Odontocete population assessment in the four-island area, Hawaii: a preliminary summary of results from 1999[1]

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Introduction

Hawaiian waters support a wide diversity of cetacean species. Although considerable research has been undertaken on cetaceans in Hawaii, virtually all efforts have focused on either humpback whales (*Megaptera novaeangliae*) or spinner dolphins (*Stenella longirostris*). The bias towards these two species is not unexpected – of all the odontocetes, spinner dolphins are probably the most accessible to researchers, due to their habit of spending day-time hours resting in shallow bays. Humpback whales have probably received considerable research attention due to their relative abundance in near-shore waters during winter months, and their listing as Endangered under the Endangered Species Act. Regardless, a number of other species of cetaceans, particularly odontocetes, are found in near-shore waters in Hawaii and are relatively accessible to small boat-based research efforts.

The purpose of this study is to examine population size and movements of the more commonly seen odontocete species in the four-island area of Hawaii. The main objectives were to: 1) estimate population size and examine movements using photo-identification of distinctive individuals; 2) examine diving (sub-surface) behavior and short-term movements using suction-cup attached time-depth recorder/VHF radio tags; and 3) examine stock structure through the collection of skin samples from suction cups used in tagging. The report presents a preliminary summary focusing on objective #1, the estimation of population size and movements using photo-identification.

Methods

Small-boat (5-7 m) based field efforts were undertaken from January 13 to November 24, 1999, based out of two ports on the southwest shore of Maui (Lahaina and Ma'alaea). A total of 99 field days (~640 hours) were spent on the water in the area between Maui, Lana'i and Kaho'olawe. Odontocetes were seen on 80 days in 124 separate encounters (Figure 1). Six species of cetaceans were recorded during this time, including 47 spinner dolphin groups, 35 bottlenose dolphin (*Tursiops truncates*) groups, 34 pantropical spotted dolphin (*Stenella attenuata*) groups, 6 false killer whale (*Pseudorca crassidens*) groups, 2 melon-headed whale (*Peponocephala electra*) groups, and 1 pygmy killer whale (*Feresa attenuata*) group. During

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each encounter, location was recorded every 5 minutes (every 10 minutes when searching), and efforts were made to photo-identify most or all individuals in a group (particularly for groups smaller than 20-30 individuals). For bottlenose dolphins, a small number of photographs taken in 1996 in this area by Dr. P. Forestell were also used to examine the rate of mark change. Data presented below should be considered preliminary, as the identifications assigned are still under review.

Results and Discussion

Bottlenose dolphins

Bottlenose dolphins are found throughout the study area, in both shallow, near-shore waters, and further offshore (Figure 2). Because group sizes are small (maximum recorded approximately 20), it is possible to photo-ID most or all dolphins present in each encounter, and efforts were made to obtain both left and right side photos of the dorsal fin and flank area. With good quality photographs, a large proportion of the non-infant population (perhaps 90%) appears to be identifiable, with most individuals having one or more nicks on the trailing edge of the dorsal fin (mean = 4.4, range 1-11), as well as large numbers of scars on the fin and body. Number of dolphins identified per day has ranged from 1 to 18 (mean = 5.6).

A total of 74 individuals have been documented, with new individuals still being documented at the end of the sampling period (Figure 3). Model population discovery curves were derived from random sampling of 6 individuals per encounter from populations of 100 and 200 individuals. The frequency distribution of resightings, when compared to that expected from random sampling of 74 individuals (Figure 4), suggests that individuals are not being observed at random, but that some are seen less frequently and some more frequently than would be expected by chance. Such differences from those expected (if individuals were being seen at random) could be explained by individuals having preferred home ranges, with the geographic scope of sampling covering the core of the home range of only a sub-set of individuals. An additional modeled discovery curve, based on the observed frequency of resightings and sampling from a population of 100 individuals, lies very close to the observed discovery curve (Figure 5). The rate of mark loss and gain appears to be very low, thus there is a low likelihood of mismatching over the period of study. Some proportion of the individuals are likely not identifiable (particularly infants), thus any population estimate based on discovery curves would have to be corrected to take this into account. If we assume that 10% of the individuals are not identifiable, based on Figure 5 the population of bottlenose dolphins which uses the area between Maui and Lanai, over a period of almost one year, is probably only in the range of approximately 110 individuals.

Spinner dolphins

Sighting locations of spinner dolphins are shown in Figure 6. Photo-identification matching has identified movements between the site shown on the south coast of Maui (La Perouse Bay) to Lana'i, and from the site shown on the northwest coast of Maui (Honolua Bay) to Lana'i, suggesting that dolphins in these three areas regularly intermix. Such long-ranging movements

(about 50 km) suggest that movements between Maui and the island of Hawaii, or between Moloka'i and Oahu, may be possible. Comparison of catalogs between these areas is clearly warranted.

Pantropical spotted dolphins

This study of pantropical spotted dolphins is the only known photo-identification based study of this species world-wide. Sighting locations of pantropical spotted dolphins show a distinct difference between day-time habitat from spinner dolphins (compare Figures 7 and 6). Photo-identification analyses with spotted dolphins are not yet complete, but suggest a population size of between 100 and 200 individuals (Figure 8). Work is needed to assess what proportion of the population is marked, and how often marks change.

A summary of tagging work was presented at the 13th Biennial Conference on the Biology of Marine Mammals (Baird et al. 1999; Roberts et al. 1999), so is not presented in detail here. Tags have been deployed on two false killer whales, with one remaining attached for just over an hour (the tag was removed by a conspecific), and the other remaining attached for 13 hours. No evidence of diurnal differences in dive behavior were noted over the 13 hour period (which included both day and night time behavior). Dive depths were relatively shallow (less than 50 m), even though the tagged animal was observed in water several hundred meters deep. A total of eight spotted dolphins have been tagged, with dive data collected from six individuals (a battery failure for the first two deployments prevented collection of any data). A total of 29 hours of dive data are now available for this species in Hawaii, and demonstrate substantial differences in day/night dive patterns.

Skin samples collected through the tagging work have been provided to the Southwest Fisheries Science Center, La Jolla, California for their stock discrimination analyses.

While field efforts for this work are no longer ongoing, analyses and write-up of results are continuing.

Literature Cited

Baird, R.W., A.D. Ligon, S.K. Hooker, S.M. Burkhart, A.C. Roberts and A.M. Gorgone. 1999. Sub-surface and night-time behavior of pantropical spotted dolphins off Maui, Hawaii. Page 10 in Abstracts of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii, November, December 1999.

Roberts, A.C., R.W. Baird and S.M. Burkhart. 1999. Reactions of odontocetes to tagging attempts using a pole-deployed suction-cup attached tag. Page 158-159 in Abstracts of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii, November, December 1999.

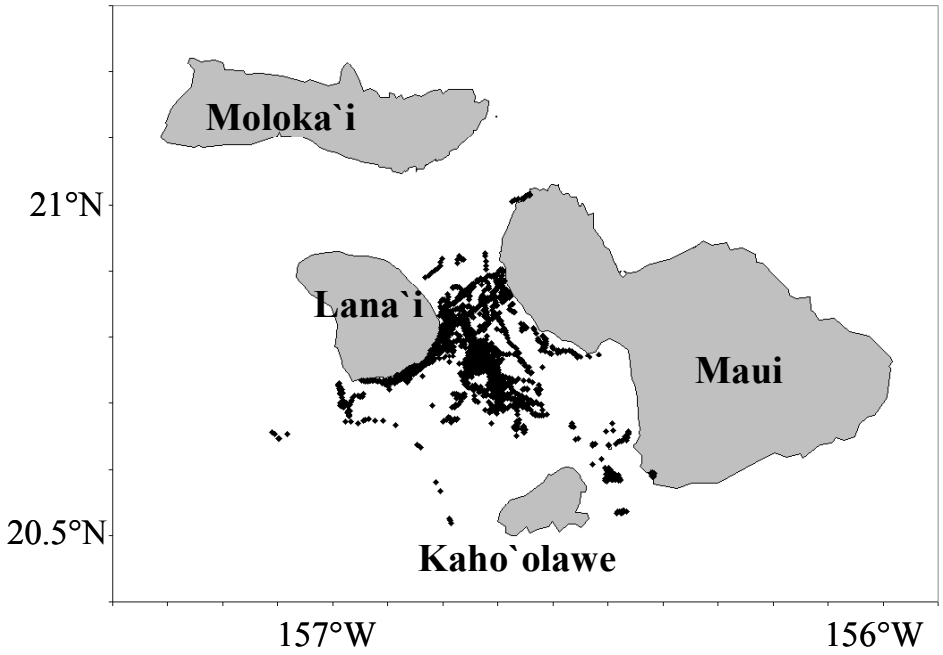

Figure 1. All odontocete sighting records from the 4-island area during 1999. This distribution can be taken as a proxy for effort, though actual effort data have been collected (though they have not yet been analyzed). Location was recorded every ten minutes, thus there are frequently multiple locations from particular encounters. Field efforts were based out of ports on the south-west shore of Maui, and concentrated in that area due to sea conditions.

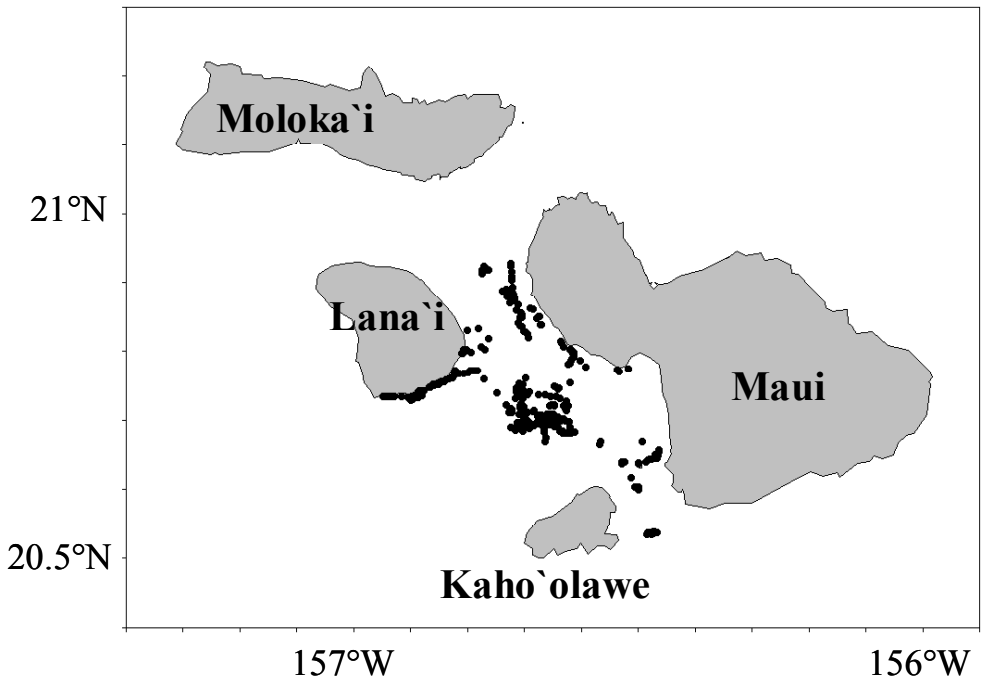

Figure 2. Sighting locations of bottlenose dolphins during 1999.

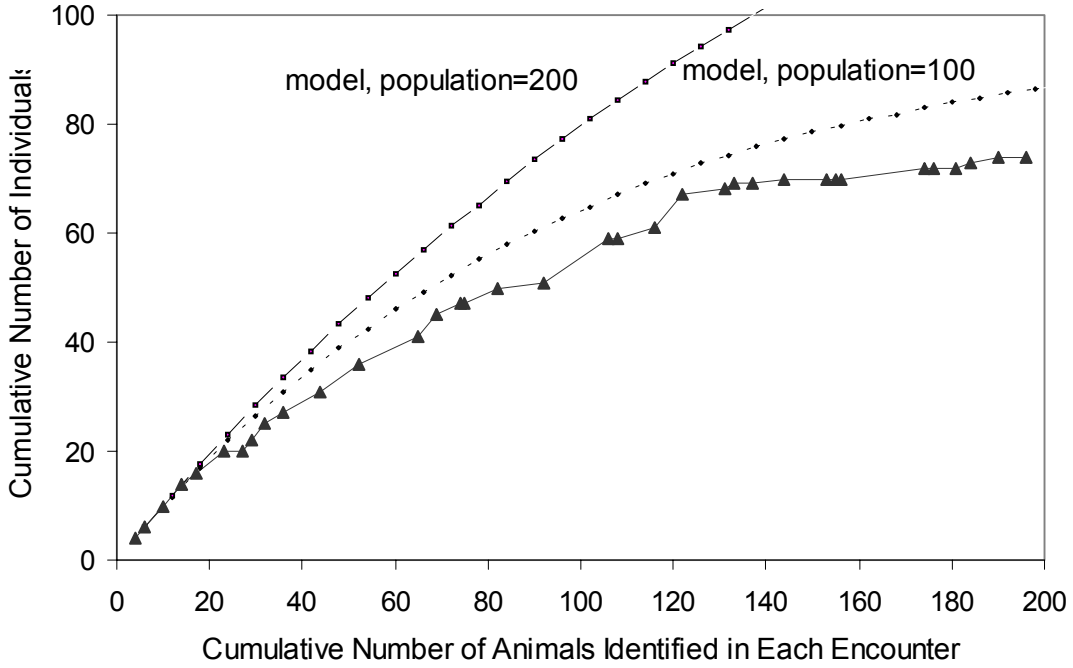

Figure 3. Rate of discovery of new individual bottlenose dolphins photo-identified in Maui waters in 1999. Two model populations are also shown, representing the theoretical discovery curves for populations of 100 and 200 individuals which are sampled at random (with 100 runs of the models). While the actual data are consistently lower than the 100 individual model line, it should be noted that the population is not being sampled at random (see Figures 4, 5) Data shown are preliminary and are subject to review.

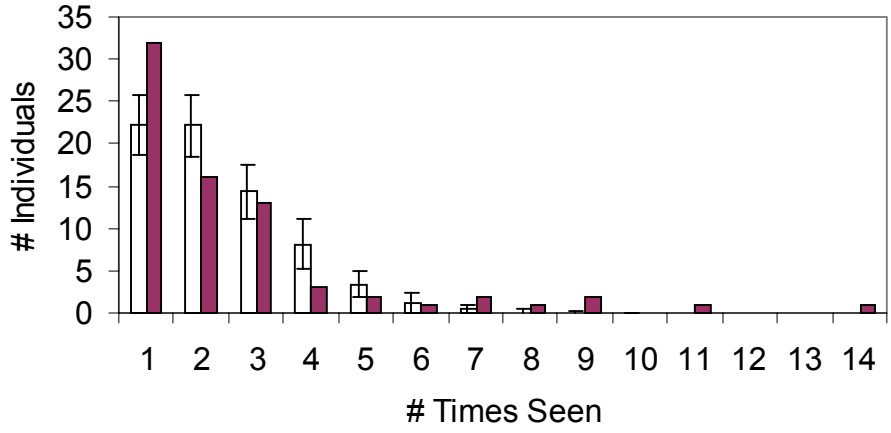

Figure 4. Frequency of resightings of bottlenose dolphins photo-identified around Maui in 1999 (solid bars). Also shown are the expected frequency of resightings if this population was sampled at random (open bars, mean values and SD of 100 permutations shown).

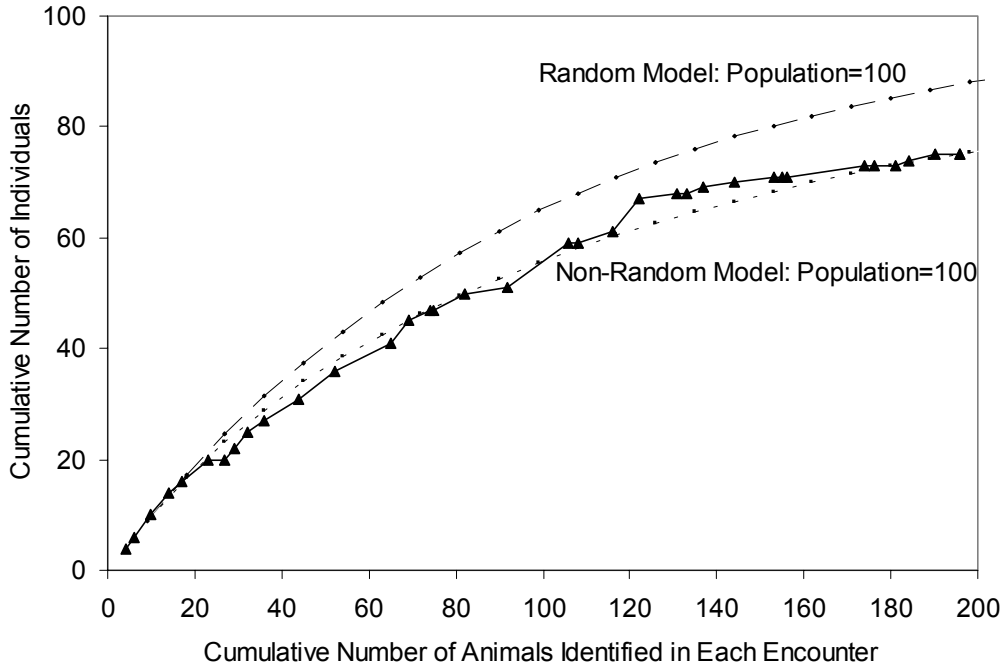

Figure 5. Rate of discovery of new individual bottlenose dolphins (as shown in Figure 3), with two model populations, a random model of 100 individuals (as in Figure 3), and a population of 100 individuals which were sighted with the same sighting frequency as found for the population (shown in Figure 4).

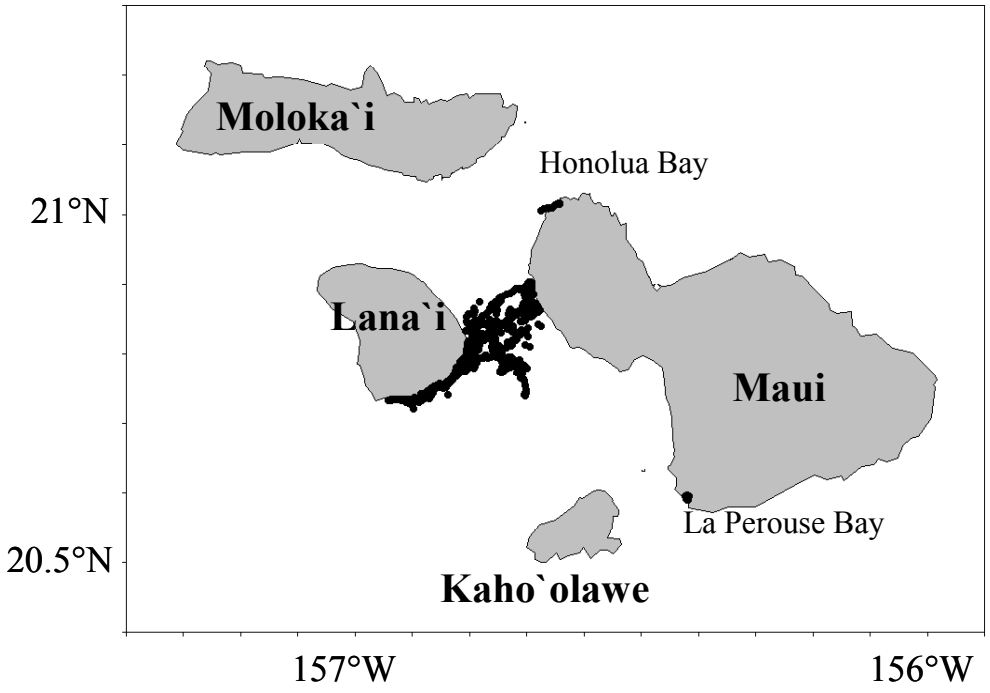

Figure 6. Sighting locations of spinner dolphins during 1999.

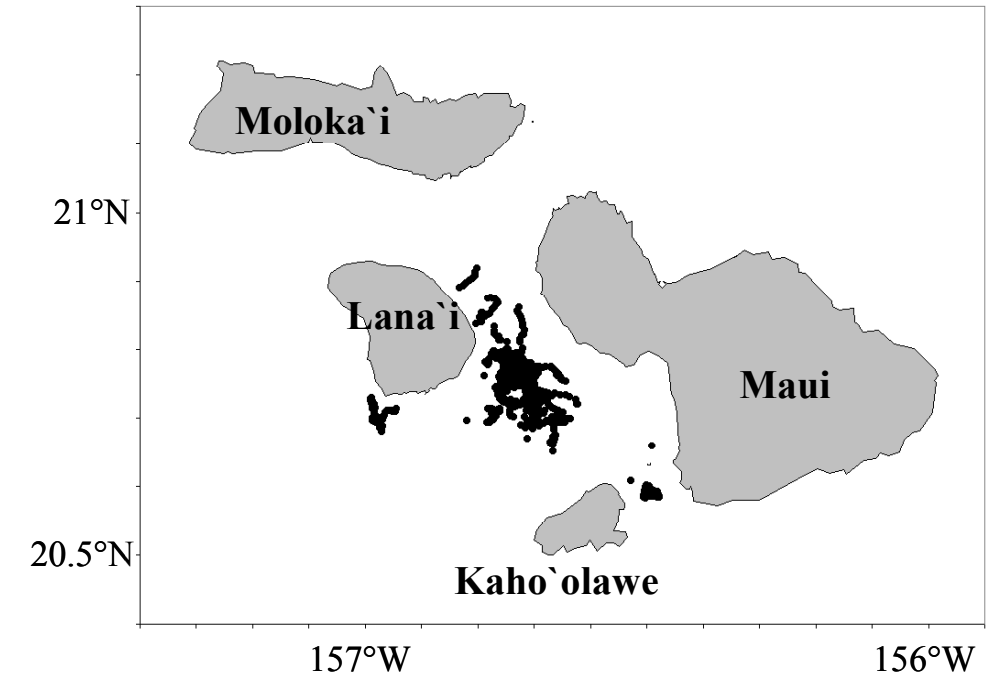

Figure 7. Sighting locations of pantropical spotted dolphins in 1999.

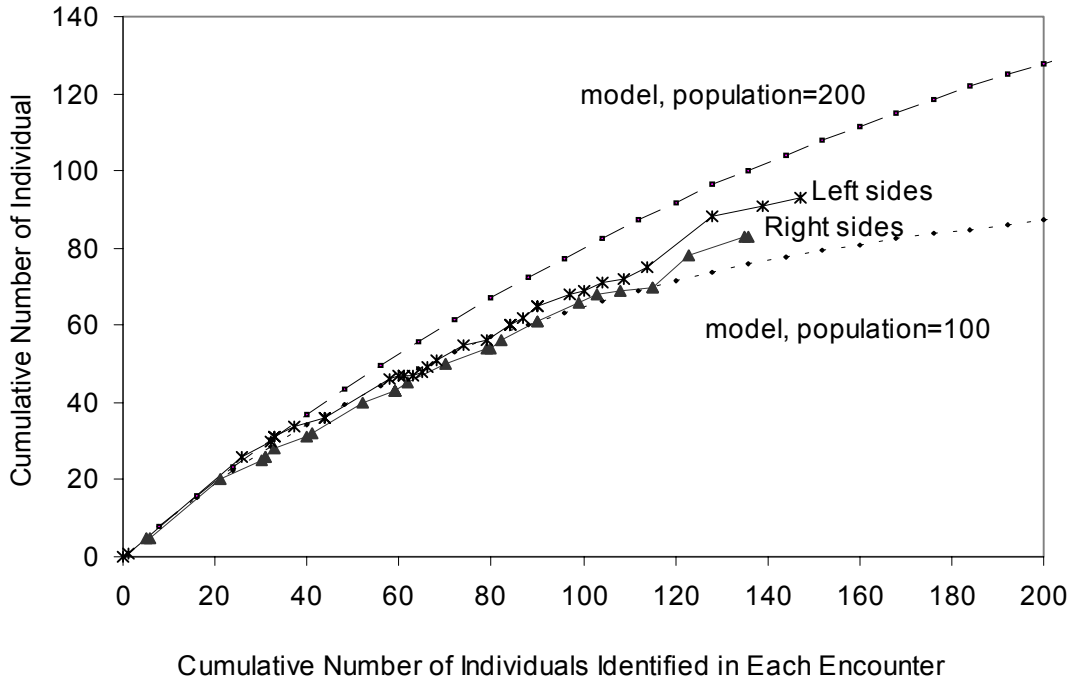

Figure 8. Rate of discovery of new individual pantropical spotted dolphins. Model populations are shown for random encounters.