

## **SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific.**

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### **Executive Summary**

Humpback whales were hunted commercially in the North Pacific until 1966 and remain on the endangered species list at the time of this report. The degree to which they have recovered from whaling in the North Pacific is difficult to determine because of the lack of accurate abundance estimates for this wide-ranging species. New methods such as photographic identification and analysis of skin and blubber biopsy samples have provided tools to examine the status of humpback whales. These animals undergo one of the longest migrations of any mammal and, within the North Pacific, their population structure and migrations appear to be complex. To effectively study and protect a species that travels widely across international borders requires a high level of collaboration among researchers and governments.

SPLASH (Structure of Populations, Levels of Abundance and Status of Humpbacks) represents one of the largest international collaborative studies of any whale population ever conducted. It was designed to determine the abundance, trends, movements, and population structure of humpback whales throughout the North Pacific and to examine human impacts on this population. This study involved over 50 research groups and more than 400 researchers in 10 countries. It was supported by a number of agencies and organizations including the National Marine Fisheries Service, the National Marine Sanctuary Program, National Fish and Wildlife Foundation, Pacific Life Foundation, Department of Fisheries and Oceans Canada, and Commission for Environmental Cooperation with additional support from a number of other organizations and governments for effort in specific regions. Results presented here include a comprehensive analysis of individual identification photographs. Additional analysis of human impacts, ecosystem markers (e.g., stable isotopes) and the genetic structure of populations are underway or planned pending further funding.

Field efforts were conducted on all known winter breeding regions for humpback whales in the North Pacific during three seasons (2004, 2005, 2006) and all known summer feeding areas during two seasons (2004, 2005). A total of 18,469 quality fluke identification photographs were taken during over 27,000 approaches of humpback whales. After reconciling all within and cross-regional matches (from both the primary match and rechecks), a total of 7,971 unique individuals were cataloged in SPLASH. A total of 6,178 tissue samples were also collected for genetic studies of population structure, with fairly even representation of wintering and feeding areas.

Migratory movements and population structure of humpback whales in the North Pacific were found to be more complex than had been previously described; a high degree of structure, however, was also apparent. Migrations between feeding and wintering areas were documented based on 873 whales that were seen on both a wintering and feeding areas. The overall pattern showed that coastal wintering regions of the western (Asia) and eastern (mainland Mexico and Central America) North Pacific were the primary wintering areas for the lower latitude coastal feeding regions. The wintering areas off Hawaii and the Revillagigedo Archipelago were the primary wintering regions for the more central and northern latitude feeding areas.

Even though the SPLASH study collected data from all known wintering and feeding areas for humpback whales in the North Pacific, the SPLASH data did suggest the likely existence of missing wintering areas that have not been previously described. Humpback whales that feed off the Aleutians and in the Bering Sea were not well represented on any of the sampled wintering areas and must be going to one or more unsampled winter locations. Thus, it is likely that SPLASH has revealed a new breeding ground for humpback whales. While it would be logical to assume that this region would be located in the eastern central North Pacific, the complexities of the migratory pathways revealed here indicate that this is not certain.

Individual whales showed high rates of return to specific wintering and feeding areas, suggesting strong site fidelity to both habitats. Interchange of whales between feeding areas both within and between seasons was unusual and all but a few of these were between adjacent areas. Similarly, whales tended to return to the wintering region they had inhabited previously, although the geographic scale of this varied by region. Whales showed frequent interchange among areas within the Hawaiian Islands but only rarely switched between broader regions. Some wintering areas that were sampled, especially Ogasawara and Baja Mexico, appeared to be transitory areas rather than migratory destinations. These findings are consistent with preliminary analyses of the genetic structure population showing a high degree of maternally-directed fidelity to both breeding and feeding grounds but a complex relationship between seasonal habitats.

Using several methods, the abundance of humpback whales was estimated to be just under 20,000 for the entire North Pacific, an estimate that is about double estimates made previously. The non-stratified Chapman-Petersen estimates of abundance were 18,000 to 21,000. Among geographically stratified models, the model assuming non-Markovian movements with capture probability proportional to sample size across years provided the best overall fit to the data indicated an abundance of 17,558 for wintering areas and 19,056 for the feeding areas. The average of these two estimates (18,302) represented the best estimate of overall abundance of humpback whales in the North Pacific, excluding calves. Over 50% of this population was estimated to winter in Hawaiian waters with large populations also inhabiting Mexican waters. The abundance estimates of humpback whales wintering in Asia and Central America were fairly low (1,000 or less). Among feeding areas, regional estimates differed greatly among models. Average estimates of abundance ranged from about 100-700 for Russia, 6,000-14,000 for the Bering Sea and Aleutians, 3,000-5,000 each for the Gulf of Alaska and the combined Southeast Alaska and Northern British Columbia area, 200-400 for Southern British Columbia-Northern Washington, and 1,400-1,700 for California-Oregon.

The SPLASH estimate represents a dramatic increase in abundance from other post-whaling estimates for the overall North Pacific, yet is consistent with a moderate rate of recovery for a depleted population. Comparison of the SPLASH estimate of 18,302 for all feeding and wintering areas to the estimate of 9,819 obtained for 1991-93 in a previous study suggests a 4.9% annual increase over this 13-year period. Going back to the estimate of 1,400 whales at the end of whaling for humpbacks in 1966, a 6.8% annual increase over the 39-year period would be required to reach the current SPLASH abundance. For Hawaii, three methods were used to compare estimates to determine trends since the early 1990s and yielded very similar annual rate of increase from 5.5 to 6.0%.

While the overall humpback whale abundance and trends in the North Pacific are encouraging, some areas should be of concern, especially Asia. The western-most feeding and wintering areas were distinct from the rest of the North Pacific with a very low level of interchange between Asian wintering or feeding areas and those in the central and eastern North Pacific. Abundance estimates in this area are low (below historical levels based on the number taken in this region) and whales along the Asian coast appear to be subject to a high level of incidental mortality.