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Computer-Matching of Sea Otter (*Enhydra lutris*) Nose Scars: A New Method for Tracking Individual Otters

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Abstract

The Sea Otter Nose Matching Program, or *SONMaP*, was developed to identify individual Alaskan sea otters using a blotch-pattern recognition algorithm based on the shape and location of lightly colored nose scars. The program ranks all the images in order of similarity, most similar first, with six images displayed at a time. The user then selects the final match. In this study, the performance of the *SONMaP* program was tested using images of otters that had been previously matched by visually comparing every otter in a catalog of 1,638 animals. After running the images through *SONMaP*, they were classified as BEST, AVERAGE, or WORST based on whether the correct match was within the first 10%, 11 to 50%, or 51 to 100% of images in the catalog, respectively. In 48.9% of the previously visually matched images, the program accurately selected the correct image in the first 10% of the catalog, which compares favorably with other computer-assisted photo-identification studies of marine mammals.

Key Words: sea otter, *Enhydra lutris*, photo-identification, computer-assisted matching, *SONMaP*, Alaska

Introduction

Recognition of individual animals enables detailed studies of movement patterns, foraging, life histories, and survival, and it is important for understanding the ecology and behavior of species (Würsig & Jefferson, 1990; McGregor & Peake, 1998). Artificial marks, such as tattoos, dyes, brands, colored or numbered tags, and telemeters (radio and satellite), have been the primary ways of identifying individual animals. However, these systems require that the animal be captured, which may stress or injure the animal and/or the researcher, and may modify the animal's behavior (McGregor & Peake, 1998). Increasingly, researchers are using natural color patterns, scars, and other features to identify animals in a wide range of taxa for which capture and marking is not desirable or logistically feasible (Langtimm et al., 1998). For example, sperm whales (*Physeter macrocephalus*) can be identified from marks on the trailing edges of the flukes (Arnbom, 1987; Whitehead et al., 1997); boat propeller-inflicted scars can be used to identify sirenians (Langtimm et al., 1998); and some pinnipeds can be identified by scars as well as by unique pelage patterns (Forcada & Aguilar, 2000; Forcada & Robinson, 2006).

Foott (1970) first suggested that female sea otters could be identified by nose scars incurred during copulation. Several other studies have since used this method to a limited extent (Calkins & Lent, 1975; Loughlin, 1980; Garshelis, 1983). Gilkinson et al. (2007) was the first to use nose scars to identify individual Alaskan sea otters to study their movements and habitat associations. In that study, the size, shape, and location of nose scars were used to distinguish individuals. Other characteristics, such as pelage color around the head, length of vibrissae, tooth discoloration, and other marks or scars, were also used. Image quality based on clarity, lighting, and contrast; visibility of the nose; and distance to the animal affected the ability to match animals. Each image was then visually compared to every other image that had been previously recorded in a catalog. In a catalog of 1,638 images, a single match required several hours of effort.

Computer-assisted matching programs have been developed for several cetacean species, including bottlenose dolphins (*Tursiops truncatus*), humpback whales (*Megaptera novaeangliae*), and southern right whales (*Eubalaena australis*). Coded descriptions of identifying features, such as the trailing edge of dorsal fins, fluke pigmentation patterns, or body patterns of callosities, were scored on digital images, then ranked against images in a catalog (IWC, 1990). No computer-assisted matching program had been developed previously for use with sea otters. In this study, the performance of a new program, the Sea Otter Nose Matching Program (*SONMaP*), is described. *SONMaP* uses blotch-pattern recognition algorithms to match the shape and location of lightly colored scar tissue in relation to normal black pigmentation of sea otter noses.

Materials and Methods

Digital Imaging of Sea Otters

This study was part of a long-term research program investigating the behavior and ecology of sea otters in Alaska (Gilkinson et al., 2007). The study area was Simpson Bay (*ca* 60.6° N, 145.9° W), located in northeastern Prince William Sound, Alaska (Figure 1). It is approximately 21 km^2 in area and is currently used during the summer by 100 to 150 sea otters, including adults, subadults, and pups (Gilkinson et al., 2007).

Digital images of sea otters were taken from June to August of 2002 and 2003 from a 6-m skiff using methods described by Gilkinson et al. (2007). The research team was composed of a driver, photographer, recorder, spotter, and GPS operator. Images were taken with a Nikon D1H digital camera with an 80- to 400-mm image-stabilized telephoto lens. When an otter was sighted, the skiff driver approached the animal slowly while the photographer attempted to obtain a frontal image of the sea otter's face, usually at a distance of about 30 m. Contact was maintained with the animal until either the photographer expressed confidence in obtaining a good image or the otter actively avoided the boat.

Image-Identification Analysis

The image-identification method was believed to work for individual recognition because sea otters accumulate scars on their nose, which leave a discoloration of pink or white, rather than the natural black skin color. These scars are acquired over a sea otter's lifetime from aggressive interactions between males, or during copulation when the male bites the female's nose to hold her in place for mating.

A catalog was created for the 806 images of sea otters taken in 2002, which was later combined with the images taken in 2003 to make a catalog of 1,638 images of otters (Gilkinson et al., 2007). The images were evaluated for quality after each survey using *Adobe Photoshop*, Version 7.0 (Adobe Systems, San Jose, CA, USA). One to four of the best images (based on proximity, sharpness, and head orientation) of each individual were cropped

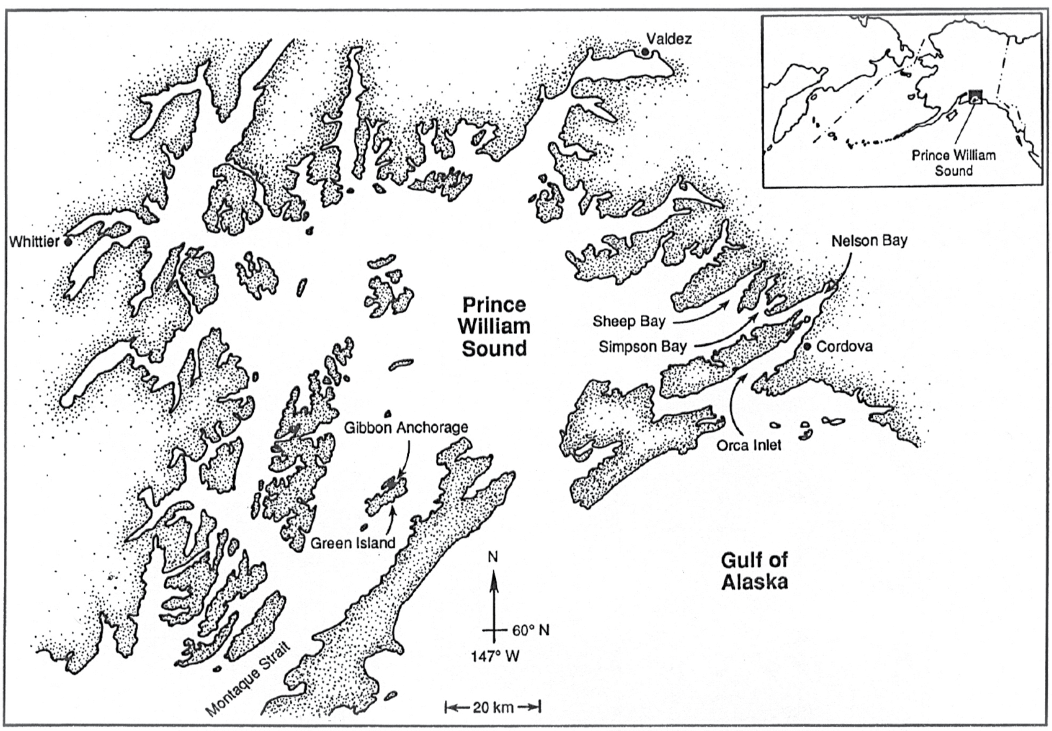

Figure 1. Map of Prince William Sound, Alaska, showing the location of Simpson Bay where digital images of sea otter noses were taken for this study

to isolate the face from the rest of the image. Then, two researchers independently matched sea otters in these images by visually comparing them with all other images in the catalog, a process that took many hours. Only those matches identified by both individuals were used to assess the computer-assisted matching program. Ninety-six images (11.9%) were visually matched from the 2002 catalog, and 186 images (11.4%) were visually matched from the combined 2002-2003 catalog.

In our analysis, we used the images of these previously matched otters (186 in total) to test the performance of *SONMaP*. The matching program, which uses a blotch-pattern recognition algorithm based on the shape and location of lightly colored nose scars, was developed by one of the authors (G. Hillman). The nose in each image was first isolated using *Adobe Photoshop*, Version 7.0. Then, using *SONMaP*, the location of the pink or white scar tissue on the nose, in relation to the normal black tissue, was interactively marked with a computer cursor. A clustering algorithm then classified all points on the nose as scarred or not, based on similarity in intensity and color to the marked points. Three points at the center-top and extreme right and left sides of the nose were marked interactively to define the boundaries, and these points were used to guide an affine transformation which converted the nose image to a standard lozenge shape and then digitally normalized this shape to correct it for a frontal orientation. Each sea otter nose image was ranked based on quality (Table 1; Figure 2) and distinctiveness (Table 2; Figure 3) of the scars. The matching of any two images was accomplished through *SONMaP* by superimposing and subtracting the normalized nose images. The degree of similarity of two images was computed as the sum of the pixel-wise intensity values for all pixels that were present within the nose area of both images. When an image was used as a query, it was compared to all other images in the catalog, and the resulting differences were sorted by magnitude. The cataloged images were then presented to the user with the most similar first, and then six images displayed at a time. The operator reviewed the proposed matches and confirmed or rejected the match, paging through the catalog if necessary until a match was found. If no match was found, then the otter was entered into the catalog as a new individual.

The images of sea otters that were matched by *SONMaP* were classified as BEST, AVERAGE, or WORST if a correct match was found within the first 10%, 11 to 50%, or 51 to 100% of images in the catalog, respectively (Table 3). Since all of the sea otters used in this analysis had been visually identified previously, all images fell within one of these three classifications.

Contingency table analysis (Conover, 1999) was used to determine whether the distribution of images in each of the four quality and the five

Table 1. Rating system for normalized quality of Alaskan sea otter nose images

Rating[a]	Criteria
Q4	Excellent quality image. Background area is clear and dark (good contrast). Edges of image are clean, not skewed. No possible glare or water spots are visible.
Q3	Good quality image. May have one to two of the following minor flaws: edges of image are slightly skewed, image is slightly blurred, and a few small possible glare or water spots are visible.
Q2	Poor quality image. Displays all flaws listed in Q3, or one to two of the following: one or two large possible glare or water spots visible, edges have major skews, and image is pixilated; poor contrast.
Q1	Very poor quality image. Image very blurred and pixilated, or image displays more than three of the above flaws.

[a]The rating system is Q1 to Q4, with Q4 indicating the highest quality images (Gilkinson, 2004).

Table 2. Rating system for normalized distinctiveness of Alaskan sea otter nose images

Rating[a]	Criteria
D5	Nose scars are highly distinctive, including a large scar or scar pattern that is evident/distinctive even in a poor quality image.
D4	Nose has at least one distinctive medium-sized scar OR has two or more small or less distinctive scar/identifying features that form a distinctive pattern.
D3	Nose has one small scar/identifying feature of distinctive location or shape OR two or more very small scars forming a distinct pattern.
D2	Nose has some scars, but they are indistinct.
D1	There are no nose scars or other identifying features.

[a]The rating system is D1 to D5, with D5 indicating the most distinctively marked individuals.

Table 3. Classification criteria for Alaskan sea otter nose images

	Classification percentage limit	2002 catalog (806 images)	2002-2003 catalog (1,638 images)
BEST classification[a]	Matched within first 10% of catalog	Matched within images 1-81	Matched within images 1-164
AVERAGE classification	Matched within first 50% of catalog	Matched within images 82-403	Matched within images 165-819
WORST classification	Matched within first 100% of catalog	Matched within images 404-806	Matched within images 820-1,638

[a]Classification of BEST/AVERAGE/WORST based on the match position in catalog

distinctiveness categories was uniform regardless of the BEST/AVERAGE/WORST classification. Due to small sample sizes, exact *p*-values were calculated utilizing a Monte Carlo simulation approach using *StatXact* (Cytel Software Corporation, 1999). Standardized residual plots (Lloyd, 1999) were used to determine where the model did not fit these data. Significance was assessed at the $\alpha = 0.05$ level; tendencies were assessed at the 0.10 level of significance.

Results

Normalized image quality and normalized image distinctiveness values were tested separately for both catalogs (2002 catalog alone and the 2002-2003 combined catalog; Tables 4 to 7). The first null hypothesis was that the distribution of images in the quality categories for each catalog was uniform regardless of BEST/AVERAGE/WORST classification:

$$H_o: P(i,j) = 0.25 \text{ for } i = 1\ldots4 \text{ and } j = 1\ldots3$$

This null hypothesis was rejected (2002: $\chi^2 \geq 47.4$, $p = 0.00005$; 2002-2003: $\chi^2 \geq 21.7$, $p = 0.00995$) for both catalogs. Based on the standardized residuals, there were significantly more Q4 images and fewer Q1 images in the 2002 BEST classification, and fewer Q1 images in the 2002 AVERAGE classification. There was a tendency for more Q1 images to occur in the 2002 WORST classification (Table 4). In the 2002-2003 combined catalog, there were significantly fewer Q1 images

Table 4. Normalized quality of Alaskan sea otter nose images; results for 2002 catalog (N = 96).

Data – Observed matrix				
2002	Quality			
	Q1	Q2	Q3	Q4
BEST	1	12	17	32
AVERAGE	0	9	9	7
WORST	5	1	3	0
Expected matrix				
2002	Quality			
	Q1	Q2	Q3	Q4
BEST	15.5	15.5	15.5	15.5
AVERAGE	6.3	6.3	6.3	6.3
WORST	2.3	2.3	2.3	2.3
Standardized residual matrix				
2002	Quality			
	Q1	Q2	Q3	Q4
BEST	**-3.68**	-0.89	0.38	**4.19**
AVERAGE	**-2.50**	1.10	1.10	0.30
WORST	*1.83*	-0.83	0.50	-1.50

Note: Bold values indicate significant standardized residuals ($\alpha = 0.05$), and italicized values signify standardized residuals that indicate tendencies ($\alpha = 0.10$).

Table 5. Normalized distinctiveness of Alaskan sea otter nose images; results for 2002 catalog (N = 96).

Data – Observed matrix					
2002	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	3	8	15	19	17
AVERAGE	2	5	6	9	3
WORST	4	4	1	0	0
Expected matrix					
2002	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	12.4	12.4	12.4	12.4	12.4
AVERAGE	5.0	5.0	5.0	5.0	5.0
WORST	1.8	1.8	1.8	1.8	1.8
Standardized residual matrix					
2002	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	**-2.67**	-1.25	0.74	*1.87*	1.31
AVERAGE	-1.34	0.00	0.45	*1.79*	-0.89
WORST	*1.64*	*1.64*	-0.60	-1.34	-1.34

Note: Bold values indicate significant standardized residuals ($\alpha = 0.05$), and italicized values signify standardized residuals that indicate tendencies ($\alpha = 0.10$).

Table 6. Normalized quality of Alaskan sea otter nose images; results for 2002-2003 catalog (N = 186).

Data – Observed matrix				
2003	Quality			
	Q1	Q2	Q3	Q4
BEST	9	26	35	21
AVERAGE	11	24	17	23
WORST	5	4	5	6
Expected matrix				
2003	Quality			
	Q1	Q2	Q3	Q4
BEST	22.8	22.8	22.8	22.8
AVERAGE	18.8	18.8	18.8	18.8
WORST	5.0	5.0	5.0	5.0
Standardized residual matrix				
2003	Quality			
	Q1	Q2	Q3	Q4
BEST	**-2.88**	0.68	**2.57**	-0.37
AVERAGE	*-1.79*	1.21	-0.40	0.98
WORST	0.00	-0.45	0.00	0.45

Note: Bold values indicate significant standardized residuals ($\alpha = 0.05$), and italicized values signify standardized residuals that indicate tendencies ($\alpha = 0.10$).

Table 7. Normalized distinctiveness of Alaskan sea otter nose images; results for 2002-2003 catalog (N = 186).

Data – Observed matrix					
2003	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	6	13	15	34	23
AVERAGE	12	22	11	17	8
WORST	5	4	2	3	6
Expected matrix					
2003	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	18.2	18.2	18.2	18.2	18.2
AVERAGE	14.0	14.0	14.0	14.0	14.0
WORST	4.0	4.0	4.0	4.0	4.0
Standardized residual matrix					
2003	Distinctiveness				
	D1	D2	D3	D4	D5
BEST	**-2.86**	-1.22	-0.75	**3.70**	1.13
AVERAGE	-0.53	**2.14**	-0.80	0.80	*-1.60*
WORST	0.50	0.00	-1.00	-0.50	1.00

Note: Bold values indicate significant standardized residuals ($\alpha = 0.05$), and italicized values signify standardized residuals that indicate tendencies ($\alpha = 0.10$).

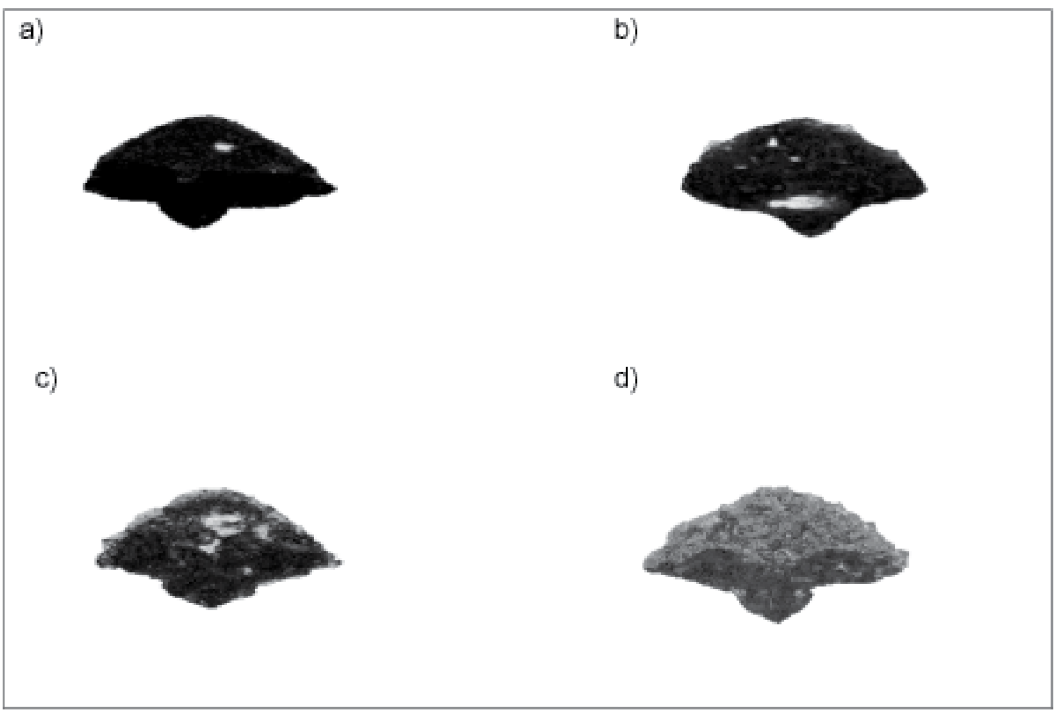

Figure 2. Normalized Alaskan sea otter nose images of differing degrees of quality: a) Q4, b) Q3, c) Q2, and d) Q1

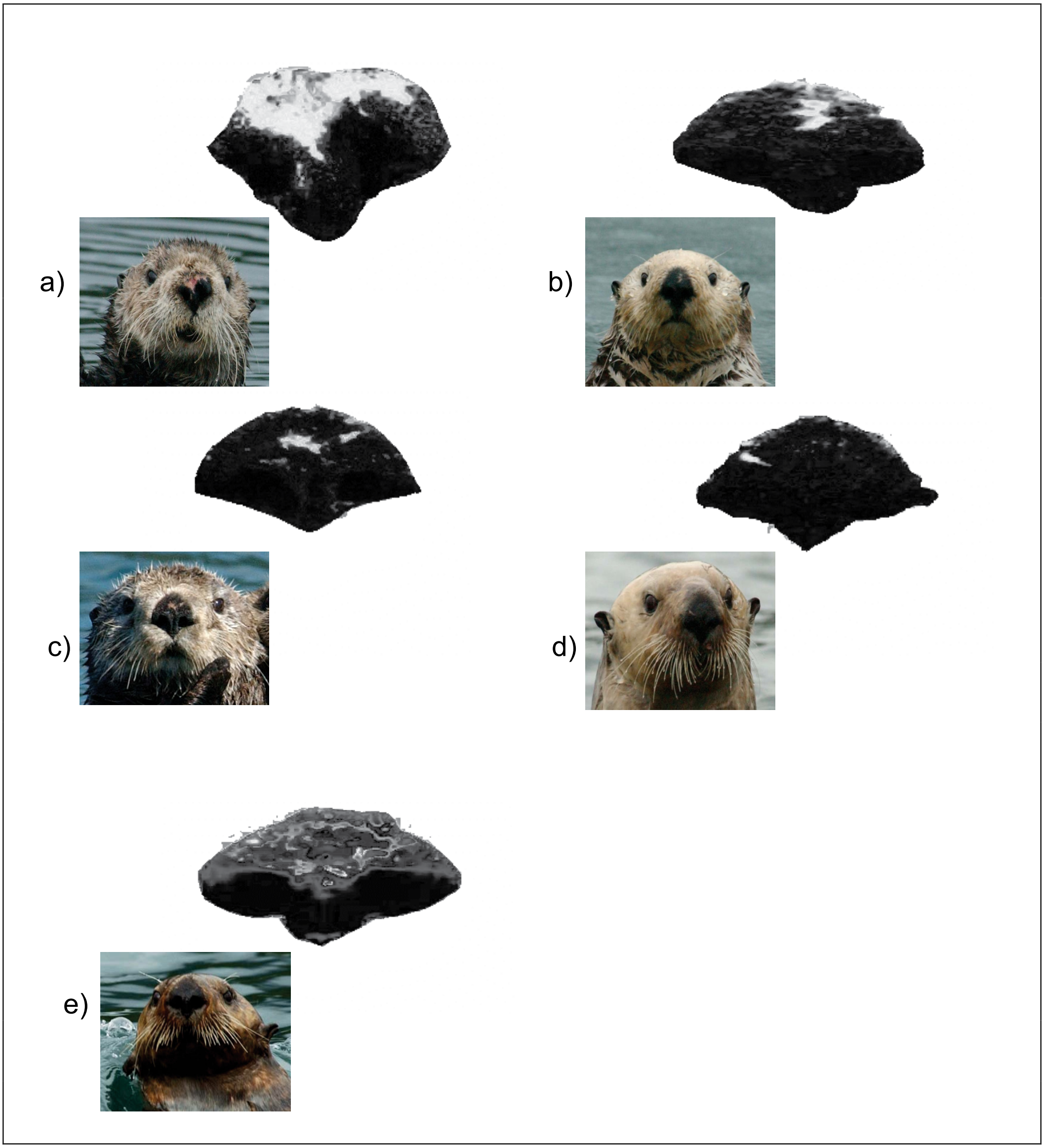

Figure 3. Normalized Alaskan sea otter nose images of differing degrees of distinctiveness: a) D5, b) D4, c) D3, d) D2, and e) D1

and significantly more Q3 images in the BEST classification. The AVERAGE classification had a tendency for fewer Q1 images (Table 6).

The second null hypothesis was that the distribution of images in the distinctiveness categories for each catalog were uniform regardless of BEST/AVERAGE/ WORST classification:

$$H_o: P(i,j) = 0.20 \text{ for } i = 1..5 \text{ and } j = 1..3$$

Again, this null hypothesis was rejected (2002: $\chi^2 \geq 29.8$, $p = 0.00275$; 2002-2003: $\chi^2 \geq 37.2$, $p = 0.00060$) for both catalogs. The standardized residuals in the 2002 BEST classification had significantly fewer D1 images, and a tendency for more D4 images. The 2002 AVERAGE classification had a tendency for more D4 images, while the 2002 WORST classification had a tendency for more D1 and D2 images (Table 5). In the 2002-2003 combined catalog, the BEST classification had significantly fewer D1 images and significantly more D4 images, and the AVERAGE classification had a tendency for more D2 images and a tendency for fewer D5 images (Table 7).

For the 2002 catalog, the true match was included in the BEST category for 69.6% of the previously visually matched images. For the 2002-2003 combined catalog, the true match was included in the BEST category for 48.9% of the previously visually matched images. Of the images in the BEST category, 28.2% of the correct matches were included in the first nine images listed by *SONMaP* in the 2002 catalog and 16.1% for the combined 2002-2003 catalog.

On average, for the 2002 catalog, a match was confirmed within the first 113 of 806 images (first 14%) selected by the software. For the combined 2002-2003 catalog, a match was confirmed, on average, within the first 328 of 1,638 images (first 20%) classified initially. By comparison, a match was found, on average, within the first 50% of each catalog (403 out of 806 images in the 2002 catalog; 819 out of 1,638 images in the 2002-2003 catalog) without the use of *SONMaP*.

For each image, approximately 30 s were needed to visually compare one image with another to ascertain a match. When *SONMaP* was used, an average of 56.5 min (0.9 h) were needed to confirm a match in the 2002 catalog, and an average of 164 min (2.7 h) were needed to confirm a match in the 2002-2003 catalog. Without *SONMaP*, an average of 201.5 min (3.4 h) were needed to confirm a match in the 2002 catalog, and an average of 409.5 min (6.8 h) were needed to confirm a match in the 2002-2003 catalog. On average, it took three times longer to find a match without *SONMaP*.

Discussion

Several computer-assisted identification programs have been developed to identify individual marine mammals from a catalog of images (Whitehead, 1990; Huele et al., 2000; Hillman et al., 2003; Beekmans et al., 2005). As with *SONMaP*, each of these systems used coded descriptions of different anatomical features that were digitally scored and then ranked against images already in the catalog. Currently, there are three computer-assisted photo-identification methods available for cetaceans. *Highlight* (Whitehead, 1990; Beekmans et al., 2005) and *Europhlukes* (Huele et al., 2000; Beekmans et al., 2005) are used to identify sperm whales, while *Finscan* (Hillman et al., 2003) is a program that was developed for identifying delphinids. Individual sperm whales were identified by comparing the markings on the trailing edge of the flukes (IWC, 1990), and individual delphinids were identified by the pattern of nicks and notches found along the trailing edge of the dorsal fin (IWC, 1990; Hillman et al., 2003).

The computer-matching process for each program is similar, although the matching algorithms differ. As with *SONMaP*, each image is compared with those already cataloged. Each method uses a matching algorithm that computes a match coefficient for each comparison (Whitehead, 1990; Hillman et al., 2003; Beekmans et al., 2005). Each program then produces an ordinal list of the best possible matches. The user visually checks the proposed matches and makes a final decision (Hillman et al., 2003; Beekmans et al., 2005).

The *Highlight* and *Europhlukes* programs were both tested using a test set consisting of 592 photographs representing 296 matched pairs of different sperm whales (Beekmans et al., 2005). As with *SONMaP*, a rating system was developed for these images. Each image was assigned a numerical rating of 1 to 5 based on the quality of the image. Each image was also assigned to one of three distinctiveness classes. The distinctiveness of each trailing edge was represented by the number of marks on the fluke. Class 1 included flukes with less than 10 marks; Class 2 included flukes with 10 to 20 marks; and Class 3 included flukes with over 20 marks (Beekmans et al., 2005).

For both methods, the quality of the images and distinctiveness of the marks contributed to the accuracy of the matching program. Of the true matches, 87.6% were included in the top nine images of the ordinal list produced by *Highlight*, and 86.0% of the true matches were included in the top nine matches of the ordinal list produced by *Europhlukes* (Beekmans et al., 2005).

Images of animals with greater fluke distinctiveness (more features) were matched more accurately by each method. There were 124 images assigned to Class 1 (least distinctive). Of these images, 51.6% of the true matches were included in the top nine images presented by the ordinal list using *Highlight*, and 57.3% of the images were included using *Europhlukes*. Of the 354 Class 2 (moderately distinctive) images, 82.5% of the true matches were listed in the top nine images presented by *Highlight*, and 78.5% were included using *Europhlukes*. Of the 114 Class 3 (most distinctive) images, 93.0% of the true matches were included in the top nine using *Highlight*, and 94.7% of the true matches were included using *Europhlukes* (Beekmans et al., 2005). With the *SONMaP* system, the true match was included in the BEST category for 69.6% of the 2002 catalog, and for 48.9% of the 2002-2003 combined catalog. Of these images, 28.2% of the matches were included in the top nine for the 2002 catalog, and 16.1% were included in the top nine for the 2002-2003 combined catalog.

Images of dusky dolphin (*Lagenorhynchus obscurus*) dorsal fins were used to test the performance of the *Finscan* system. Each processed dorsal fin image was compared by *Finscan* to each of the 65 other images in one test set. Also, to test the efficiency of the system when using a larger catalog, each image was tested a second time against a catalog of 250 images, and a third time against a catalog of 650 images (Markowitz et al., 2003). The average number of digital images presented by this system before the true match was 4 out of 65, 15 out of 250, and 45 out of 650 images, meaning that the true match occurred within *ca* the first 6% of each catalog (Markowitz et al., 2003). The average number of images presented by the *SONMaP* system before the true match was 113 out of 806, or 14%, of the 2002 catalog, and 328 out of 1,638, or 20%, of the 2002-2003 combined catalog. Overall, *SONMaP* did not perform as well as *Highlight*, *Europhlukes*, or *Finscan* for identifying the true match in the top nine images. This may reflect either inherent differences in the performance of the matching algorithms or the requirement for images of high quality and distinctiveness to appear in the top nine images for *SONMaP*.

As indicated by the results, *SONMaP* can be used to help identify individual sea otters with nose scars from a large catalog. Nose scars in adult females result from injuries received during copulation, when the male grasps the female by the nose and upper lip with its teeth (Foott, 1970; Estes & Bodkin, 2002; Gilkinson et al., 2007). There is little published information on the nose scars in adult males. The source of these scars is most likely the result of antagonistic interactions with other males (R. W. Davis, pers. obs.).

A high degree of stability of natural marks is desirable if they are to be used for identification (Pennycuick, 1978). Neither this study nor the study by Gilkinson et al. (2007) investigated the stability of sea otter nose scars over time; therefore, whether there is stability is unknown. Eight individuals were identified via their natural marks in both years, thus some scars were stable for a least one year (Gilkinson et al., 2007). Since female otters may mate every year (Riedman & Estes, 1990; Jameson & Johnson, 1993), there is the possibility that scars will change annually. Nevertheless, several females with pups were observed without nose scars during the course of this study, which indicates that not all copulations result in scarring.

As with the aforementioned programs, the accuracy of *SONMaP* appears to be highly dependent on the quality of the image and the distinctiveness of the marks. The *SONMaP* system was tested using previously matched images as opposed to only images of higher quality. The image catalogs used in this study were also larger (2002 catalog = 806 total images; 2002-2003 catalog = 1,638 total images) than the catalogs of other matching programs. These factors must be considered when comparing the performance of the *SONMaP* system with other computer-assisted matching programs.

The limitations of *SONMaP* are similar to other matching programs. Unequal capture probability is a potential problem in sea otter image-identification as well as in other studies (Pennycuick, 1978; Whitehead, 2001; Gilkinson et al., 2007). Certain sea otters are more easily approached by the photographer than others (S. E. Finerty, pers. obs.), which produces better quality images for those individuals (IWC, 1990). The matching of images is not only influenced by image quality but also by the method used, the distinctiveness of the marks, and the user (Carlson et al., 1990; Beekmans et al., 2005). The most likely sources of error to the system are loss or changes of the original marks, which can lead to a known individual being identified as a new individual. Major changes in marks can also lead to false positives in which multiple individuals are identified as the same individual (Langtimm et al., 1998). However, the *SONMaP* catalog is constantly updated with the most recent images of each individual. Therefore, subtle changes in nose scars can be tracked over time, allowing the operator to correctly identify known individuals.

SONMaP is a user-dependent program. As with other programs, the user must assign descriptions of marks and thereby decide how the marks should be interpreted. If the images are to be processed over a number of years, it is likely that input for the matching program will be generated by different users. The more decisions that are made by the user, the higher the probability of inconsistency and error (Beekmans et al., 2005). A user training program would increase consistency in the use of *SONMaP* and other matching programs.

With images of high quality and distinctiveness, the performance of *SONMaP* was similar to that of other matching software designed and tested for use with cetaceans. However, the quality of the raw and normalized images and the distinctiveness of the nose scars greatly influenced the accuracy of the *SONMaP* program. *SONMaP* did perform well enough to provide significant assistance in the process of image-identification by reducing the time needed to match sea otters within a catalog by 67%, and it can be used in the field. Until more information is obtained on the stability of sea otter nose scars, *SONMaP* may be most useful for identifying sea otters on an annual basis. However, it may be possible to identify some sea otters, especially adult males, over longer periods of time.

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