

Supplementary Material



Figure S1: Examples of poor quality (top row) and good quality (bottom row) images from the pool frog image collections, based on human-eye discernibility of unique identifying features of individuals.

Technical details of the algorithms used in the study

Wild-ID

Wild-ID (Bolger et al., 2012; http://www.teamnetwork.org:8080/Wild.ID/download.jsp) uses the Scale Invariant Feature Transform (SIFT) algorithm which recognises and compares key features in an image collection and calculates a similarity score for each in respect to other images in the same collection (Elgue, et al. 2014; Halloran, et al. 2014; Matthe, et al. 2017). The application presents the top most likely image-matches based on this similarity score for the user's final confirmation or dismissal. For our study, we considered only the image with the highest match-likelihood score as correct or not. . Successful match rates for each collection were calculated from the program output.

I3S-Spot

I3S-Spot (Hartog & Reijns, 2014; http://www.reijns.com/i3s/download/I3S_download.html) uses the Speeded-Up Robust Features (SURF) algorithm. This requires the user to manually select key feature points within an image from which a 'fingerprint' is created and geometrically analysed (Treilibs, et al. 2016; Sannolo, et al. 2016; Gonzalez-Ramos, et al. 2017; Matthe, et al. 2017). The application then presents the top most likely image-matches based on a calculated similarity score for final confirmation or dismissal. For our study, we considered only the image with the highest match-likelihood score as correct or not. The I3S-Spot algorithm requires a minimum of three reference points and twelve feature points for each image to be initally catalogued. In this study reference points were defined as 1) between the eyes, 2) base of the left dorsal ridge, 3) base of the right dorsal ridge. The spotted/blotched dorsal skin patterns were considered key features. To minimise user effort, the number of feature points used for this study was limited to twelve (Fig. S2).

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Figure S2: a) An example of reference points (between the eyes, base of the left dorsal ridge and base of the right dorsal ridge) and b) key features that are identified during image processing when using I3S-Spot.



Figure S3: Schematic summary of methods for comparing two image-matching software algorithms(Wild-ID and I3S-Spot), including pre-sorting, processing, and data analysis phases.

Table S1: Summary of image collections used in this study, excluding those rejected due to lack of human-eye discernibility of unique identifying features. Known number of matches refers to those identified as correct matches by a species expert prior to analysis by I3S-Spot and Wild-ID. *These values are calculated based on mean number of images matches from the three repeats.

Dataset year	Age	Sex	Total no. of images	Known no. of matches	Mean no. matches Wild-ID (±SD)*	Mean no. matches I3S-Spot (±SD)*
2010	Adult	Female	29	9	6.7 (0.5)	3.7 (1.2)
	Adult	Male	29	9	5 (0)	4.3 (1.2)
	Juvenile	Unknown	24	8	1.7 (0.5)	2.7 (0.9)
2011	Adult	Female	27	11	3 (0)	5.3 (2.1)
	Adult	Male	28	12	2 (0)	6.3 (0.5)
	Juvenile	Unknown	0	0	0	0
2012	Adult	Female	30	0	6 (0)	6 (1.6)
	Adult	Male	35	12	4.3 (0.5)	9.3 (0.5)
	Juvenile	Unknown	35	15	4.3 (0.9)	7.3 (0.5)
2013	Adult	Female	28	10	4 (0)	4.3 (0.9)
	Adult	Male	28	11	2.7 (0.5)	6.7 (0.5)
	Juvenile	Unknown	0	0	0	0
2014	Adult	Female	24	8	2.3 (0.5)	5.3 (0.5)
	Adult	Male	36	16	7.3 (0.5)	8 (0.8)
	Juvenile	Unknown	27	11	5.7 (0.5)	6.3 (0.9)
2015	Adult	Female	0	0	0	0
	Adult	Male	0	0	0	0
	Juvenile	Unknown	0	0	0	0
2016	Adult	Female	23	9	5 (0)	5 (0)
	Adult	Male	21	8	4 (0)	5.7 (0.5)
	Juvenile	Unknown	0	0	0	0
2017	Adult	Female	18	7	3 (0)	5 (0.8)
	Adult	Male	23	9	4.7 (0.5)	5.3 (0.5)
	Juvenile	Unknown	0	0	0	0