

Using Photo-Identification to Study Pilot Whale Social Organization

Susan H. Shane and Dan McSweeney

West Coast Whale Research Foundation, U.S., P.O. Box 1768, Santa Cruz, CA 95061, USA.

ABSTRACT

Photo-identification of uniquely-marked individuals was the primary research tool used in studies of pilot whale (*Globicephala macrorhynchus*) social organization at Santa Catalina Island, California (1983–8) and the Big Island of Hawaii (1985–8). Pilot whales showed fairly high site fidelity, especially in Hawaii. Pod cohesiveness over time was marked in Hawaii but less evident at Catalina. Pods in both study areas were composed primarily of presumed adult females with juveniles and calves. Presumed adult males were rare, and when seen, did not associate with the same pod all the time. Pair-wise association analyses at Catalina showed some degree of social affiliation between some individuals. Thirty-four to 45% of pilot whales in the two study areas were identifiable which compares favorably with bottlenose dolphins (44%) but is lower than humpback whales (92%) and Risso's dolphins (67–95%). Despite some problems, photo-identification is a promising technique for studying pilot whale social organization.

INTRODUCTION

Photographic identification of individual cetaceans has not been used previously in long-term studies of pilot whales (*Globicephala* spp.). Here, we present preliminary data from two photo-identification studies of short-finned pilot whale (*G. macrorhynchus*) social organization and discuss the problems associated with using photo-identification techniques to study this species.

One study was conducted during six consecutive winters at Santa Catalina Island, California (33°25'N, 118°35'W) from January 1983 to February 1988. Pilot whales traditionally have gathered in the nearshore waters (usually less than 1km offshore) of Catalina Island each winter to feed on aggregations of spawning squid, *Loligo opalescens* (Norris and Prescott 1961; Dohl, Norris, Guess, Bryant and Honig, 1978). Pilot whales were photographically identified at Catalina during four different winters (1983–1986) and off the southern California mainland (Palos Verdes Peninsula) during one winter (December 1986). There were no pilot whales seen at Catalina during two winters (1987–1988).

The second study was conducted nearly year-round from 1985–88 off the island of Hawaii (19°40'N, 156°10'W). Pilot whales in Hawaii usually were seen along a 40km stretch of the Kona coast, 5–16km offshore. The present analysis is based on a sample of five encounters with pilot whales in Hawaii, including three days in 1986 and two days in 1987. These five days were selected because one distinctively-marked individual was present on each occasion.

MATERIALS AND METHODS

Research at Catalina was conducted from a 5m *Boston Whaler* with an 85hp *Evinrude* outboard engine. Pilot whales were photographed using a *Canon* AE-1 camera with 70–210mm zoom lens and power winder. Most photographs were taken using *Kodachrome* 64 color transparency film at shutter speeds of 1/125 to 1/1000 of a second. On occasion, *Ektachrome* 200 color transparency film or *Tri-X* (ASA 400) black and white film were used. All photographs taken of pilot whales from 1983–86 (approximately 1,600 color transparencies and 550 black

and white negatives) were considered in this analysis. Color transparencies of a pod of about 25 pilot whales off Palos Verdes Peninsula, 35km north of Catalina, on 12 and 14 December 1986 and color transparencies taken in December 1980 and in April 1982 at Catalina were provided by other researchers (see Acknowledgements) and also used in the analysis. The choice of whether to use color transparencies or black and white film is not clear cut. *Tri-X* black and white film offers a high ASA with relatively little graininess, thus permitting the photographer to employ high shutter speeds under most conditions. However, color transparencies provide subtle details of fin characteristics that are often lost in black and white images, but with the low ASA of 64, high shutter speed is impossible under low light conditions.

The Hawaii study platforms were a 6m *Zodiac* inflatable with a 90hp *Mercury* engine and a 6m *Boston Whaler* with twin 60hp *Suzuki* engines. Two *Canon* cameras (A-1 and F-1), fitted with 400mm (f 4.5) and 300mm (f 2.8) lenses were used. *Tri-X* film was pushed to 1600 ASA and shot at shutter speeds of 1/1000 to 1/2000 of a second. A total of 757 contact images was evaluated in this analysis.

Individual whales were considered to have been identified only if they were sighted on at least two different days. One of us (SHS) sketched the whales' dorsal fins while viewing the photographs (slides, negatives or contact prints) through an 8X magnifying loupe. The sketches permitted rapid comparison of fins. When similar sketches were found, the two photographs were compared to determine whether the fins belonged to the same individual. In cases where a match was questionable, a second person was shown the photographs, and a match was scored only if both people agreed that the fins were the same. At Catalina, white dorsal saddle patterns supplemented dorsal fin marks in identifying some individuals.

The proportion of identifiable whales in Hawaii was calculated by determining the ratio between the number of identified fins and the total number of fin photographs that were clear enough to have been identifiable if identifying marks were present (N=535) on a sample of three days. We assume that the whales which might not have been photographed had the same ratio of identifiable to unidentifiable fins as those photographed.

Age class and gender were determined subjectively based on data in Kasuya and Marsh (1984). Data extrapolated from Kasuya and Marsh (1984) suggested that weaning has occurred by approximately age 3 (length = 260cm) and that mature females range in size from 320–360cm. Thus at Catalina any animal three-quarters of the length or less than an adult which it accompanied closely was considered a calf (i.e. $260/340 = 76\%$). Those whales which appeared significantly larger in total length and dorsal fin size than the next largest animals in the pod were presumed to be adult males.

Associations between individuals were based on whales occurring in the same pod. Shane (unpub. data) used Schaller's (1972) formula to measure the degree of association between pairs of identified whales during January-February 1983 at Catalina: a value of 1.0 meant that two whales were seen together at every sighting, whereas a zero meant two whales were never seen together.

RESULTS AND DISCUSSION

Among the many potential applications for photo-identification data (e.g. individual association patterns, site fidelity, population estimation, pod cohesiveness), we chose to focus on site fidelity and aspects of pilot whale social organization. Here we present results from a sample of the data we have collected on pilot whales in our two studies. From Catalina, all available data were used. From Hawaii, data were used from pods containing one focal animal on the assumption that these pods were representative of the population as a whole.

Site fidelity

Day-to-day and year-to-year resightings of recognizable individuals can indicate the degree of fidelity to an area. Thirty-two whales were sighted on two or more days at Catalina (Fig.1). Fifteen of these whales were sighted during two or more seasons. In Hawaii, 30 whales were sighted two or more times (Fig.2). Twenty-seven of these 30 whales were seen during both years.

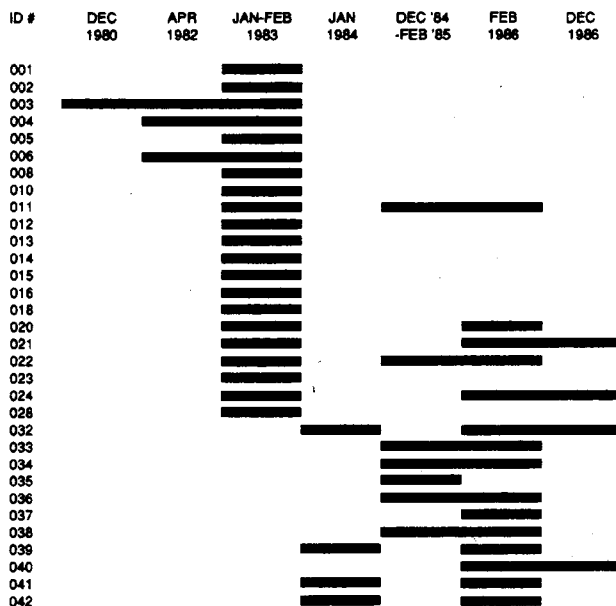


Fig. 1. Sightings of individually-identifiable pilot whales at Santa Catalina Island from 1980 through 1986 and at Palos Verdes Peninsula, California in December 1986.

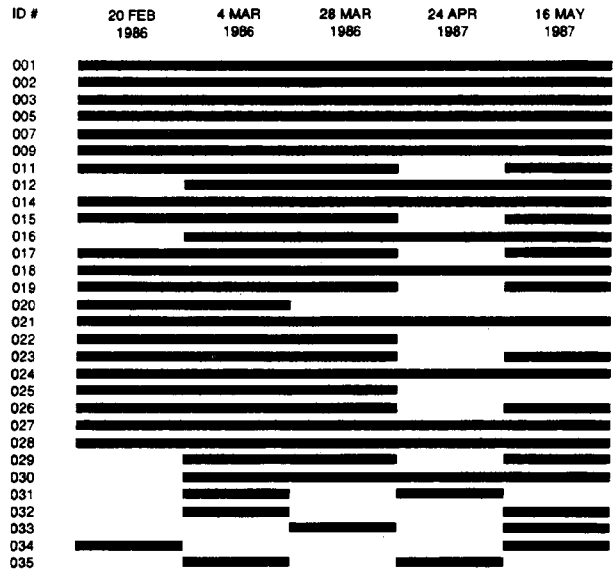


Fig. 2. Sightings of individually-recognizable pilot whales off the Kona coast of Hawaii on five days in 1986 and 1987.

These results suggest a relatively high degree of at least seasonal site fidelity in pilot whales, particularly in Hawaii. Most of the whales in Hawaii were seen repeatedly within and between years in the same area. Pilot whale occurrence at Catalina was severely disrupted by the 1982–3 El Niño event (Shane, 1985). This anomaly must be considered when interpreting the lack of absolute fidelity of individual whales to the Catalina area each winter. Of course the failure to sight an individual whale does not necessarily mean that it was not present. Gaps in our data may cause us to underestimate site fidelity and pod cohesiveness.

Pod cohesiveness

The number of identifiable whales in common between four pods sighted during four winters in southern California ranged from one to six. Pod cohesiveness within one season was demonstrated by a group of 20 pilot whales which always were seen together and never with any other pilot whales from 29 December 1984 to 28 February 1985 (Shane, 1985).

In Hawaii, 12 of the 30 pilot whales seen two or more times were seen together on all five study days. Nine whales were seen on four days, three on three days and six on two days.

These results indicate a higher degree of pod cohesiveness in Hawaii than in California.

Pod composition

January-February 1983 was the only winter when many different pods were encountered at Catalina. During that time presumed adult males were seen rarely, and there was never more than one per pod (Shane, unpub. data). Of all pilot whales seen during that season, 7.7% were calves. Calves comprised 19.6% (± 7.4) of the whales in a subset of pods containing immature animals that winter. The pod of 17 seen in January 1984 at Catalina was composed entirely of whales the size of adult females or subadult males (Shane, 1984). The 1984–5 pod of 20 contained 19 whales of adult female/subadult male size plus one calf (5%) (Shane, 1985). The February 1986 pod of 33 contained 30 whales of adult female/subadult male size,



Fig. 3. Photographs of one identified pilot whale (Catalina ID, no. 34) which indicate some of the problems associated with photo-identification. (A) Image is out of focus, so nicks are indistinct and the dorsal saddle is fuzzy. Scratches on the leading edge of the dorsal fin healed and vanished over time (photo taken in December 1984). (B) Intensity of dorsal saddle diminished as compared with 1984 due to light conditions. Dorsal saddle partially obscured by dorsal fin shadow (photo taken in February 1986). (C) Pattern on left side of dorsal saddle is completely different from that on the right side (photo taken in February 1986).

two juveniles and one calf (3%). There were no data on the composition of the pod photographed off Palos Verdes Peninsula in December 1986.

In Hawaii, one pod contained no presumed adult males. The remaining four pods each contained two to three presumed adult males (average = 6% of estimated pod size). Calves were not counted in Hawaii.

The presumed gender and size composition of pods in Hawaii and Catalina was consistent with what has been found in stranded and hunted pods of pilot whales (Sergeant, 1962; Kasuya and Marsh, 1984). Groups were dominated by presumed adult females accompanied by

juveniles and calves. Presumed adult males were comparatively rare and individual adult males did not appear to associate with the same pod all the time.

Individual associations

We quantified association patterns between individuals at Catalina but not Hawaii. Shane (1985) reported that two whales who may have been mother and offspring, based on observations in 1983, were found closest to one another more often than any other pair of whales in 1984-5. Forty-four pair-wise associations were calculated for pilot whales seen in the same pod at Catalina in 1983 (Shane,

unpub. data); ten associations had values of 0.50 or greater, indicating a degree of social affiliation between some individuals.

Problems with pilot whale photo-identification

Some of the problems encountered in our studies of pilot whales are common to any cetacean photo-identification study: (1) distant or out of focus photographs (Fig. 3a); (2) photographs taken at an angle to the whale; (3) an insufficient number of photographs of a group, making it likely that some identifiable animals were missed; (4) changes occurring over time in the characteristics used to distinguish a given animal—scratches on the fin may last for weeks or even months but heal and vanish over a longer period of time (Fig. 3a).

An additional problem peculiar to pilot whale photo-identification involves the use of their white dorsal saddle patterns. Pilot whales in Hawaii have faint saddles, but they are only apparent underwater. At Catalina, not all whales have obvious saddles, and the saddles of those that do vary in visibility. Saddles are often partially or completely obscured by light conditions, water, the shadow the dorsal fin casts on the whale's back or by other whales surfacing beside the focal animal (Fig. 3b). Since dorsal saddle patterns differ on the left and right sides of an individual, it is impossible to match photographs of the same animal using a left-side view and a right-side view unless there are distinctive nicks on the fin as well (Fig. 3c).

Proportion of whales which were identifiable

Not all cetacean species are equally susceptible to photo-identification. We calculated that 33.5% (± 4.43) to 35.0% (± 3.27) of the Catalina pilot whales were identifiable, while 45.3% (± 2.89) of the pilot whales in Hawaii were identifiable. The percentage of identifiable bottlenose dolphins (*Tursiops truncatus*) in southwest Florida was 44% (± 0.059 ; Shane, 1987). B. Würsig (pers. comm.) estimated that 15–20% of spinner dolphins (*Stenella longirostris*), spotted dolphins (*S. attenuata*) and dusky dolphins (*Lagenorhynchus obscurus*) are photographically identifiable.

Other cetacean species have much more distinctive natural markings than do pilot whales. For example, one of us (DM) calculated that 92% of humpback whales (*Megaptera novaeangliae*) in a random sample of 534 flukes seen on 12 days in Alaska during 1983–85 were identifiable. Kruse (1989) estimated that 67.2% of Risso's dolphins in Monterey Bay are identifiable. She identified over 95% of the Risso's dolphins in one pod of 25 photographed for 4.3 hours. Since the effort per animal during this encounter was comparable to that for pilot whales in our studies, this estimate may more accurately reflect Risso's dolphin identifiability than does the 67.2% estimate.

Although pilot whales are not as distinctively marked as humpback whales or Risso's dolphins, they are roughly comparable to bottlenose dolphins in terms of the percentage of identifiable animals in a given population. Photo-identification studies of bottlenose dolphins have produced a rich understanding of the species (Würsig and Würsig, 1977; Ballance, 1987; Shane, 1987; Wells, Scott and Irvine, 1987), and the same can be expected from pilot whale research over the long term. The reason for the disparity between the proportion of identifiable animals in Hawaii (about 45%) and Catalina (about 34%) is unclear. It may be an artefact due to the relatively lower number

and quality of photographs taken at Catalina or it may be a real phenomenon. Information on the cause of the nicks and cuts on the dorsal fins will help to determine this.

CONCLUSION

Photo-identification is a promising technique for studying pilot whale social organization. Our data suggest that pilot whale pods are fairly stable. Perhaps they fit somewhere between the fluid groups of Hawaiian spinner dolphins (*S. longirostris*) (Norris and Dohl, 1980) and the very cohesive groups of killer whales (*Orcinus orca*) in the North American Pacific northwest (Bigg, 1982; Heimlich-Boran, 1986).

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