>6-Feb</b>
End date	10-Feb	14-Mar	10-Mar	27-Feb	<b>14-Mar</b>
Days with surveys	4	3	3	6	<b>16</b>
Total boat surveys	8	3	3	6	<b>20</b>
Survey nmi	618	222	338	134	<b>1,312</b>
<b>Humpback sightings</b>					
Sightings	10	1	2	1	<b>14</b>
Animals	20	1	3	1	<b>25</b>
Days whales seen	3	1	1	1	<b>6</b>
Surveys whales seen	6	1	1	1	<b>9</b>
<b>Sighting rates</b>					
Percent of days whales seen	75%	33%	33%	17%	<b>38%</b>
Percent of surveys whales see	75%	33%	33%	17%	<b>45%</b>
Whales/survey	2.50	0.33	1.00	0.17	<b>1.25</b>
Whales per nmi	0.032	0.005	0.003	0.022	<b>0.019</b>

Table 3. Daily summaries of effort, sightings, and identifications in Costa Rica and Panama in 2002.

Date	Leader	Time		Dura- tion	nmi	Humpback whales				Other		
		Start	End			#Sit.	#Anim	#ID	ID's	species	Comments	
<b>Southern Costa Rica</b>												
6-Feb	Kristin	7:44	17:06	7:52	88.3	1	2	0			Sa,	Mother/calf pair
6-Feb	Frank	7:42	17:04	8:02	55.1	2	3	1	10411		Sa,Tt	Mother/calf pair, same as other boat
7-Feb	Kristin	7:42	17:02	8:00	56.9	3	6	1	10411		Sa	Mother calf pair, 10411 deen twice
7-Feb	Frank	7:30	16:06	8:45	85.0	1	1	1	10806		Sa	Singer
8-Feb	Kristin	7:12	16:28	7:02	73.6	0	0	0			Sa,Tt	Bad weather
8-Feb	Frank	7:46	16:40	7:13	85.0	0	0	0			Sa	Bad weather
10-Feb	Kristin	7:11	17:17	9:43	118.6	2	6	4	10965,10122,11294,10806		Sa, Sb	Incl. group of 5-7 whales and singer
10-Feb	Frank	7:40	14:51	9:47	55.8	1	1	0			Sa	same singer as Kristin's boat
<b>Panama</b>												
22-Feb	Kristin	11:50	14:41	2:50	36.6	0	0	0			Sa, Tt	
23-Feb	Kristin	7:46	13:28	5:41	75.6	0	0	0			Sa	
24-Feb	Kristin	7:51	13:20	6:01	85.4	0	0	0			Sa	
25-Feb	Kristin	8:13	14:45	6:05	55.8	1	0	0			Sa	Singer
26-Feb	Kristin	8:12	11:08	2:58	37.6	0	0	0				
27-Feb	Kristin	8:14	11:54	3:38	46.7	0	0	0			Sa, Tt	
<b>Golfo Papagayo, N Costa Rica</b>												
8-Mar	Kristin	8:04	15:37	7:25	62.4	2	3	1	10725		Sa, Sag	one mother/calf pair
9-Mar	Kristin	7:56	11:48	3:54	41.0	0	0	0			Sa	
10-Mar	Kristin	8:29	11:30	3:01	31.0	0	0	0			Sa	
<b>Southern Costa Rica</b>												
12-Mar	Kristin	13:34	16:33	2:55	49.0	1	0	1	10973			Breaching
13-Mar	Kristin	7:43	14:52	7:12	93.7	0	0	0			Sa	
14-Mar	Kristin	7:46	14:46	6:58	79.6	0	0	0			Sa, Tt	

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 4. Summary of aerial survey effort off of Costa Rica and Panama 2002.

<b>Date</b>	<b>Begin</b>	<b>End</b>	<b>Area surveyed</b>	<b>Distance nmi</b>	<b>Humpbacks</b>		<b>Dolphins</b>		<b>Comments</b>
					<b># sight.</b>	<b># anim.</b>	<b># sight.</b>	<b># anim.</b>	
2/3/2002	0933	1640	Southern and Central Costa Rica	522	1	2	10	368	
2/13/2002	0911	1537	Northern Costa Rica	483	1	1	1	31	poor weather
3/4/2002	0940	1611	Panama, Southern and Central Costa Rica	603	0		12	567	
3/5/2002	1017	1628	Northern Costa Rica	443	1	1	11	439	

Table 5. Group composition of humpback whale sightings in study area off Costa Rica, 1996-2001.

<b>Group type</b>	<b>1996</b>		<b>1997</b>		<b>1998</b>		<b>1999</b>		<b>2000</b>		<b>2001</b>		<b>2002</b>		<b>Total</b>	
	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>	<b>#</b>	<b>%</b>
Lone singers	5	33%	2	7%	7	39%	5	16%	14	48%	8	24%	4	29%	<b>45</b>	<b>27%</b>
Singles	5	33%	6	22%	4	22%	4	13%	6	21%	3	9%	2	14%	<b>30</b>	<b>18%</b>
Pairs	3	20%	15	56%	5	28%	4	13%	2	7%	7	21%	3	21%	<b>39</b>	<b>23%</b>
Mother/calf	0	0%	3	11%	2	11%	14	44%	1	3%	4	12%	4	29%	<b>28</b>	<b>17%</b>
Mother/calf/escort	0	0%	0	0%	0	0%	5	16%	5	17%	10	30%	0	0%	<b>20</b>	<b>12%</b>
Groups larger than 2	2	13%	0	0%	0	0%	0	0%	1	3%	1	3%	0	0%	<b>4</b>	<b>2%</b>
Rowdy Groups	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1	7%	<b>1</b>	<b>1%</b>
Undetermined	0	0%	1	4%	0	0%	0	0%	0	0%	0	0%	0	0%	<b>1</b>	<b>1%</b>
<b>Total</b>	<b>15</b>		<b>27</b>		<b>18</b>		<b>32</b>		<b>29</b>		<b>33</b>		<b>14</b>		<b>168</b>	

Table 6. Results of photographic identification research of humpback whales in Costa Rica and Panama

Year	ID's	Unique whales	New whales	No. matching California	% matching California	Comments
pre-1996	5	5	5	4	80%	2 IDs by Richard Sears (1988), 2 by Carol Henderson (1990), 1 by Marco Saborio (1995) all off S. Costa Rica
1996	16	13	12	11	85%	2 IDs by Herbert Michaud and 1 by Bill Muraco off Drake Bay, 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 and 2 IDs each from Laura May and Andre Koneig, both in Northern Costa Rica
2000	26	12	7	11	92%	1 ID from Northern Costa Rica (Calambokidis)
2001	25	16	11	14	88%	2 IDs from Panama (Rasmussen) and 2 (mom/calf) that match 2001 California (11445 and 11446)
2002	11	7	6	6	86%	1 identification from Carolina Garcia in Bahia Honda, Panama, and 1 from Golfo Papagayo (Rasmussen)
<b>All Years</b>	<b>142</b>	<b>81</b>	<b>-</b>	<b>69</b>	<b>85%</b>	

Table 7. Humpback whales identified in February and March 2002 in Costa Rica with summary of sighting histories.

ID	Date	Region	Role	California			Comments
				Times seen in CA	Locations seen in California*	Years seen in Calif.	
10411	6-7 Feb	S Costa Rica	Pair	13	GF, SL, MB, offshore MB	90-96, 98, 01	
10411	17-Feb	Panama	Pair				
10122	10-Feb	S Costa Rica	Rowdy group	15	GF,NC,MB	87, 91, 97, 99-01	
10806	10-Feb	S Costa Rica	Singer	5	SL, SB, HM, MB	91, 94-97	
10965	10-Feb	S Costa Rica	Rowdy group	14	HM,GF,MB,SB	96-01	
11294	10-Feb	S Costa Rica	Rowdy group	0			Seen off N Costa Rica March 1999
10725	8-Mar	N Costa Rica	Single	34	MB, GF	92-00	
10973	12-Mar	S Costa Rica	Single	4	GF,MB,PA	96, 98, 99	

\*California locations: GF-Gulf of Farallones, HM-Half Moon Bay, MB-Monterey Bay, NC-N California, PA-Point Arena,

Table 8. Summary of match rate from Central America (incl S Mexico) to other regions.

<b>Region</b>	<b>Unique IDs</b>	<b>Matches to Cent Amer.</b>	<b>% matches Cent. Amer.</b>
Cent Amer.	81		
Mexico (matching not complete)	240	4	1.7%
S California (to Pt Sur)	382	42	11.0%
Monterey Bay to Half-Moon Baay	696	50	7.2%
Gulf of Farallones to Pt Arena	765	48	6.3%
N California	293	18	6.1%
Oregon and S Washington	86	2	2.3%
N Washington/S Brit. Columbia	139	0	0.0%

Table 9. Proportion of hydrophone deployments in which humpback whales were heard. Results are biased upwards by more frequent deployments when locating a singing whale.

<b>Year/ Region (S Costa Rica unless noted)</b>	<b>Hydrophone deployments</b>		
	<b># of times deployed</b>	<b>Song heard</b>	<b>%</b>
1996	79	19	24%
1997	82	13	16%
1998	255	54	21%
1999	238	52	22%
2000	455	193	42%
2001 N Costa Rica	30	17	57%
2001 S Costa Rica	368	48	13%
2001 Panama	57	18	32%
2002 N Costa Rica	17	0	0%
2002 S Costa Rica	146	51	35%
2002 Panama	53	7	13%
<b>All Years</b>	<b>1780</b>	<b>472</b>	<b>27%</b>

Table 10. Times and locations of recordings of humpback whale songs, 2002.

<b>Date</b>	<b>Time</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Tape track</b>	<b>Leader</b>
6-Feb-02	10 15	8 44	83 50	Cassette	Frank
6-Feb-02	11 22	8 46.68	83 45.69	Cassette	Frank
7-Feb-02	10 30	8 54.61	83 42.03	Cassette	Frank
10-Feb-02	16 22	8 42.906	83 42.928	DAT CR-02 Tr. 1	Kristin
10-Feb-02	09 53	8 42.408	83 45.415	DAT CR-02 Tr. 2	Kristin
25-Feb-02	10 18	8 05.051	82 10.533	DAT CR-02 Tr. 3	Kristin

Table 11. Summary of sightings of marine mammals off Costa Rica, 1996-2002.

<b>Species</b>	<b>96</b>	<b>97</b>	<b>98</b>	<b>99</b>	<b>00</b>	<b>01</b>	<b>02</b>	<b>Total</b>
<b>Baleen whales</b>								
Humpback whale	15	27	18	32	29	33	14	<b>168</b>
Bryde's whale			1					<b>1</b>
Unidentified Baleen whale		1				1		<b>2</b>
<b>Toothed whales</b>								
Sperm whale	1							<b>1</b>
Killer whale		2						<b>2</b>
False Killer whale	1		2		1	3		<b>7</b>
<b>Dolphin Species</b>								
Spotted dolphin	20	36	35	63	83	74	42	<b>353</b>
Bottlenose dolphin	8	2	7	2	3	17	5	<b>44</b>
Rough Toothed dolphin			1		1		1	<b>3</b>
Common Dolphin			1					<b>1</b>
Spinner dolphin				1				<b>1</b>
Unidentified dolphin	26	8	12	1	2	10		<b>59</b>
<b>Total sightings</b>	<b>71</b>	<b>76</b>	<b>77</b>	<b>99</b>	<b>119</b>	<b>138</b>	<b>62</b>	<b>642</b>