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NEWS AND COMMENTS

Rapid high-quality imaging of fishes using a flat-bed scanner

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Photography has played an increasingly important role in fish taxonomy, systematic studies, aquarium literature, field guides, and fisheries literature. Images are a particularly important aid in taxonomy for recording pigmentation patterns as well as meristic and morphometric characteristics. Photographs have also been used for estimating fish weights and lengths (Baugh 1982).

Several techniques have been developed for photographing preserved fish specimens (Randall 1961; Emery and Winterbottom 1980; Flescher 1983; Holm 1989). The most popular technique (Emery and Winterbottom 1980) involves the use of an inclined glass plate inside an aquarium to stabilize the specimen and artificial lighting. This setup has two disadvantages; the imaging of specimens is slow, and small fish specimens are sometimes difficult to position between the inclined plate and the aquarium glass.

The value of digital images, termed "e-Vouchers" (Monk and Baker 2001), in documenting both specimens that are too large to retain, and in providing broader access to smaller specimens, is becoming an important data layer in modern natural history collections. However, the growing scale of biological inventories means that strategies are needed to gather high-quality images rapidly and cost-effectively. There is also an increasing trend for modern genetic resource collections to maintain online catalogs, the most elaborate of which host digital images illustrating various aspects of organismal morphology. For example, the international Fish Barcode of Life campaign (http://www.fishbol.org) aims to establish a comprehensive reference library of DNA barcodes for all fish species within the next 5 years, a task that will require the sequence analysis and imaging of some 500,000 specimens.

Here we report a simple, inexpensive technique for imaging small- to medium-sized fishes by using a standard flat-bed photo scanner (HP Scan Jet 4850), clear transparency film for copiers, a ruler, and a color bar (total cost approximately 200 US$). Figure 1 shows the workplace used for imaging frozen fish specimens up to 25 cm in length.

The transparency film was first placed on the scanner surface, followed by one to five specimens. We employed transparency film to protect the scanner surface from exposure to water, preservation liquid, and secretions from the fish skin. Its use also avoids cross-contamination of samples, which might pose a problem for subsequent genetic analysis.

By convention, lateral photographs of the left side are most useful for taxonomic purposes. Because size and coloration are often important for identification, a color bar and ruler were included in every scan. To ensure optimal illumination, a brushed glass plate was placed above the fishes. To avoid reflections, most of the water or preservation liquid was removed from the fish skin before imaging.

Scans were taken with different resolutions ranging from 300 to 1,800 dpi. The resulting images were processed with Adobe®Photoshop®6.0. Single-specimen images were cut (4 × 3 formats) from the raw scan. The color bar (scaled down) and the ruler areas in the scan were cut and pasted as additional layers into every single image. The layers were merged and every image saved as high-resolution file in the tiff-format (for archival) and a reduced version (down-scaled to 300 dpi) as jpeg-file.

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Fig. 1 Workplace and equipment used for scanning small, frozen fishes

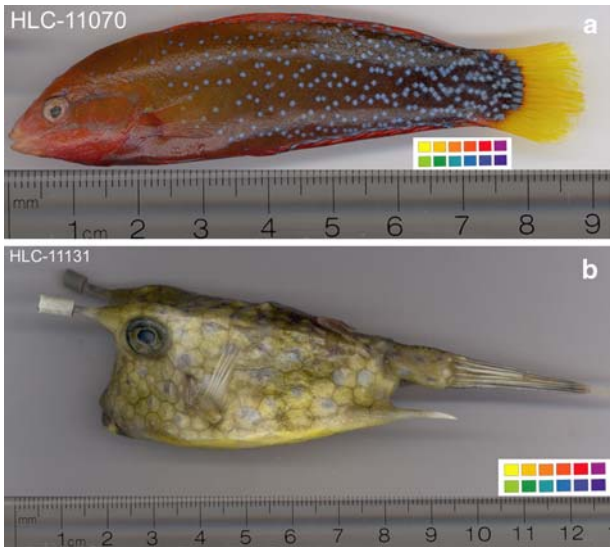

Fig. 2 A freshly frozen yellowtail coris (*Coris gaimard*) (**a**) and a longhorn cowfish (*Lactoria cornuta*) (**b**). Scans were made with 600 dpi resolution. Images were processed with Adobe®Photoshop®6.0

Although most modern scanners can deliver very high resolutions, there is a trade-off between resolution and duration of the scan. We found that scans at 600 dpi provided images with adequate resolution as well as much depth of field and sense of texture (Fig. 2). Beside the speed of this method (20–30 specimens per hour), flat-bed scanners deliver homogenous illumination and high color fidelity. Because bright colors fade rapidly after death, photographs should be taken soon after collection and prior to fixation if possible. However, to facilitate both genetic analysis and digital image capture, whole specimens can be frozen instead.

While whole body lateral views are essential, more detailed photographs of diagnostic features, such as the head, are critical for the identification of some species. Because a 600-dpi scan provides a good source for image enlargements of taxonomically important features, it is valuable to store raw high-resolution scans as well as lower resolution lateral images. The latter could serve as a database reference in museum collection indices or as an e-Voucher for DNA barcodes.

Standard scanners cannot fully substitute for conventional photography because they are not portable and because their bed sizes restrict work to specimens ranging in size from 1–25 cm. However, they do provide a rapid method to gain high-quality digital images for the approximately 70% of extant fish species that fall into this size range. Since scanners are far more robust and far less expensive than digital cameras offering similar performance and because operating costs are low (0.1 US$ per specimen for transparency film and background paper), this technology is particularly suitable for organizations with a limited budget. Moreover, scanners also provide an effective way for large specimen collections to quickly generate high numbers of digital images for online catalogues and databases.

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