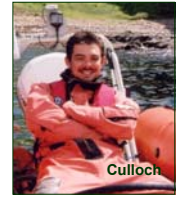


# THE USE OF COMPUTER-ASSISTED MATCHING SOFTWARE IN THE RE-EVALUATION OF AN ESTABLISHED BOTTLENOSE DOLPHIN PHOTO-ARCHIVE

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## Introduction

Whether conducting behavioural research or establishing population parameters, photo-identification is generally regarded as the most effective, non-invasive method available to researchers for gathering information about cetacean societies in the wild. Nevertheless, misidentification of individuals during the photo matching process can be hard to avoid, and can subsequently result in the accumulation of false positive / negative errors over time, leading to erroneous estimations of population size (Stevick *et al.*, 2001). Whilst application of a strict grading system for photograph quality allows corrections to be made to minimise this bias (Culloch, 2004), advances in computer-assisted matching programmes provide a welcomed development in addressing this intractable problem.

## Methods

In the present study, the extraction programmes *FinEx* and *FinMatch*™ v.1.1.0 (developed for Europhlukes by CWI, Amsterdam) were applied to an existing archive of bottlenose dolphin (*Tursiops truncatus*) images (from 1997 to 2004 inclusive) to isolate errors that may have resulted from previously undetected misidentifications. This analysis was carried-out prior to the calculation of population estimations for *T. truncatus* in the outer southern Moray Firth, NE Scotland. Accordingly, only “marked” animals – individuals with dorsal edge nicks or tears – were used in this evaluation. The major steps of the extraction and matching process are described in detail in the handbook accompanying this software. However, a brief summarisation of the stages involved is illustrated in figure 1 a-c, below left.

## Results

➤ From a total of 96 “marked” bottlenoses, 2 false positive errors (where two images of 2 different individuals were recorded as 1 individual) and 22 false negative errors (where two images of 1 individual were recorded as 2 separate individuals) were found from 578 sightings in the present study. This resulted in a revised total of 82 marked individuals in the bottlenose archive.

➤ When extracting dorsal fins displaying multiple serrations (Fig. 2), subsequent matches were found to have a higher *match probability* if the point of fine extraction was taken from the uppermost point of the top nick to the lower most point of the bottom nick (depicted by arrows in fig). Where nicks were well-spaced along the dorsal edge (as seen in Fig. 1b), however, the *match probability* was greater if each nick was extracted independently.

➤ Conversely, in practice, the matching programme *FinMatch*™ was not very effective in finding matches for animals with shallow dorsal nicks that had acquired one or more “new” nicks – particularly where the new nick was found to be larger than the existing nick(s). In this case, a positive match was still very much dependent upon the familiarity and knowledge of an experienced observer; although once found, the software could be used to confirm the match by extracting and comparing individual nick positions, thereby giving greater confidence in the decision making process.

➤ The accuracy of positive matches was found to be further dependent upon the visibility of the dorsal base, i.e. the full *baseline* of the dorsal should ideally be selected by the user during extraction (as indicated by points A & B in Fig. 1a) for best results.

➤ Finally, after to the removal of false positive/negative errors from the database, all but the best and/or most recent right or left dorsal image for each marked animal were deselected from the project panel window in *FinEx*. Subsequently, even inexperienced personnel could use the *FinMatch* software to effectively identify new recaptures.

## References

- Culloch, R.M. (2004). *Mark recapture abundance estimates and distribution of bottlenose dolphins (Tursiops truncatus) using the southern coastline of the outer Moray Firth, NE Scotland*. M.Sc. thesis. University of Wales, Bangor. pp. 85.
- Stevick, P.T., Palsbøll, P.J., Smith, T.D., Bravington, M.V. & Hammond, P.S. (2001). Errors in identification using natural markings: rates, sources, and effects on capture-recapture estimates of abundance. *Can. J. Fish. Aquat. Sci.* **58**: 1861 - 1870.

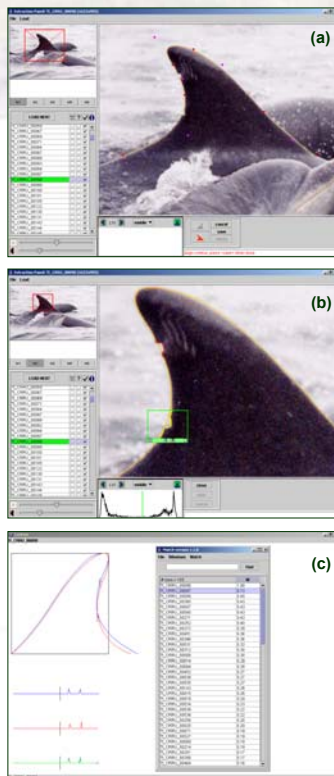


Figure 1 (left). Showing (a) the first stage of the *FinEx* dorsal extraction program - note the control points which are moved around until the perfect outline of the virtual (undamaged) fin is traced; (b) the second stage in the extraction process. Here the fine extraction of the nicks is defined by dragging a rectangle (the extraction frame) around the feature. The boundary pixels are subsequently determined by the software and a threshold level redefined by the user (by moving a slider in the Threshold Panel). Note the upper nick has already been extracted and is shown in red; and (c) the *FinMatch* program which allows the user to select a desired image for comparison against all other extracted images within a designated project file. The results of this analysis are subsequently ranked (by highest match probability) according to a grading system ranging from 1.00 (a perfect match) to 0.00 (no match).

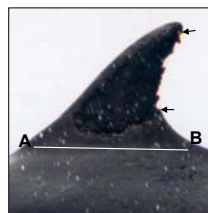


Figure 2 (above). An example of a *Tursiops* dorsal fin showing multiple serrations of the trailing edge. The arrows refer to the extraction procedure and the horizontal line shows the base position of the dorsal fin.

## Discussion & Recommendations

The Europhlukes software proved particularly useful in the present study for the detection of integral errors within the established archive, and its application is likely to be equally valuable to any new study for the eradication of comparable errors in the first place. Although a laborious task for archives containing in excess of 150 marked individuals, once extractions have been made, the software serves as a useful tool for photo-ID studies in addition to existing methods of organisation, ranking and retrieval. That saying, user discretion and experience of the study animals remain of utmost importance in the identification process, especially where animals acquire new nicks between encounters. Furthermore, since not all recognisable dolphins in a population bear distinguishing dorsal edge marks, procedures for the retrieval of individuals displaying other features, such as unusual fin shapes, or unique pigmentation patterns, would be a useful addition to this existing software.