REMIBAR

Evaluation of Migration Barriers Remediated as part of Remibar

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As part of the LIFE project Remibar, 304 culverts or dams (also called objects) that constituted migration barriers for aquatic organisms and otters in the Counties of Norrbotten and Västerbotten have been removed or rebuilt. These migration barriers were located in five project areas in five river systems that were part of the EU Natura2000 network. In the County of Norrbotten, the areas included in the project were the Ängesån project area (part of the Torne River drainage basin), the Råneälven project area (part of the Råne River drainage basin) and the Varjisån project area (part of the Pite River drainage basin). In the County of Västerbotten the Sävarån and Lögdeälven project areas encompassed the Sävar River and the Lögde River drainage basins.

The majority of the structures that constituted migration barriers for fish and other aquatic organisms consisted of culverts (251 objects) that were often too narrow and too steep, while 42 objects consisted of dams. Eleven migration barriers consisted of bridges that were lacking possibilities for otters to pass underneath the road safely. Most of culverts (77.7 % of the culverts) were replaced by arches, while 12.4 % were replaced by bridges, and 6.0 were replaced by wider culverts (fig. 1). A smaller proportion of the culverts were not replaced but remediated by constructing a rocky ramp downstream the culvert (2.4 %) or removed and not replaced with a new construction as the roads were no longer in use (1.6 %) (fig. 1). The 42 dams were removed, and the original or existing water level was maintained through the construction of a rocky ramp. The eleven objects that constituted migration barriers for otters and other medium-sized mammals were remediated so that those animal groups should be able to pass the road-river crossing without crossing the road.

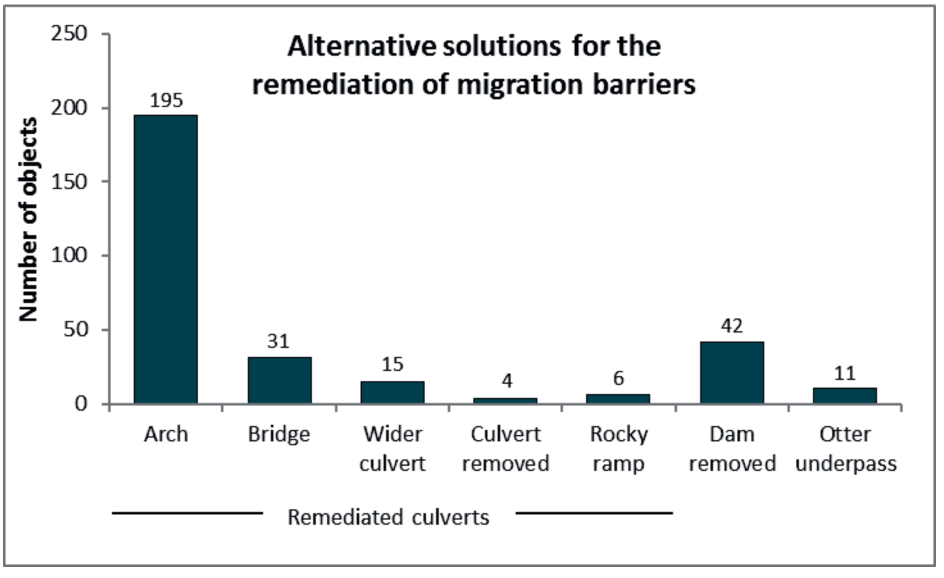

Figure 1. Number of objects replaced with different solutions.

While migration barriers occur naturally in rivers and streams, Remibar has focused on remediating man-made migration barriers, so called artificial migration barriers. An artificial migration barrier is created when fish, invertebrates and other animals cannot pass a man-made construction. This occurs when the water velocity is too high as a result of the diameter of the culvert being too narrow, of that the gradient is too steep. It also occurs when the construction creates a vertical rise that is too high for the fish to jump past.

One objective of the remediation efforts has been to make the former migration barriers passable for all species, not only salmonids that are strong swimmers. This has resulted in a development of technically gradually better solutions, especially when remediating migration barriers consisting of dams. Also when the solutions have involved the construction of arches, bridges etc., the focus has been to not just remediate the migration barrier, but also make it a functional part of the habitat (fig. 2).

Figure 2. Object 244 in the Sävarån project area. Natural habitat under a bridge.

In total, 304 migration barriers have been remediated. Most of these were located in the Sävarån project area (97), followed by the Lögdeälven project area (74), the Råneälven project area (53), the Ängesån project area(30) and the Varjisån project area (30). The number of remediated objects per project area according to type are presented in figure 3.

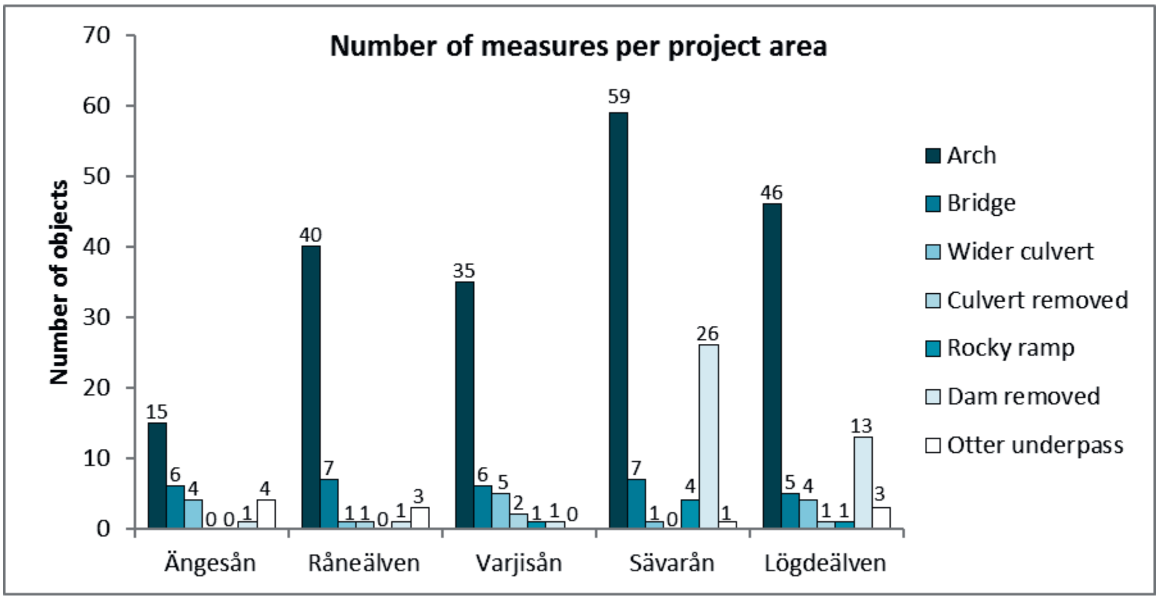

Figure 3. Number of objects per project area according to type of solution used.

Reducing water velocity – re-opening migration routes

The factors that turn a structure into a migration barrier include high water velocities, a high vertical drop at the outlet, and low water levels compared to the rest of the creek. If the water current in a creek with a steep incline is forced into a narrow culvert, it results in high water velocities.

A culvert with a suitable design imitates the conditions that occur naturally in the creek and enables migration of the species that occur naturally in the creek. Such a culvert has the following design:

1. the creek should not be narrowed down when it enters the culvert. No waterfall should be created at the inlet or outlet or inside the culvert.

2. The water velocity and depth inside the culvert, including variations in the two parameters, should imitate those that occur naturally in the creek.

3. The bottom substrate should imitate the bottom substrate in the creek.

When measuring water velocities before and after a measure it is important that the measurements are taken under similar conditions. The water velocity is linked to the water flow and it is therefore difficult to obtain comparable conditions at different seasons due to the strong spring floods in Norrland during the months of April and May, which is followed by low flows during late summer and early fall. The remediation efforts in Remibar have been carried out during a period of five year, during the bare ground season. It is not determined whether the water flow was similar at the two occasions when measurements were taken. In the county of Västerbotten water velocity was not measured during the inventories of the objects prior to the start of Remibar.

Instead of measuring the water velocity it is in most cases easier to measure the change in the factors that determine water velocity, i.e, the width of the new structure, the incline of the structure, and the substrate, compared to the previous structure. In addition, water velocity in the culvert is determined by the river flow and the gradient of the area. As the river flow increases due to rain and snow melt, it is important to take these factors into consideration when replacing a culvert. In spring (April-May) during the spring flood the depth and sometimes also the width of the river increase as flow increases. By using the natural width of the creek as a reference and making the new structures wider than the natural width of the creek, the water velocity in the road-river crossing is no long a result of the shape of the structure.

The figures below show culvert width (fig. 4) and water velocity (fig. 5), of the culverts that were replaced with arches and wider culverts, before and after measure. The 84 objects (of the 304) that consisted of dam removals, bridges, rocky ridges and underpasses targeting otters have not been included in the calculations of width and water velocity. Also, approximately another 10 objects have not been included in the calculations since they lacked complete measurements before or after the measure.

To get an estimate of the natural width of the creek prior to the start of the project, measurements were taken at 1-3 locations upstream the barrier, within a distance of 10-50 m, at spots that were considered representative of the watercourse. In the Lögeälven river system, the width of the new structures exceeds the natural width of the rivers and creeks with 33 % in average. In Sävarån the new structures are 13 % wider than the natural width of the river/creek, in Råneälven 52 %, in Varjisån 15% and in Ängesån exceeds the average natural width by 19 % in average. Only the objects that were replaced by an arch or a wider culvert are used in the calculations.

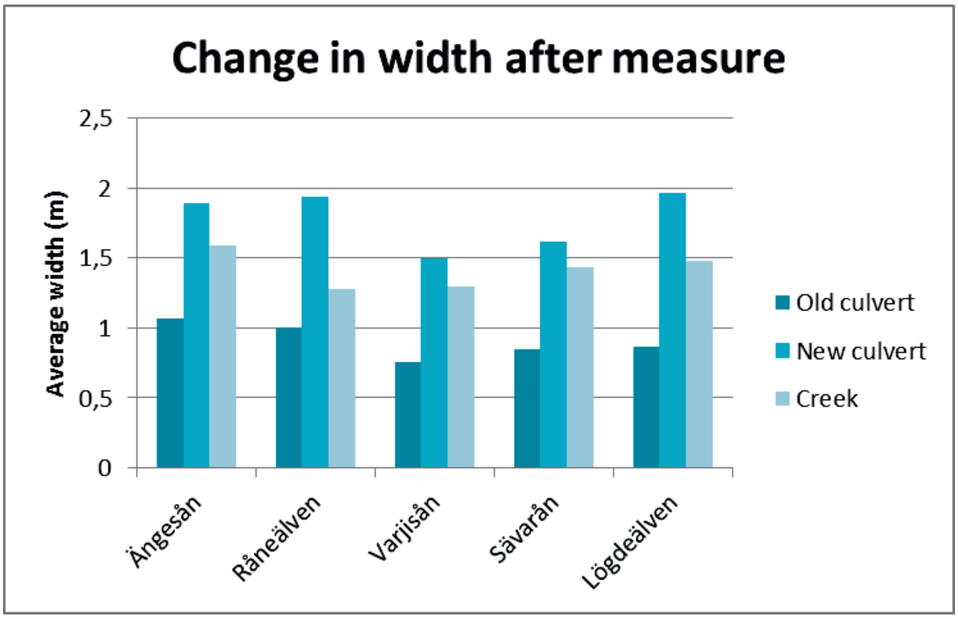

Figure 4. Comparison by executed objects in average width.

Most species of fish, with the exception of the adults of some species of salmonids, cannot swim upstream when the water velocity is too high. In Remibar the water velocity has been significantly reduced, as indicated in figure 5. As a result, species that are weak swimmers, e.g., perch, common roach, and pike, are now able to migrate past the former migration barrier. As described earlier, the water velocities were measured during the bare ground season and at different levels of water discharge. However, most measurements were taken when the water levels were not high. The calculations are made from the objects that were replaced by an arch or a larger culvert, not dams or bridges. No measurements of the "former water velocity" were taken in the Lögdeälven and Sävarån project areas. The results show clearly that the water velocity has been reduced following the replacement of the culverts.

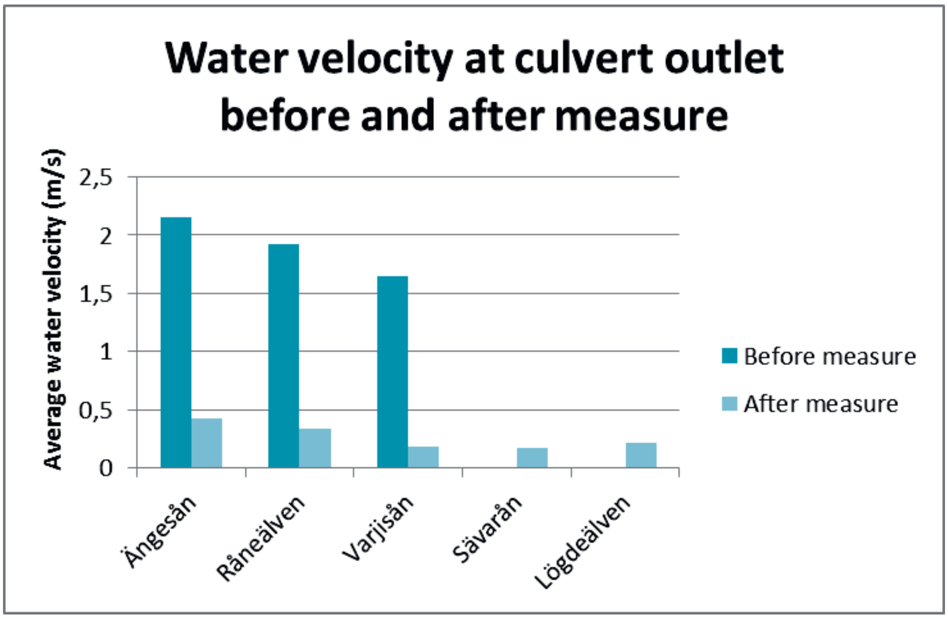

Figure 5. Measurements after culvert replacement in Remibar.

Dam removal

In Remibar a total of 42 dams have been removed or remediated in the five project areas. Most of them (39) were located in the county of Västerbotten (26 in the Sävarån and 13 in the Lögdeälven project areas). In the County of Norrbotten, one dam was remediated in each project area (fig. 6). Most of the dams were small and located in creeks and rivers, while eight dams were located at the outlet of a lake. For the dams located at the outlets of lakes the water level upstream the dam has been maintained through the installation of a wooden sheet piling across the watercourse.

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