Telemetry of ringed seals. Studies of habitat use.

In order to organise the use of the environment efficiently, it is important to take into account the critical life needs and habitats of wild species. Most of the time it is possible to establish these by means of simple observations or inventories, as the studied species or the signs of their activity can be found in nature. As far as marine mammals are concerned, the regular study methods are insufficient, because most of the time these animals are not observable and, as a rule, the water environment does not allow to see signs of their activity. For semi-aquatic mammals – like the seal – it is possible to describe the part of their life cycle that encompasses the time that the animals spend on plain sight. Previously, direct observations have been used both to describe their distribution as well as habitat use, but such information is not suited as a basis for competent decisions on nature protection or nature usage, as it describes a relatively small portion of the actual whole. Therefore, the specimens have to be studied in the sea environment, which is understandably possible only by individually tagging the animals. To a certain extent, simple tagging methods can be used similarly to, for example, the ringing of birds, or even fur patterns can be used as unique "fingerprints", but a more precise measurement of habitat use patterns requires more complex methods.

Technological development witnessed over the last decades has brought along the development of autonomous monitoring devices. These are basically data recorders that are attached to study objects and are able to process the collected data and transfer it over different radio-based communication tools. These devices are generally known as telemetry or distance-read tags, which – depending on the set task – can be passive microchips, simple radio transmitters or micro-computers able in real time to analyse several data channels simultaneously.

Marine mammals have a three-dimensional living environment and to have a complete picture of it, it is necessary to take into consideration all three dimensions. Data recorder must measure and endure high hydrostatic pressure during deep-sea diving and be able to register also the measurement location over a relatively short period of time that the animal spends on the surface. Therefore, the choice of devices is limited and a data recorder was selected as most optimum for the measurement of habitat use of ringed seals in the Gulf of Riga. A Data recorder gets input from pressure and conductivity sensors and a special GPS-application (FastLoc GPS) that – unlike common devices – enables the calculation of location on the basis of the momentary "vision" of the system's support satellites. Taking into account the position of the Gulf of Riga in the densely populated area, it was decided to transfer data not by satellite-based radio communication, but by ordinary GSM mobile phone communication. By combining the rather simple inputs and linking them with time factor, the entire behaviour of animals can be established in rather great detail. The conductivity sensor lets us measure the time spent in water, the pressure indicates the depth of diving and pressure changes in time also show the diving curve. Between two dives, the GPS adds to the collected data the assessment of location with the precision of 30 metres. The set of data is first analysed by a programme working within the recorder and when the animal arrives in the strong broadcast range, the modem sends the content of the memory card to a land-based server, which stores the data and processes the inputs into "readable" information.

In the present study we aimed at establishing which parts of the sea are vital for the ringed seals to satisfy their different life needs. The functions that were considered most important in the context of the initial task were resting, foraging and breeding and the frequency of migration between the parts of the sea supporting these functions. In outputs, the smallest measurement unit used on the spatial scale was a square kilometre. The measurements were, however, made with a considerably lower resolution, but considering the combination of the data with data from other fields of study on the one hand and the real biological significance of the living environment on the other, the square kilometre is a sufficient measurement unit. Temporally it is also possible to monitor seals with the precision of at least one minute, but based on biological cycles and the purpose of the data, we established that the "resolution" suitable for the model is 24 hours. Thus, the summarised dataset describes the use of each square kilometre of the study area by one seal during one 24-hour period. Such filtration of data allows to take into account sharp irregularities in the representativeness of the data, e.g., if the seal spends a longer period on the border area of such two squares that are determined by calculation, but have identical qualities in natural conditions. If the repeated crossing of the border is registered, it would show a short-time quantitative increase in the use of these areas, whereas in reality both squares have only been used once on the scale of 24 hours. As a result, each square is given its 24-hour seal value with the minimum measured unit of 1. The maximum value depends on the number of individually tagged specimens that visited the square in a chosen time frame (24 hours, a week, a season, absolute survey).

However, tagged specimens represent only a part of the possible behaviour of the whole population and the results measured cannot therefore preclude alternative behavioural patterns. In other words, if no tagged specimens visited a square, it cannot be stated that the ringed seals do not use this particular square. Similarly, the value 0 is not suitable for models with multiple inputs, as it may null also other parameters as a result of multiplications made during the analysis. However, such situation cannot occur in the natural environment. In order to avoid such outcomes, all fields were given a value other than 0 in telemetrical measurements; actual measurements ensured sufficient resolution for further applications.

As a significant result of telemetrical mapping, we succeeded – by employing 20 tags using identical measuring methods – in establishing the sea areas in the Gulf of Riga that are critical for ringed seals, and the temporal changes in the use of these areas for foraging, resting or breeding over an activity period of one year. Spatial data indicate regular migration paths between the resting areas (the Väinameri sea) and the foraging areas (the central and southern parts of the Gulf of Riga), and changes in behaviour and habitat use before and during the winter breeding period. Based on telemetrical data, it was possible to establish the role of sea ice – the seasonally emerging habitat – in the life of these mammals. Spatial movement of the tagged individuals and cyclical changes in their behaviour enable to some extent make generalisations as to what are the habitat requirements of the whole population, because observations revealed similar 24-hour and seasonal cycles. The big similarities detected between different tagged specimens also over the years, on the one hand, and the individual behaviour of animals included simultaneously in one measurement, on the other hand, let us assume that the telemetrical study of ringed seals describes adequately the habitat requirements of the rare species, and enable to consider possible decisions that concern the protection and use of marine resources in the Gulf of Riga region. Similarly important is the contribution to general knowledge, because as much as the

present study drew also from the data collected during previous studies, the enlarged database can also provide input for more specific or basic studies.

Ringed seals are very susceptible to the various effects of human activity and strongly influenced by ice conditions. Both factors have a direct impact on the survival of the species in the longer term.

The ringed seal population of the Gulf of Riga may be considered local. Only occasional animals travel north (the estuary of the Gulf of Finland) from the main stopping sites, and they usually return.

The main ***resting sites*** of the ringed seals are located in the northern part of the Gulf of Riga, especially in the Väinameri sea. Suitable resting sites are limited in number, as the animals prefer sheltered rocky coastal areas close to small islets. Ringed seals use such areas all year round during the ice-free season.

Foraging sites are quite far from resting sites. During foraging trips, the seals travel hundreds of kilometres. Most of the ringed seals spend a lot of time in the deeper central part of the Gulf of Riga. In summer, the main foraging sites are located in the depth of 20 m and 50 m (Figure 1).Towards autumn, the seals spend more time in and around resting sites; their foraging trips are shorter and made to shallower coastal waters (Figure 2).

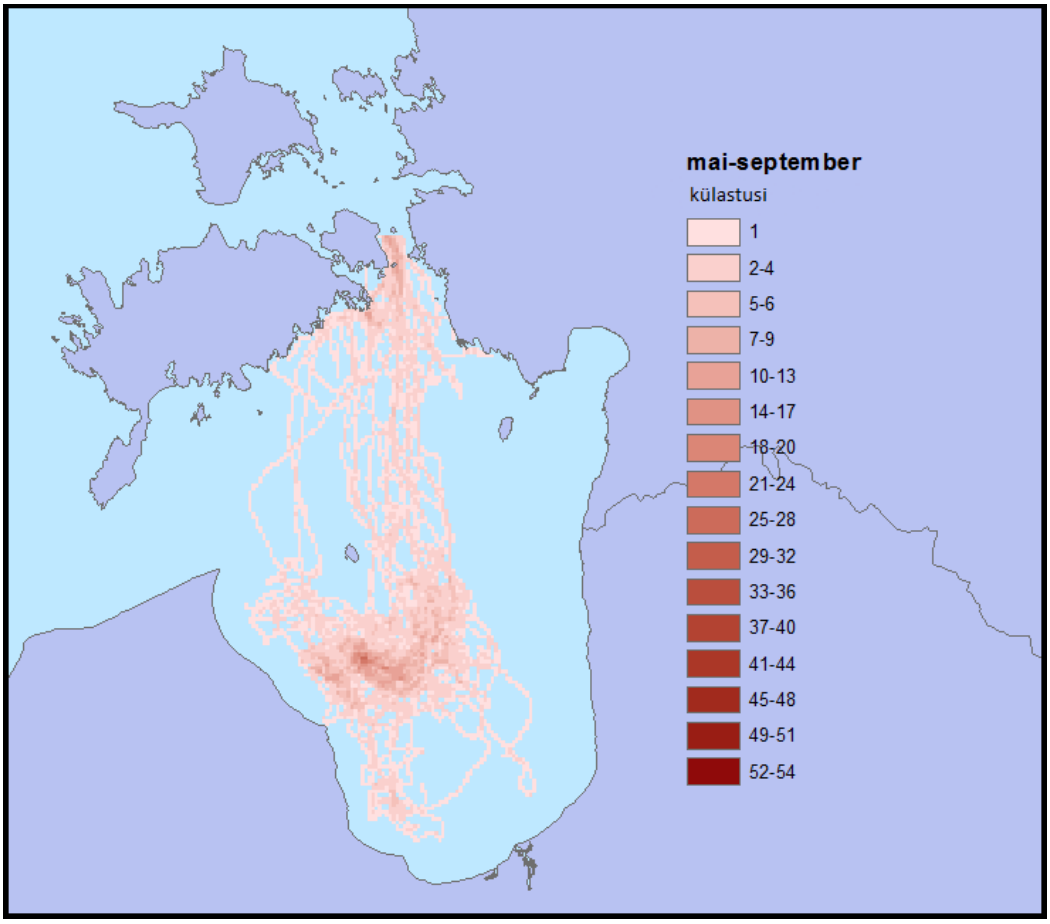

Figure 1. Summer foraging areas of ringed seals and migration between resting and foraging sites.

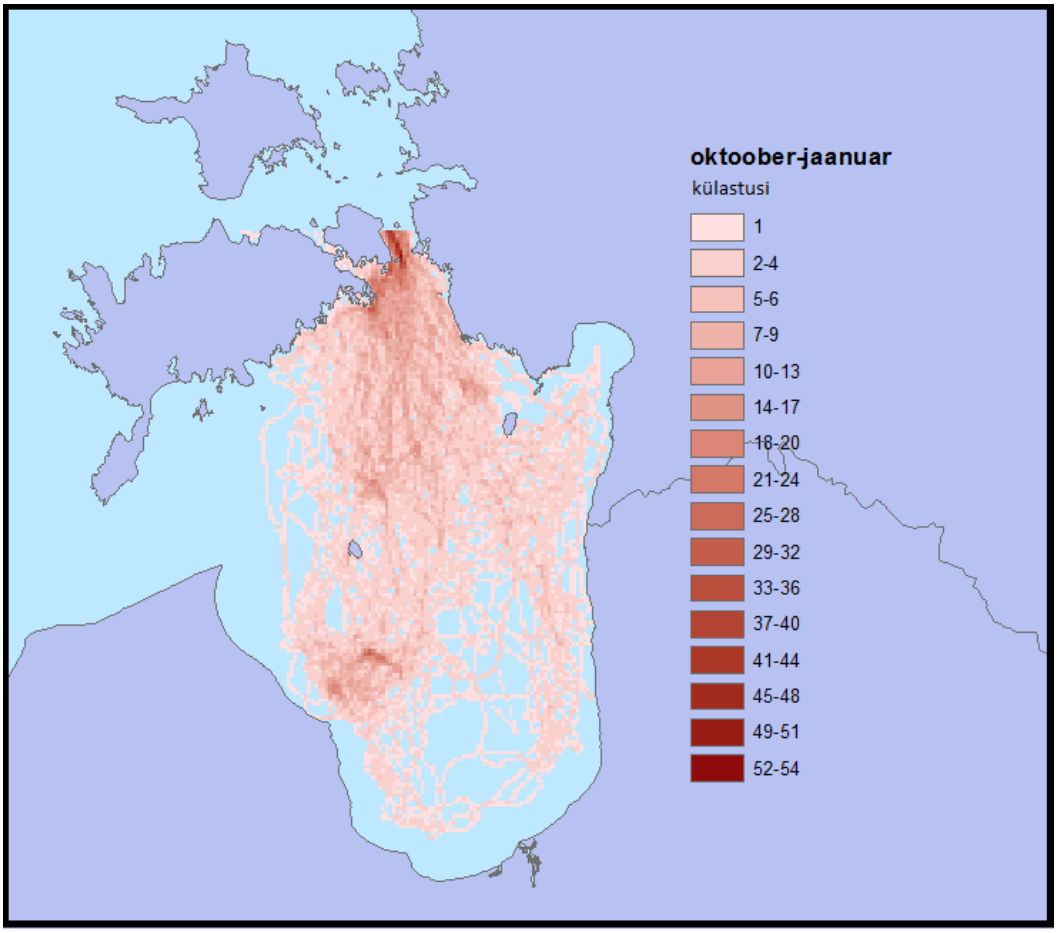

Figure 2. Autumn foraging areas. A visibly more intensive use of areas closer to the coast.

When the ice starts to form, the animals begin to migrate from the coast towards the sea following the ice-border. Overwhelmingly they move south from the Väinameri sea, to the Gulf of Riga. However, when the ice-formation is delayed, a significant part of the population remains in the Väinameri sea for the whole winter. Before the breeding season that starts in the middle of February, the seals settle preferably on the ridged ice. The ridges of ice gather drifting snow and provide shelter from the wind. In the snowdrifts behind the ridges, the seals also have their birthing lairs. The location of breeding areas depends on the harshness of winter and differs from year to year. Both the current research as well as earlier studies have shown that very often ringed seals choose for breeding the northern part of the Gulf of Riga, where the suitable ice conditions form sooner (Figure 3). After birth the pups spend up to 6 weeks with their parents. Research shows that the animals are settled during that time and move only together with the drifting ice, when the breeding site is located on such ice.

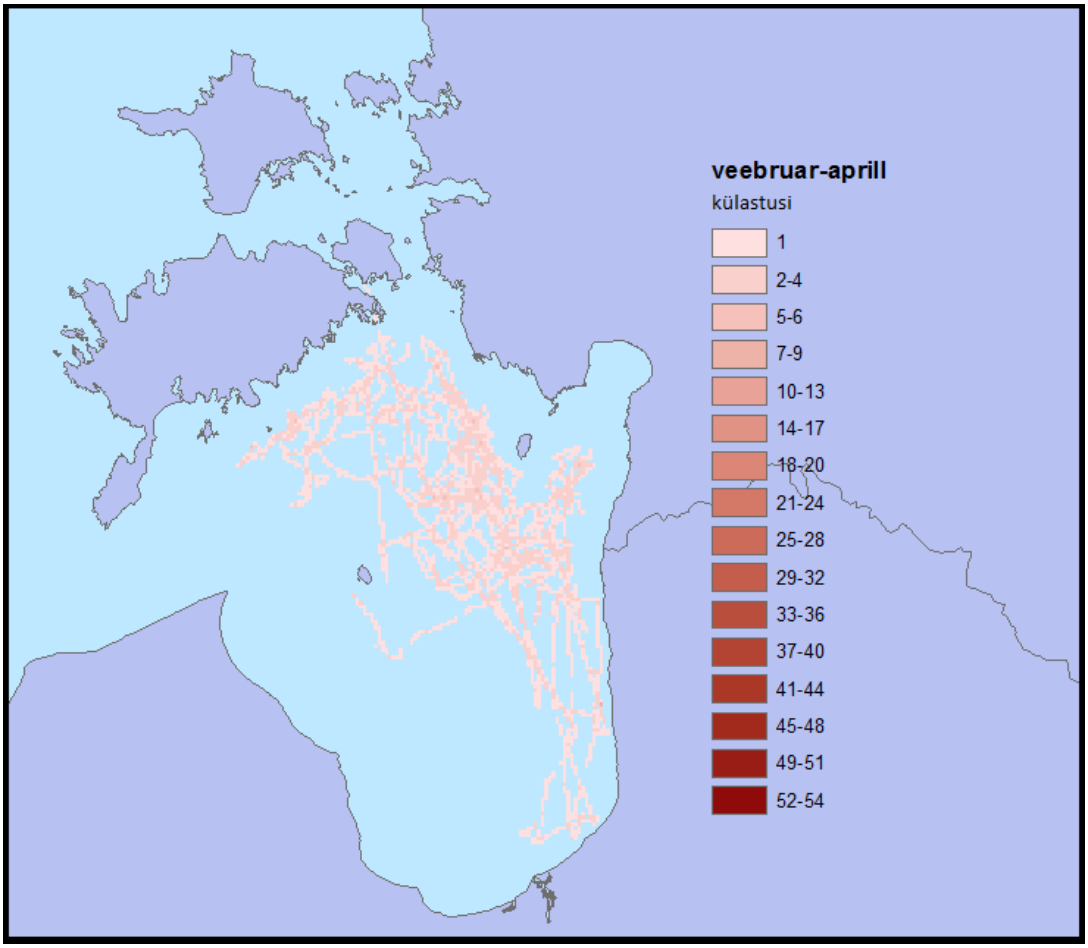

Figure 3. Distribution of ringed seals in the winter of 2012 with above average temperatures. The noticeable movements on the southern coast of Saaremaa and the eastern coast of the Gulf of Riga were due to drifting ice. The figure demonstrates well the location of main breeding regions.

After the pups are born, the seals start to moult, which lasts for a month. If the ice is stable during that time, the animals spend most of the time out of water. Our telemetrical studies did not cover the moulting period, because by that time the animals had lost the tags glued to their fur. Information on the distribution of seals during the moulting period was gathered by aerial survey. When larger cracks and polynias begin to form during the ice melt, the ringed seals start to re-migrate north to the Väinameri sea and the moulting ends on the rocky shallows of the resting sites after the ice breaks. However, the ringed seals do not stay long in the Väinameri sea, because they have to restore their energy resources that they have lost in winter during the breeding and moulting periods. During winter the seals lose up to 50 kg, i.e. half of their body weight.

Migrations to the foraging areas located in central part of the Gulf of Riga are fast – 150 to 180 km are covered in a few days.

The data on diving collected during telemetry indicates that even during such quick migrations the seals spend most of the time diving and, irrespective of the depth, the dives always reach to the bottom. Dives last usually 10 to 12 minutes and the time between the dives that is spent on the surface lasts from 3 to 5 minutes. During foraging the dives last longer reaching up to 25 minutes. The length of foraging trips

varies depending on the animal as well as the season. Usually the seals' stay in the foraging areas is longer in summer and shortens as the autumn approaches. The seals could remain in the central part of the Gulf of Riga for as much as 2 months, but usually the foraging trips do not last longer than 2 to 3 weeks. In autumn when the sea cools, the foraging areas get closer to the coast. By that time their energy resources are restored and they do not need to feed so intensively any more. The animals spend more time in their resting sites and in good weather can lie on the same rock for 24 hours. Their diurnal activity cycle is quite clearly established. From the afternoon until the early morning hours they spend most of their time out of water. In windy and rainy days the seals prefer to stay in the water.