JULY 2004 MASS STRANDING OF MELON-HEADED WHALES IN HAWAI'I

FACT SHEET FOR FINAL REPORT

April 27, 2006

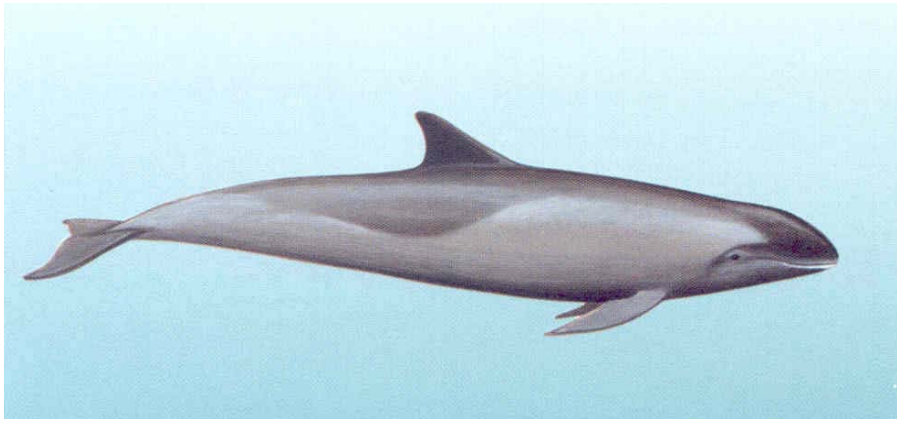
What happened?

On July 3, 2004, approximately 150-200 melon-headed whales (*Peponocephala electra*) were seen congregating in shallow waters of Hanalei Bay offshore, Kaua'i, Hawai'i. NOAA Fisheries notified the local marine mammal stranding network and placed biologists and a response team onsite to monitor the situation. Additional marine mammal experts in California and Washington D.C. were on alert and ready to travel to the area in case the whales stranded on the beach.

On July 4, 2004, the response team successfully assembled local volunteers to form a flotilla with 20-30 kayaks and gently urged the whales back to the open sea. That same day a single animal was seen swimming in the Bay. One day later (July 5, 2004), a single calf was found dead on shore. The carcass was recovered and sent immediately to marine mammal experts in California for scanning which was not available in Hawai'i. An extensive and thorough necropsy was then conducted to investigate the cause of death.

What is known about melon-headed whales?

Melon-headed whales are part of the dolphin family ("Delphinidae") and are pelagic (deep water) cetaceans found worldwide in tropical and subtropical waters. They feed on fish and squid, and adult melon-headed whales can be at least 8.5 feet (2.6 meters) long. They are black with lighter areas along their sides and belly, and they have tall dorsal fins that curve backwards. Melon-headed whales form large groups comprised of 150 to 1,500 individuals. At sea, it is easy to confuse them with false killer whales (*Pseudorca crassidens*) and pygmy killer whales (*Feresa attenuata*) which look similar in appearance.

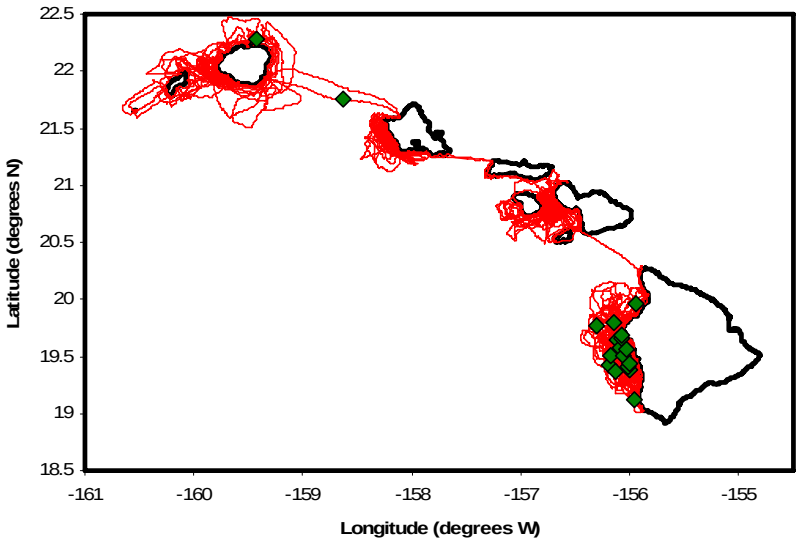


Melon-headed whale (*Peponocephala electra*)

Illustration by Garth Mix from: Wynne, Kate and Malia Schwartz. 1999. Guide to Marine Mammals and Turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, University of Rhode Island and NOAA Sea Grant. 114 pp.

What is known about melon-headed whales around the Hawaiian Islands?

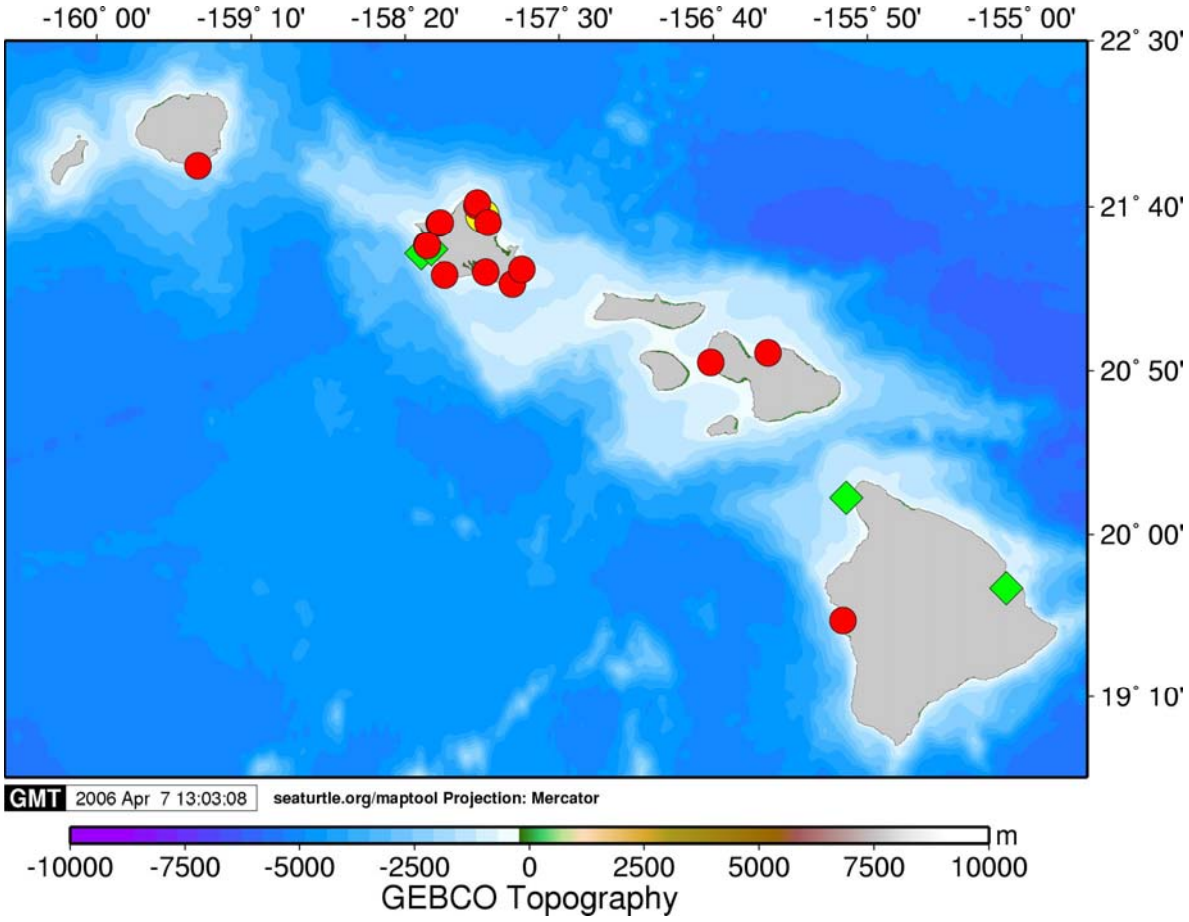
The best estimate of abundance near the main Hawaiian Islands (within 25 nmi) is 154 based on the Mobley et al. (2000) analysis. Considering that Baird et al. (pers.com) determined, using boat-based observations involving 18 sightings, a mean group size of 147 for melon-headed whales in Hawai'i, the entire abundance near the main Islands could be found in a single group. However, Mobley et al. (2000) found a much smaller mean group size (13.5), perhaps indicating that animals may also be more dispersed at times. The median group size determined during the surveys around the Hawaiian Islands and in the eastern tropical Pacific over the past 2 decades (24 sightings) is approximately 90 (Barlow, pers. comm.). Baird et al. (pers. comm.) have sighted a group with sufficient frequency off the lee side of the Big Island to indicate that there may be island-associated individuals around Hawai'i.



Map showing distribution of melon-headed whales (green diamonds) and survey effort (red lines) from small boat surveys around the main Hawaiian Islands (Baird, unpublished).

What is known about historic stranding events with melon-headed whales in Hawai'i and elsewhere?

Historic stranding records for Hawai'i from 1955 to the present indicate there have been 13 stranding events of melon-headed whales in the Hawaiian Islands, but each only involved one or two animals. Mass strandings involving large numbers of melon-headed whales like the July 2004 event have not been previously documented in Hawai'i during the 20th century. However, there is one historical record from 1841 of approximately 60 melon-headed whales driven ashore by native Hawaiians as part of a drive fishery.



All recorded instances of melon whale strandings and captures in the main Hawaiian Islands. Red circles are strandings of single animals, the yellow circle is a mass stranding of 2 adult males, and the green diamonds represent captures of live animals, both at sea and near shore. Bathymetry data from the GEBCO Digital Atlas, British Oceanographic Data Centre.

Worldwide, there have been 24 recorded mass strandings of melon-headed whales between 1957 and the present (not including the U.S.). The geographic locations of these strandings have included Japan, Taiwan, Australia, Vanuatu, the Marshall Islands, the Seychelles, Costa Rica, Brazil, and Venezuela.

For the U.S., there are two mass strandings of melon-headed whales on record: (1) the July 2004 event in Hanalei Bay, Hawai'i involving 150+ animals, and (2) the March 2006 event in Vero Beach, Florida involving 5 animals.

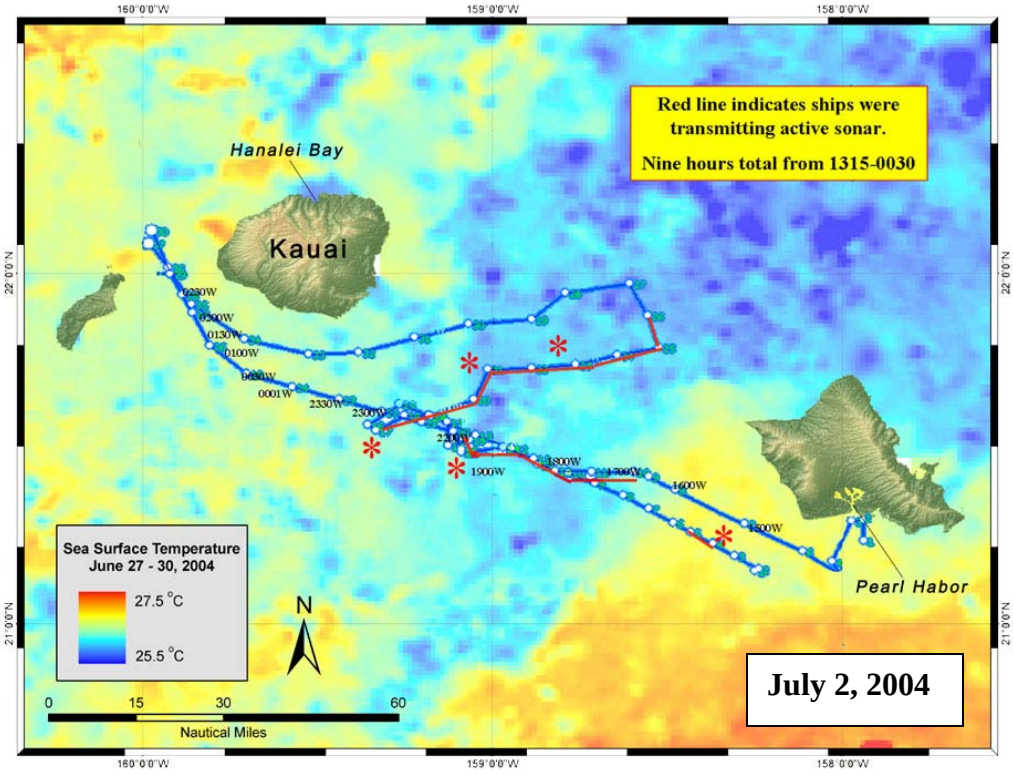
Melon-headed whales swimming in tight circles in Hanalei Bay, July 3, 2004.
Photo by Gretchen Johnson

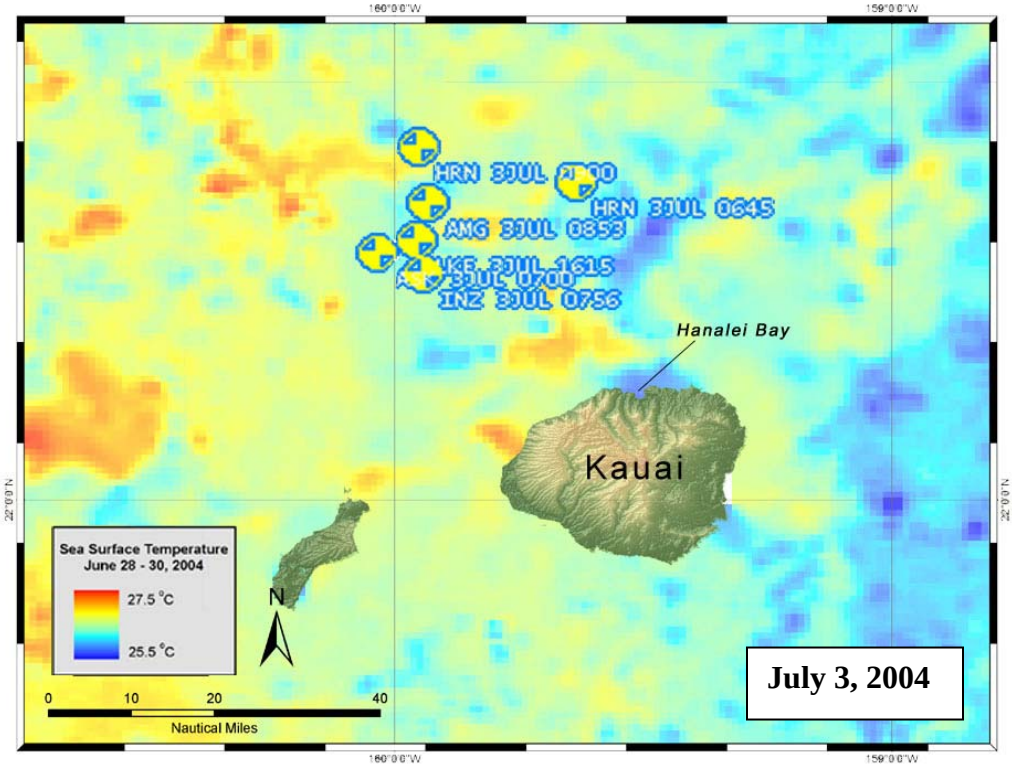
What caused the stranding of these whales? Did sonar play a role?

Environmental analyses did not indicate any compelling reason that the animals entered the bay on the morning of July 3, 2004 nor remained in the bay through the morning of July 4, 2004. There were no obvious significant weather or oceanographic events, harmful algal blooms, or known unusual biological predator or prey events that could explain the animals' behavior moving into the bay nor the groups continued presence in the bay.

The only known, large-scale, anthropogenic activities occurring in the vicinity of this stranding event were the Rim of the Pacific ("RIMPAC") active sonar transmissions covering much of the area between the islands of Oahu and Kaua'i on July 2nd and those occurring at the Pacific Missile Range Facility (PMRF) on July 3rd. This investigation considered the possibility that military, mid-frequency sonar transmissions on the afternoon and evening of July 2nd caused the group of whales to move from areas to the south and east of Kaua'i into Hanalei Bay on the morning of July 3rd and that transmissions on July 3rd played some role in their refusal to depart. The results of this analysis indicate that such an association was possible based on the estimated sound transmission conditions and reasonable animal movement speeds over the time period. The analysis is limited in that the location of the animals prior to their arrival in Hanalei Bay is unknown, and omnidirectional (rather than focused) propagation of the sonar is presumed.

Sound propagation models of the RIMPAC sonar exercises conducted by NMFS on July 3, 2004 at PMRF off the NW coast of Kaua'i suggest that sonar transmissions could have been detectable near or within Hanalei Bay; analyses by U. S. Navy, 3rd Fleet (2006) support and in fact considerably strengthen this conclusion. If sonar transmissions were audible at Hanalei Bay during the exercises, they could have contributed to the animals remaining there on July 3, 2004.





Vessel movement and sonar transmissions on July 2-3, 2004 during RIMPAC exercises.

What were the necropsy results on the single calf that died?

On July 7, 2004, a full necropsy, magnetic resonance imaging, and computerized tomography examination were performed on the calf to determine the manner and cause of death. The combination of imaging, necropsy and histological analyses found no evidence of infectious, internal traumatic, congenital, or toxic factors. Although cause of death could not be definitively determined, it is likely that maternal separation, poor nutritional condition, and dehydration contributed to the final demise of the animal.

Left lateral view of neonate calf recovered on July 5, 2004.
Photo by The Marine Mammal Center

What do scientists look for when investigating acoustic trauma in marine mammals?

Scientists examine the demographics and circumstances surrounding the strandings and do complete examinations of as many animals as possible to evaluate cause and manner of death for the whole group. Based on the findings from recent investigations, they look for hemorrhages in tissues with particular emphasis on acoustic tissues (*e.g.*, ears, acoustic fats in the jaw and around the ears, and sinuses) and the brain. Lipid or gas emboli (*i.e.*, fat or air bubbles in tissues or vessels) in various body organs or vessels have been found in animals from mass strandings associated with sonar activities, therefore scientists also closely examine carcasses for evidence of such emboli. The actual mechanism of these gas or fat emboli is not known.

How does sonar impact marine mammals?

The potential effects of sonar on marine mammals remain an area of scientific uncertainty. Laboratory information regarding hearing and the effects of noise provide quantitative means of estimating the ranges at which sonar and other human sound sources may be detectable to marine mammals and may affect them. These data indicate that many active sonar systems are audible to many marine animals over considerable distances in many cases and that, if sufficiently intense or sustained, may affect hearing or other systems. However, behavioral and physiological responses of marine mammals to sound sources are highly context-specific and poorly understood. Our understanding

of the type and magnitude of behavioral and physiological responses to active sonar, and the extent to which these responses may contribute to marine mammal stranding events remains rudimentary.

How did the U.S. Navy respond to the situation?

NOAA Fisheries Service formally requested the Navy suspend its activities temporarily, in hopes that the whales would move farther out to sea. The Navy cooperated and immediately ceased operations of its active sonar on the afternoon of July 3rd. The decision by the Navy to cease operations of active sonar as requested by NMFS may have provided an opportunity for the stranding network to herd the milling animals out of the bay.

What is the final conclusion about this event?

While causation of this stranding event may never be unequivocally determined, we consider the active sonar transmissions of 2-3 July, 2004, a plausible, if not likely, contributing factor in what may have been a confluence of events. This conclusion is based on:

1. The evidently anomalous nature of the stranding;

2. Its close spatiotemporal correlation with wide-scale, sustained use of sonar systems previously associated with stranding of deep-diving marine mammals;

3. The directed movement of two groups of transmitting vessels toward the southeast and southwest coasts of Kaua'i;

4. The results of acoustic propagation modeling and an analysis of possible animal transit times to the Bay; and

5. The absence of any other compelling causative explanation.

The initiation and persistence of this event may have resulted from an interaction of biological and physical factors. The biological factors may have included the presence of an apparently uncommon, deep-diving cetacean species (and possibly an offshore, non-resident group), social interactions among the animals before or after they entered the bay, and/or unknown predator or prey conditions. The physical factors may have included the presence of nearby deep water, multiple vessels transiting in a directed manner while transmitting active sonar over a sustained period, the presence of surface sound ducting conditions, and/or intermittent and random human interactions while the animals were in the bay.