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IWC Photo-identification catalogues: draft guidelines

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INTERNATIONAL
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BACKGROUND

The International Whaling Commission (IWC) has a history of using data and analyses from photo-identification catalogues to assist with its work. (Within this document the term ‘photo-ID catalogue’ describes a database that includes whale identification photographs with corresponding dates and geographic positions. Photo-identification data have been used to identify patterns of movement, residency, habitat use, population structure and to estimate abundance and other population parameters (e.g. Bradford *et al.*, 2008; Calambokidis *et al.*, 2009; Carroll *et al.*, 2011; Koski *et al.*, 2010; Wedekin, *et al.*, 2010; Whitehead *et al.*, 2008; see also *Rep. int. Whal. Commn., Special Issue* 12, 1990).

Recognising the great value of such studies (e.g. IWC, 1990), the IWC has supported the development of photo-identification catalogues to facilitate assessment work (e.g. Southern Hemisphere humpback whales, Southern Hemisphere blue whales and Pacific gray whales). Such catalogues can also assist in providing information on entanglement, ship strikes and health status.

The IWC has supported (financially or by submitting photographs from IWC cruises) what can broadly be considered two types of photo-identification catalogues:

- (1) ‘independent’ catalogues that are pertinent to specific on-going assessments but for which maintenance and control belongs outside the IWC; and
- (2) ‘repository’ catalogues that have IWC oversight.

Repository catalogues are supported for the general value of their data and potential use for assessment in the future whether or not they are currently being used by the IWC in an on-going assessment (e.g. the Antarctic Humpback Whale Catalogue). Catalogues can move from one status to another during the progress of assessments. In repository status, catalogue holders need only submit an annual report (see reporting, below). For an on-going assessment, the data requested may include full catalogues, re-sighting records, and possibly additional, associated data (behaviour, sex, age class, etc.). In this case, if an independent catalogue has received funding it would provide a summary report in addition to the contributed data.

Conservation and scientific benefits of shared catalogues

Photo-identification catalogues are usually compiled from regional surveys in an area that typically represents only part of the range of the focal species. The effective study and management of whales at the population level benefits from a broad (full range if possible) spatial coverage. These are wide ranging animals that travel across regional and international boundaries and comprehensive research and management depends on the collaboration among researchers as well as governments. An important role for the IWC, in being able to provide the best scientific basis for conservation and management advice, is to encourage such collaboration to allow broad and robust assessments of cetaceans.

For example, to understand broad ecological patterns or undertake range-wide assessments, it is necessary to combine (‘reconcile’) catalogues amongst research groups. The comparison of photo-identification catalogues between regions can reveal whale movement patterns, migration routes, and determine breeding and feeding area linkages. Using photo-identification data from throughout a species or population’s range allows for a greater

understanding of population structure and provides data for a more comprehensive abundance estimate. Examples of outputs from some large ocean-wide catalogue reconciliations are given in Table 1.

Table 1
Examples of results from ocean-wide photo-ID catalogue reconciliations.

Acevedo, J. <i>et al.</i> 2007. Migratory destinations of humpback whales from the Magellan Strait feeding ground, Southeast Pacific. <i>Marine Mammal Science</i> , 23(2), pp.453-463.
Constantine, R. <i>et al.</i> 2012. Abundance of humpback whales in Oceania using photo-identification and microsatellite genotyping. <i>Mar Ecol Prog Ser</i> 453: 249-261.
Garrigue, C. <i>et al.</i> 2011. Movement of individual humpback whales between wintering grounds of Oceania (South Pacific), 1999 to 2004. <i>J. Cetacean Res. Manage</i> , 3, pp.275-281.
Mizroch, S. A. <i>et al.</i> 2004. Estimating the adult survival rate of Central North Pacific humpback whales. <i>Journal of Mammalogy</i> 85(5):963-972.
Weller, D.W. <i>et al.</i> 2012. Movements of gray whales between the western and eastern North Pacific. <i>Endangered Species Research</i> , 18(3), pp.193-199.

Publications from YoNAH - North Atlantic humpback whales

Smith, T. D., <i>et al.</i> 1999. An ocean-wide mark-recapture study of the North American humpback whale (<i>Megaptera novaeangliae</i>). <i>Marine Mammal Science</i> 15:1-32.
Stevick, P. T. 2001. Errors in identification using natural markings: rates, sources, and effects on capture-recapture estimates of abundance. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 58: 1861-1970.
Stevick, P. T., <i>et al.</i> 2003. North American humpback whale abundance and rate of increase four decades after protection from whaling. <i>Marine Ecology Progress Series</i> 258: 263-273.
Stevick, P. T. <i>et al.</i> 2006. Population spatial structuring on the feeding grounds in North Atlantic humpback whales (<i>Megaptera novaeangliae</i>). <i>Journal of Zoology</i> , 270(2), 244-255.

Publications from SPLASH - North Pacific humpback whales

Barlow, J. <i>et al.</i> 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. <i>Marine Mammal Science</i> 27(4): 793-818.
Calambokidis, J. <i>et al.</i> 2008. SPLASH: Structure of populations, levels of abundance and status of humpback whales in the North Pacific. Final report for Contract AB133F-03-RP-00078. 57pp. Available from < http://www.cascadiaresearch.org/files/Projects/Archived_projects/SPLASH/SPLASH-contract-Report-May08.pdf >
Straley, J. <i>et al.</i> 2009. Assessment of mark-recapture models to estimate the abundance of a humpback whale feeding aggregation in Southeast Alaska. <i>Journal of Biogeography</i> 36(3): 427-438.

Data access for shared catalogues

For population assessments where there is no reconciled IWC catalogue or for which the IWC has not developed a data availability agreement, the IWC uses analyses of data from multiple catalogues but the data themselves are not necessarily available to all Committee members (or even shared among the different contributors). However, any scientist (including catalogue holders of contributed data) may submit a request for data access to the data owner(s) through the IWC and its broad data availability process¹. Such requests are handled on a case-by-case basis and the IWC (as a neutral entity) works to facilitate an appropriate data sharing agreement although the ultimate decision remains with the data owner. Requests must include a proposal that specifies the intended analysis and how it benefits the Scientific Committee and/or adds to the scientific knowledge of the species in question.

Data sharing agreements are in place for established IWC collaborative catalogues, such as the Antarctic Humpback Whale Catalogue and the Southern Hemisphere Blue Whale Catalogue. Researchers studying populations that correspond to these species and geographic designations are encouraged to join these collaborative catalogues and make use of the reciprocal data sharing agreements.

¹ For more information, see the IWC Scientific Committee Data Availability protocol, Procedure B <<https://iwc.int/data-availability>>.

All catalogues sponsored in whole or in part by the IWC **must** have a data availability agreement that facilitates access for Scientific Committee members; the protocol will be published on the IWC website.

OBJECTIVES OF THE GUIDELINES²

To date, the IWC collaborative catalogues have been developed on an *ad hoc* basis responding to specific needs. Whilst this has worked to a greater or lesser extent – we envision that IWC assistance to facilitate collaboration amongst research groups and the development of reconciled catalogues may increase (e.g. with gray whales in the western North Pacific). It is therefore important to develop guidelines for photo-identification catalogues either (a) being sponsored by the IWC or (b) contributing photo data/analyses of such data to the IWC for assessment purposes. The conditions for these two types may vary in some instances. The aim is that catalogues adhere to common standards (e.g. with respect to photograph subject and quality, data submission, maintenance and reporting) such that they provide data at a level sufficient to allow the IWC to meet its population assessment and conservation goals. The guidelines are general in scope and intended for use by all kinds of photo-ID projects. They are not guidelines on field techniques, although appendices providing examples of good practice may be developed at a later stage.

For use in population assessments, photo-identification catalogues must be fully reconciled internally. Identification photographs should be submitted to the IWC (see discussion below) with at least date and location data.

CATALOGUE CONTRIBUTIONS FOR POPULATION ASSESSMENT - PROTOCOLS

I. Photo subjects for large whales, by species³

Primary photo subjects in bold.

- Blue whales – **left and right side with dorsal fin**, fluke if available
- Fin whales – 2-3 photos of each side: **dorsal fin** and flank; **chevron and blaze**
- Sei whales – 2 photos of each side: **dorsal fin, flank**
- Brydes whales - **left and right side with dorsal fin**
- Minke whales - **left and right side with dorsal fin**
- Humpback whales – **fluke**; left and right dorsal fin and/or flank if no fluke available
- Omura's whales – **left and right side with blaze, chevron, and dorsal**
- Gray whales - **left and right side with dorsal hump**; fluke
- Right whales – callosity patterns; **vertical view of head**, lateral left and right sides of head
- Bowhead whales – **vertical view, entire dorsum**
- Sperm whales – **fluke**

Dorsal side and fluke photos should be linked for individual whales whenever possible.

II. Catalogue organisation

The objective is to facilitate matching (e.g. new photographs within an existing catalogue⁴ and/or between catalogues⁵). There are several ways to achieve this e.g. grouping photographs within a catalogue based on similar natural markings – color or dorsal fin shape, for example – facilitates the inter-matching process. New identification photos can then be compared first to similarly marked animals, speeding up the process to finding a match, if it exists (e.g. see Gendron and Ugalde de la Cruz (2012), Agler *et al.* (1990), and Allen *et al.* (1994) as examples for blue whales, fin whales, and humpback whales, respectively. This can be an appropriate way to organise catalogues, whether the catalogue is in printed or electronic format. A similar approach can be used in a catalogue held in a database format where individual photographs can be coded for one or more features.

III. Internal catalogue reconciliation

The inter-matching of photographs can be conducted manually (by eye) or computer-assisted (generally custom software and often species specific). Using the manual method, photographs can be compared in printed format,

² The guidelines should be regularly reviewed (every 3 years?) and updated as necessary

³ At present only large whales are considered but this can be expanded to small cetaceans in due course

⁴ Reconciling a catalogue internally

⁵ Reconciling two or more catalogues

electronic format or a combination of both formats. This step may vary by species, by catalogue size, and by the staffing and funding resources available to the catalogue. All methods are valid as long as a clean validated dataset is produced.

Matches must be **unequivocal**, based on good quality photographs, and exhibiting a minimum of three match points.⁶ All inter-matches should be confirmed by a second matcher. For IWC catalogues, the IWC **must** conduct/oversee cross-matching exercises on catalogue subsets to confirm internal reconciliation (and estimate errors) at specified intervals.

IV. Image Quality Coding

The quality coding of photographs is undertaken by most catalogues to ensure (as much as possible) that there is an equal probability that matches will be recognized and to reduce the amount of bias highly distinctive or indistinctive individuals might otherwise produce. It is essential that such coding is used in IWC catalogues and that the method is documented. Typically catalogues use 3, 4, or 5 quality categories (excellent – poor) in their coding systems, based on features such as the angle and distance of the animal relative to the camera, lighting, and focus. See Friday *et al.* (2000) and Mizroch and Harkness (2003) for examples of quality coding. For the IWC, photographs of upper quality only are to be submitted. (Details will be agreed for individual catalogues.)

Note the important difference between quality and distinctiveness. Photo quality is based on the features of the photo (above) regardless of how well the whale in the photo is marked. The tendency is to code the photo of an indistinctive whale with few natural marks as a poor quality photo; this bias must be avoided as must the reverse.

V. Submissions to the IWC

‘Independent’ catalogues for use in assessments, not held by the IWC	IWC sponsored catalogues, held by IWC or with IWC oversight
Images	Images
Jpg photo format in the highest resolution available ⁷ (RAW is too large) ⁸	The highest resolution available (including RAW if available)
Best identification photo(s) per individual	Best identification photo(s) per individual per sighting
Higher quality photographs only (to be agreed on a case by case basis)	Higher quality photographs only (to be agreed on a case by case basis)
Associated data can be included in the metadata of images (but this is not required)	Associated data included to the extent possible
Associated data*	Associated data*
Data submitted as a flat file (i.e. in Excel) and in IWC-specified order (on a case by case basis; the IWC will inform research groups specifically)	The data will be held by the IWC in an appropriate database format
Include a record for every year (or season) that an individual is photographed (only one set of identification photo(s) is submitted) ⁹	All sightings will be documented (within and between years)

*This will include some or all of the following (to be specified on a case by case basis and dependent on availability). **At a minimum: whale identification number; photo label; photo subject (e.g. left side); date¹⁰; position expressed as lat/lon.¹¹** (If only a rough location is known submit the approximate lat/lon but identify it as approximate.). Additional data: behavior; sex; mother or calf designation; biopsy sample number; satellite tag number; comments. Comment to be qualitative, e.g. info on association with another known individual, unusual behavior, unusual scar.

⁶ A match point is a unique physical feature recognizable in both photographs (e.g. a nick in the dorsal fin, a specific swirl or spot(s) in the pigmentation, a scar).

⁷ Note that it is better to collect fewer photos of the highest resolution than more photos in a lower resolution. Low resolution photos are unusable for photo-ID.

⁸ RAW format might be accepted for archive purposes if the IWC is the main holder of single range-wide catalogue. Otherwise it is expected that research groups will archive their original photos and submit copies to the IWC.

⁹ There may be assessments that wish to examine the fluidity of inter-seasonal residencies, in which case all records within a season would be requested.

¹⁰ A resource for data standards regarding dates is ISO 8601: <https://www.iso.org/iso-8601-date-and-time-format.html>

¹¹ Researchers are encouraged (but not required) to use a GPS logger to embed GPS data directly into the photos’ metadata. It is also possible to add location data to photos using easily available, inexpensive software.

VI. Archiving

All IWC sponsored catalogues must back-up and archive their photos and data in multiple places including long-term offsite storage (e.g. backed up on 2-3 hard drives as well as on an institutional or cloud server). Confirmation of archival storage must be included in the report to the IWC (see below).

VII. Reporting

A report should be submitted to the IWC for every year of funding; in a few cases this is an annual report. Templates for such reports will be provided by the IWC (they may vary if an assessment is on-going, for example). Normally the report would include the geographic areas, years/seasons, and number of individuals compared to the existent catalogue, along with results of the comparisons yielding the number of matches, the number of newly identified individuals, and the subsequent total number of identified individuals in the catalogue. The report should also contain a detailed Methods section that describes how inter-matching and quality coding were conducted. Listing of data archival locations should be included. Recent publications generated from catalogue data should be listed.). It is suggested that established long term catalogues include a periodic error estimation in their reporting. Information on validation and error checking should be included in the report.

For an example, see a recent annual report from the Antarctic Humpback Whale Catalogue, Stevick *et al.* (2015

Reports are required from both assessment and repository catalogues.

N.B. TECHNICAL APPENDICES INCLUDING EXAMPLES OF GOOD PRACTICE MAY BE ATTACHED TO THESE GUIDELINES THAT WILL BE REGULARLY UPDATED

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