Photo-ID in Lake Saimaa - best practices for current and future use

Photo: UEF

Action A3: Remote sensing approaches as a novel monitoring tool for ringed seals

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Introduction

Photo-identification (Photo-ID) is a study method that identifies specific permanent physical characteristics, which are visually recognized to be unique for an animal individual. Globally it is an increasingly important non-invasive tool for monitoring and studying many wild animal species in both terrestrial and marine habitats. Also ringed seals (*Pusa hispida*) have permanent, distinctive fur patterns enabling the individual identification throughout their lifespan (Koivuniemi et al. 2016) (Fig 1). Systematic photo identification monitoring of Saimaa ringed seals (*P. h. saimensis*) has been conducted since 2010 in the main breeding areas and since 2016 around the whole Lake Saimaa (Koivuniemi et al. 2016, 2019).

Figure 1. Permanent pelage patterns enable identification throughout the ringed seal's lifespan. The arrows are showing the same fur pattern of the female (Phs196) photographed during different years.

Photo identification of Saimaa ringed seals have been proven to produce high quality data on the whole population. The data can be utilized when studying individual movements (Biard et al. 2022), capture-recapture population estimates (Koivuniemi et al. 2019), molting patterns (Biard et al. 2022, Niemi et al. 2022, 2023), reproductive rates, health, social network (fig. 2), site fidelity (Koivuniemi et al. 2019, Biard et al. 2022), usage of the artificial nests (Action D2) and disturbance and predation pressure (Action D2). In the future, combining Photo-ID and genetic data provides possibilities to estimate genetic heritage and parentage relationships of the Saimaa ringed seal population. The Photo-ID data has been used also to help choose suitable individuals for translocations (Action C1) and monitor the individuals in their new habitats (Action D1). Boat based camera surveys are conducted by researchers and trained volunteers. Around 20 people with their own area of responsibility have been conducting surveys in recent years. This action utilizes the established network of volunteers in Metsähallitus Actions. In addition, game camera traps have been used successfully, while they are cost-effective and user-friendly approaches to get large image datasets. Our findings have encouraged that Photo-ID can be applied as a potentially valuable tool also for other rare seal stocks and it is now utilized in studies of Baltic ringed seals (*P.h. botnica*) in the Archipelago Sea (Action A3.)

Figure 2. Photo-ID also reveals (A) social networks, when multiple seals using the same sites are photographed and identified and (B) reproduction rates (mother-pup pair) of the Saimaa ringed seal.

Ethics/Overview of legislation for conducting photo-identification of Saimaa ringed seals

The endangered Saimaa ringed seal is included in the Annex IV species of European Commission´s Habitat Directive (Council Directive 92/43/EEC). According to the directive and national law, deterioration or destruction of breeding sites or resting places are prohibited. Although photo identification is considered as a non-invasive method, it cannot be overruled that photographing the seals during their molt in spring can cause disturbance (Niemi et al. 2013). Therefore, the photo-ID research is permitted by the Finnish environmental authorities ELY-centers. Furthermore, guidelines to minimize any disturbance are given to the photographers as well as to the public (South-Savo ELY center 2021, see also citizen science).

Citizen science

The seals live in proximity to humans in Lake Saimaa and some degree of seal watching is also taking place. A platform to receive seal photos from the public was created in 2016 together with WWF Finland (https://norppagalleria.wwf.fi/) and Metsähallitus. WWF Finland also launched a live camera (https://wwf.fi/luontolive/norppalive/) streaming popular molting sites of the seals for the public in 2016 that also promoted the platform to collect public data. This "wildlive" camera has been a huge success since then and collected millions of watchers. Data received through the public has increased from 20 to over 220 sightings per year. Notably several of the same people tend to submit seal photographs yearly. The original platform however was not the most user friendly and therefore it was updated and a new version was launched in spring 2023 by WWF Finland (https://wwf.fi/norppagalleria/) together with the renewal of the data management system (see

below). In the current version the public can search a certain seal and see one photo of it, the time frame the seal has been observed, the water basins it has been photographed, the sex of the seal, year of birth if known and how many observations have been made. Additionally, there is a link for submitting public seal observations on the website. The link forwards the user to the Seal Codex (see data management) seal sighting report form or to e-mail address photo-id(at)uef.fi. In the current form the Seal Codex is in English only and it serves many different species. Obligatory fields for observation submission include image upload, date, and region. Furthermore, researchers are hoping to receive accurate location info, photographer name and contact info. Same info can be sent via e-mail.

Data management

At the beginning of the data collection a data management system Discovery (Gailey & Karczmarski 2012) was used. After launching the citizen science data collection in 2016, the data management was moved to a platform of Wildbook (https://www.wildbook.org/doku.php) based catalog (https://norppagalleria.wwf.fi), where the data collection from the public could be combined. In 2022, the system was renewed to Seal Codex (https://seals.wildme.org/) that includes the HotSpotter recognition program. Seal Codex is a free online platform for multiple seal species. The system serves researchers, however the public view was left out, although the public can send their observations via Codex (see citizen science). Benefits of these data management systems are that the data is available for any user with the rights and all sorts of data enquiries are possible through the system. The precise locations of seal observations are visible only to the user who uploaded the observation into the program and to the user who has entered into a collaboration agreement (researchers). The seal sites are protected in case of endangered Saimaa ringed seal. Public viewers can only see the water basin where the observations have been made. The Seal Codex is being developed to serve better the wanted features together with researchers and developers. In addition to the online platforms, the data is being saved on hard disks which are stored at the University of Eastern Finland. When the data management system is completed, it would be desirable if it would stay as a permanent solution for future usage.

Identification procedures

During the project, two different methods have been used for identification: manual matching and semi-automated matching to compare the observed seal pelage pattern with the ones stored in the database. With the increasing amount of data, manual identification has been slow and created a need for automatic recognition programs. However, as the seals are photographed in various angles, under varying light conditions, from varying distances and the animal itself is quite flexible in its

present, the task has been surprisingly difficult for recognition programs. The photos need to be segmented to differentiate the seal from the background, light level adjusted and then the recognition of the patterns is possible. So far two AI based programs have been promising: HotSpotter that has been integrated into the data management system Codex and SealID (Nepovinnykh et al. 2022) that was created specifically for Saimaa ringed seals. In the future there are some plans to possibly integrate these methods. Manual identification is still needed and essential for effective identification. The results of the recognition programs also need to be verified manually for accuracy and reliability.

Time window of surveys

The ringed seals spend around 80% of their total time submerged (Hyvärinen et al. 1995). The time window, when most seals are visible for photographing, is molting season in spring, when they haul out on land for extended periods and are typically more reluctant to enter the water (e.g. Niemi et al. 2023). The main molting season peaks around 18-20th of May and the season lasts on average 16 days (Niemi et al. 2022). After this period, the number of hauled out seals decreases drastically when the molting is over. However, there are always individual variations on the timing of molt and some individuals are only reached early or late spring. Therefore, the best option for Photo-ID surveys would be to cover the ice-covered season until around mid-June. However, logistically, especially ice time surveys are often difficult to carry out. Therefore, the recommendation is to collect data systematically so that it is covering at least the main molting season in May, which time window reaches a major part of the study population.

Data collection methods

Combining camera traps and boat-based camera surveys provide more identified individuals and re-sightings than either dataset alone (Koivuniemi et al. 2019). It is known that sampling methods may cause bias into the data due to animal personalities (e.g. Biro et al. 2009). Active boat surveys may capture more bold individuals, whereas passive camera traps may reach more shy individuals too. The boat surveys allow capturing seals that use random haul-out sites as well as sites that are used regularly (Koivuniemi et al. 2019). Camera traps provide a large amount of data that is high-quality, and in many cases ideal for identification and collection of more data on individuals (sex and age class) and surrounding habitat (behavior, disturbance, other species). The recommendation is to use both sampling Photo-ID methods whenever possible. In addition, data gained from the public has been proven to be beneficial, especially from the edge areas and built shoreline habitats. In boat surveys, the recommendation is to use digital single-lens reflex cameras with tele lenses up to 300-400 mm. Hauled out seals are approached with outboard motorboats, and if possible, both flanks should be photographed, as they are not similar in fur patterns.
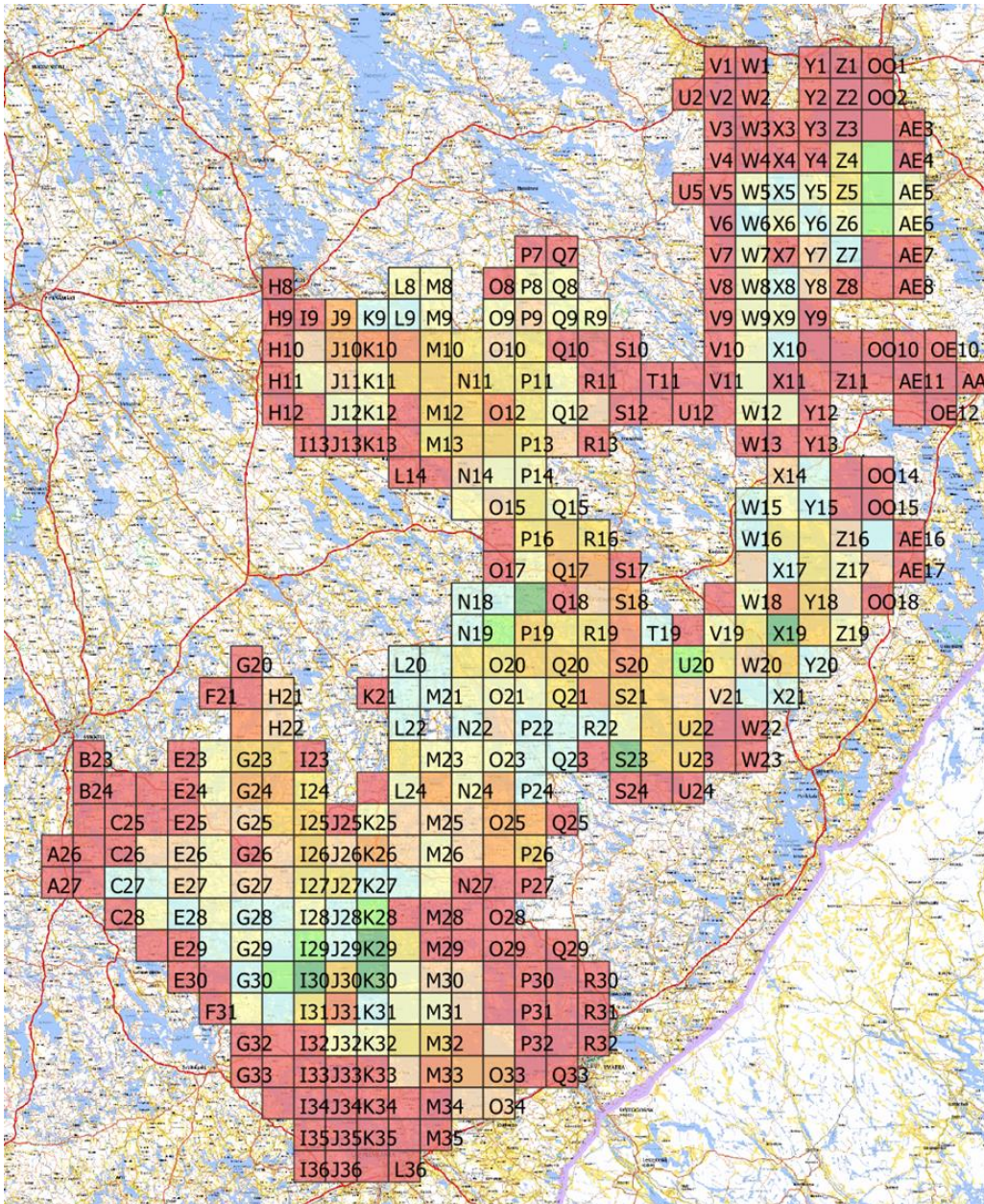
Figure 3. Example of the effort map with codes of 5 km grids. Each grid gets color depending on the number of times passed and how well the grid has been observed.

Basic game camera models operated by batteries are suitable for use. Sending option is not needed, while images are recorded into SD-memory cards (recommended size 6-32 G). Time Lapse mode (for example two pics every ten minutes) is recommended over motion triggering, when it produces most suitable data for analyses and prevents empty images produced by moving vegetation and reduces maintenance needs. The use of camera traps requires permits from the landowners.

To estimate the coverage of the Photo-ID effort, each photographer records the study area and estimation of the coverage (area went through completely, partly, only passing by) of the survey on 5 x 5 km grids (Fig 3). Based on this information, an effort map can be created where each grid is evaluated by how many times it has been visited and how well the whole grid has been surveyed. The information on survey effort is essential, when utilizing the data in population models.

Future perspectives and Continuity

Photo-ID is shown to be a novel tool to population monitoring, especially for sensitive and endangered species like ringed seals that require non-invasive sampling methods. Data has to be, however, systematically collected and analyzed. Varied methods such as camera traps, boat surveys and citizens science can be utilized for gaining the most cost-effective results. For reliable Saimaa ringed seal population estimates, at least a four-year time series of ID-data is needed. Depending on the purpose it must be decided whether every year's effort is necessary or could the yearly area / biannual surveys be possible. Due to the non-invasive nature and multipurpose use of the data, the method should be integrated to the annual monitoring program of Metsähallitus Parks & Wildlife Finland. Furthermore, the data serves as a long-term database for varied research aspects. The methods used in the Photo-ID serve risk estimation purposes as well, for example to collect information on human induced disturbance and predation pressure. Therefore, it is recommended that the Photo-ID data collection should continue also in the future for gaining uninterrupted time series for future research and monitoring.

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