Longitudinal comparisons of digital photography of marine mammals from aircraft and shore

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ABSTRACT

Rapid progress and affordability of photographic technology with increasing improvements in image resolution have facilitated advancements in efficiency and alternative approaches in data collection for marine mammals. We report these recent improvements by comparing marine mammal photographs taken during 2008-2013 aerial surveys of 16 marine mammal species in the Southern California Bight, shore-based studies of bottlenose dolphins (Tursiops truncatus) in Galveston Bay, Texas (2011-2013), and gray whales (Eschrichtius robustus) off Sakhalin Island, Russia (2004-2010). Various Canon and Nikon high-definition cameras ranging from 8.2-26.3 MP resolution and 70-1600 mm lenses with image stabilization were used during the studies. Results of these photographic comparisons demonstrate the evolution of digital photography advancements with the successful capture of individuals, as well as detailed information for behavioral ecology studies. For example, (1) individual identification of marine mammal species from aircraft not previously reported (Rosco’s dolphins, Grampus griseus), killer whales (Orcinus orca), and blue and fin whales (Balaenoptera musculus and B. physalus), (2) shore-based individual identification of bottlenose dolphins up to 400 m and of gray whales up to 2 km from shore, (3) instantaneous differentiation/confirmation of short-beaked vs. long-beaked common dolphins (Delphinus delphis and D. capensis) from 1,500 ft altitude with a 36 megapixel (MP) camera, (4) reduced proportion of “unidentified” dolphin and whale species, and (5) potential translation of the behavior, social associations and durations, and relative position within the group of some individually identified delphinids and other species not previously studied in this manner. High-definition digital photography reduces costs and acquisition/processing time from earlier “tried and true” analog photography. This facilitates, advances, and compliments the efficacy of data collection for population and behavioral ecology studies on marine mammals, most recently allowing capture of individual identification images at distances of up to 2 km away.

SOUTHERN CALIFORNIA BIGHT – Aerial Photos

- Resight of photo-ID if blue whale, S. California.
- Photographed from a small circling plane on 23-27th of altitude on 26 June 2012 at 12:55 (Top: and 13:40 (Bottom).
- The black circle denotes a short scarp and to photo-identify (ID) this individual on three different occasions between the same day of 1 ft each of her.
- Photo-ID was critical to confirm that the individual was on the same individual when other blue whales entered the area.
- Photo taken with a Nikon 800 MP D3 S MP still camera with a 80-400 mm internally stabilized lens.

- Photographed from a small circling plane from 313 m altitude on 29 July 2013 at 13:55 (Top), 241 m altitude on 17 November 2008 at 13:55 (Bottom), and 477 m altitude on 26 March 2013 at 13:23 (Top Right).
- Individual Risso’s dolphins have been photo-identified within one focal photo session from the aircraft with the same camera as the blue whale (left photo).
- However, we have not yet cross-compare Risso’s photos across days.

- Photographs from a small circling plane from 232 m altitude on 21 January 2012 (photo by G. Bearzi) and 241 m altitude on 21 January 2012 (photo by G. Bearzi).
- Individual Risso’s dolphins have been photo-identified within one focal photo session from the aircraft with the same camera as the blue whale (left photo).
- However, we have not yet cross-compare Risso’s photos across days.

Sakhalin Island, Russia – Shore-based Photo-ID

From July – September 2004-2005, shore-based photo-identification (ID) methods were employed on western gray whales off northeastern Sakhalin Island, Russia. This was part of a behavioral monitoring program that covered 66 km of coastline in part of the northern feeding grounds of this species.

- A Nikon D5 with a 100-400 mm Nikkor lens was used, over 2 years in a feasibility study.
- Based on this success, we supplemented using vessel-based photo-ID efforts, additional equipment (Nikon D2Xs and Sigma lens vary 500-800 mm f/5.6-6.3, Leica 900 mm), 26, 200+ photos across days.
- The expected camera equipment significantly increased the number of individuals photographically captured.
- The larger focal length facilitates photo-ID of individuals from shore at distances of at least 2,500 m.
- All photographs were captured in RAW format and processed with specialized identification software, IDENTIFIER.
- There was one shore-based photo-ID team in 2004-2005 and two shore-based photo-ID teams from 2006-2008.

- Distance to successfully photo-ID an individual was highly dependent on environmental conditions and lighting at the time.
- From 2008-2009, a total of 100+ days of shore-based photo-ID efforts yielded 184 individuals with a mean of 5.8 sightings ranging 1-26.
- Shore-based efforts from 1995-2008 photo-ID 141 individuals from this shore-based/photographic population.
- We believe the shore-based photo-ID efforts were highly successful:
  - Supplement vessel-based photo-ID efforts.
  - Provide the ability to identify small whales under weather conditions, such as high rain, snow, and not possible vessel-based surveys.

CAMERA COMPARISONS ACROSS OUR STUDY YEARS

<table>
<thead>
<tr>
<th>YEAR</th>
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<th>MEGAPIXELS</th>
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<tr>
<td>2004</td>
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<td>2008-2011</td>
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<td>2013</td>
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- (Left) Long-beaked common dolphins photographed from circling plane at 277 m altitude on July 25, 2015 by B. Würsig under NMFS permit 15608.
- (Right) Short-beaked common dolphins photographed from circling plane at 277 m altitude on May 26, 2015 by B. Würsig under NMFS permit 15609.
- Both photos made with a Nikon D4S 16 MP 3 megapixel still camera with a 80-400 mm internally stabilized lens. Specimen were identified in the field.

GALVESTON SHIP CHANNEL, TEXAS – Shore-based Photo-ID

Between September 2011 and January 2012 we conducted a feasibility study to assess the possibility of photo-identifying common bottlenose dolphins (Tursiops truncatus) from the coast in the Galveston Ship Channel, Galveston, Texas. This population has been studied from here and the possibility for this has not previously attempted photo-ID from shore here until recent camera technological advances.

We used a Nikon D3S reflex camera (12.3 MP) equipped with a NIKKOR 40-400 mm f 4-5.5-6.3 D VR. Photo were taken from shore along a 1 km stretch of coast by a small sound cruise using a stereo. The expected increased stability while allowing for quick set up adjustments necessary to take photos during dolphins’ short-lasting surfacing. All images were shot in RAW format and processed with Adobe Lightroom 4.

Delphinus photos were obtained on 21 days, totaling 16 observations. From 1,540 photos, we photo-identified 76 dolphins at distances up to 495 m. Ten individuals were re-identified in three or more days, and 14 in two days. The remaining 15 were only seen once.

| Tursiops truncatus, about 400 ft from the camera, 11 November 2011 (photo by G. Bearzi) |
| Tursiops truncatus, about 300 ft from the camera, 11 January 2012 (photo by G. Bearzi) |