

## **The Age of Living Female Gray Whales (*Eschrichtius robustus*), Estimated from Photographic Identification Data**

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### **Abstract**

The minimum ages of breeding female gray whales (*Eschrichtius robustus*) were determined from photographs obtained during the periods from 1977-1983 by Jones & Swartz, from 1996-2000, 2003 (UABCS), and from 2005-2016 (LSIESP/UABCS). Recaptures (matches) of individual whales were used to estimate their minimum ages as the number of years from the time of the earliest photograph to the most recent. Photographs of 18 “re-captured” whales confirmed 17 female and one presumed male gray whale minimum ages ranging from 26 to 48 years, and confirm that these females are continuing to reproduce and visit Laguna San Ignacio with their new calves. These are the oldest photographic identification data for any living gray whales, clearly demonstrating the fidelity of breeding female gray whales to Laguna San Ignacio, and underscore the value of long-term photographic identification based research.

**Key words: gray whale, photographic-identification, minimum age, breeding lagoons, fidelity**

### **Introduction**

Estimating the age of mysticete cetaceans is difficult owing to their longevity and oceanic natural history. Most estimates of age are inferred from the size distribution of harvested whales (Berta et al. 2005; Sumich 2014), whaling artifacts found embedded in harvested whales (George & Bockstoce 2008), and the number of growth layers in the wax ear-plugs of dead mysticetes (Blokhin & Tiupeleyev 1987).

Rice and Wolman estimated the age of harvested female gray whales from the number of corpora albicantia in their ovaries, assuming that the average pregnancy rate is 2-years and produces one corpora albicantia, plus the average age of 8 years for the onset

of sexual maturity (Rice & Wolman 1971). The oldest female gray whale they examined had 34 corpora albicantia and was estimated to be 76 years old (34 corpora x 2 = 68 years + 8 years to sexual maturity = 76 years).

Here we report estimates of minimum age for living reproducing female gray whales from the analysis of photographic identification data (Photo-ID) obtained in the winter aggregation areas (Laguna San Ignacio, Laguna Ojo de Liebre and Bahía Magdalena lagoon complex) in Baja California Sur, Mexico during the whales' winter reproductive seasons from 1977 to 2018.

## Methods

The distinctive and individually unique markings and scars on the backs of gray whales make them excellent subjects for Photo-ID based research because these features persist and are recognizable over long periods of time (Jones 1990). Gray whales to be photographed were routinely approached in outboard motor driven 4.5 m long inflatable boats (1977 to 1983) and 7 m long fiberglass “pangas” (1996 to present). Attempts were made to photograph both the left and right sides of each whale. From 1977 to 1983 gray whales were photographed using 35 mm single lens reflex (SLR) cameras fitted with 100 mm to 300 mm zoom telephoto lenses on color transparency film (e.g., Ektachrome and Kodachrome). For comparison with more recent photos, color transparencies were scanned and saved as JPEG color digital images at 600 dpi (dots per inch). Beginning in 1996 gray whales were photographed with digital SLR cameras fitted with 70 mm to 300 mm zoom telephoto lenses, and the images saved as NEF (RAW) and JPEG fine files. The best digital images were selected, edited with digital photographic software (i.e. Adobe Photoshop and ACDC digital image editing software) to improve sharpness and resolution. Edited images were used to produce digital photos for each individual gray whale, and these were assigned unique identification reference numbers indicating: the date the image was obtained; the location; the left or right side photographed; and whether the whale was accompanied by a calf. These numbered photographs were compiled into annual catalogs and posted on the LSIESP website ([www.sanignaciograywhales.org](http://www.sanignaciograywhales.org)) for distribution and comparison with other regional photographic catalogs.

Photographs of gray whales obtained on their winter breeding areas of Baja California, Mexico (Figure 1) during three time periods were compared. The earliest photographs were collected in Laguna San Ignacio by Jones and Swartz (1984) from 1977 to 1983 and included 83 right side and 74 left side images. These were compared with 2,812 right side images obtained in Laguna San Ignacio and Laguna Ojo de Liebre from 1996 to 2000 and 2003 by researchers from the Programa de Investigación de Mamíferos Marinos of the

Universidad Autónoma de Baja California Sur (UABCS) and 6,533 right side images and 5,084 left side images obtained in the three breeding areas from 2005 to 2018 by researchers from the Laguna San Ignacio Ecosystem Science Program (LSIESP/UABCS).

The minimum age of individual whales were estimated as the number of years between the first year a whale was photographed and the year of the most recent photographic re-capture of that individual whale. If a whale was first photographed as a female with a calf, it was assumed that whale was at least 8-years old, and 8-years was added to the number of years between the first sighting and the most recent re-capture to account for the average number of years required for that female to attain sexual maturity and begin reproducing.

## Results

The comparison of the 1977-1983 photographs from Laguna San Ignacio revealed matches or re-captures of 18 individual whales with photographs obtained between 1996 and the present. These included 17 breeding females and one whale that has been seen in six different years as a single whale (never photographed with a calf) and presumed to be a male (Table 1). Eleven individuals were first photographed as single whales during the period 1977-1983 and subsequently re-captured one or more times with a calf years later, indicating that these females had reached the age of sexual maturity during the period 1977-1996. And six more were seen with a calf since the first period (1977-1983). The estimated minimum ages for these re-captured whales ranged from 27 years to 48 years.

## Discussion

These estimates of gray whale ages are the oldest Photo-ID data for any living gray whales, and further demonstrate that natural occurring markings are a reliable way to identify individual gray whales over long periods of time. These results also confirm that some female gray whales demonstrate a fidelity to the Laguna San Ignacio winter aggregation and breeding area by returning to this breeding lagoon with their calves over many years.

Rice & Wolman (1971) reported that the oldest breeding female gray whale they examined was 76 years old when she was killed. Our estimated age of living breeding females ranges from 26 to 48 years, proposing that some of these living females are in the middle of their reproductive lives, and could be expected to live at least for another 20 to 30 years. But also some of these whales could be even older than estimated in our study, because with the Photo-ID, we can determine the minimum age when a whale was

documented with a calf for the first time, but we ignore the prior history to this first sighting

Eleven of the 17 re-captured female whales were first photographed as single whales between 1977 and 1983, and then later photographed as females with calves, suggesting that they attained reproductive maturity and began reproducing during the period 1977 to 1996. It is noteworthy that these females, and perhaps others that remain un-photographed, are returning to Laguna San Ignacio with their calves over the 40-yr span of this study, and that they are continuing to successfully mate, birth and rear their calves in this lagoon long enough to be re-photographed during the winter reproductive season. This fidelity to Laguna San Ignacio as a favored area for some breeding females underscores the need to maintain it as a marine protected area for reproduction of this species during the winter breeding period.

These findings confirm, and we concur with, the opinion of Jones (1990) that photographic identification based research provides a "unique opportunity" to estimate life history and reproductive parameters from living whales that include: calving interval; regional fidelity, duration of stay in a particular location, habitat use, and longevity. While photographic identification methods require non-lethal, non-invasive research over many years, photographic monitoring of living whales will continue to provide new information on the whales' behavior and reproductive biology throughout their lives.

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