Effects of artificial lakes on migrating juvenile brown trout (Salmo trutta)

To mitigate the negative effects of nitrogen loading to coastal areas, the development of artificial lakes has become an internationally used management tool to reduce the nitrogen load of streams to the sea. This thesis focuses on the effects of artificial lakes on downstream migrating brown trout (Salmo trutta) smolts. Anadromous brown trout migrate as juveniles from freshwater to the sea and are forced to negotiate artificial lakes to reach the marine habitat. Telemetry studies were conducted between 2005 and 2017 to investigate mortality, predation and passage time of wild and hatchery-reared smolts in the artificial lake Egå Engsø that was developed in the year 2006 in the Danish lowland stream Egå. Models were used to examine the role of biotic and environmental factors for lake passage. In the first manuscript (MS I), the results of telemetry studies that were conducted before the lake was developed are summarized and compared to the results of a long-term PIT telemetry study that was initiated in 2009. We found a mean mortality of 74% of smolts negotiating the lake, whereas no mortality could be observed before the lake was established. There was a significant increase in passage time after the lake was developed and water temperature and discharge were identified as important environmental and climate factors affecting survival. Since streams that contain a population sink like artificial lakes might be a preferred target for stocking, the performance of hatchery-reared brown trout smolts compared with wild conspecifics was evaluated in the second manuscript (MS II). While there was no difference between the two groups in survival or passage time, the hatchery-reared smolts had very low return rates from the sea. Taking this low return rate and evenly high lake-mortality into account, stocking of hatchery-reared smolts in systems with artificial lakes is not recommended for conservation purposes of anadromous sea trout populations. In 2016, a radio-telemetry study was conducted (MS III). This study aimed to investigate individual behaviour of smolts negotiating the lake and reveal information about predation. The results indicate highly erratic movement patterns of fish during lake passage and confirmed pike predation. In MS IV, net ground speed in two equally long stretches in the stream and in the lake, were compared. The results quantify the massive difference of migration speed in lentic and lotic environments and elucidate how artificial lakes disrupt the downstream migration of brown trout smolts. The results from this thesis are alarming and suggest that anadromous brown trout population are most likely unable to sustain themselves when artificial lakes are created in streams. Stocking is no sufficient measure to sustain affected populations. Since sea trout is a species of high biological, cultural and economic importance, management bodies are advised to take these results into account when considering measures to reduce nutrient emissions

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