Coarse fishing close season on English rivers

Appendix 3c – Pike (Esox lucius) feeding and spawning behaviour: a literature review

Background

In preparation for the close coarse fish season consultation, we need to appraise in more detail the potential risks associated with option 3 - a partial change with the proposed close season being from 15th April to 30th June. With regards to option 3, three early season spawning species (dace, pike and grayling) have been identified as potentially being at risk, so a further review of the literature was commissioned to shed more light on these risks. This paper looks at the potential impacts on pike. In our appraisal of option 3, key questions to ask are:-

- What are the UK river pike spawning times?
- Do UK river pike show spawning migratory behaviour?
- Do UK river pike feed at or around spawning?
- What mitigation measures could protect breeding pike during the period 15th March till 15th April?

Growth & Feeding

Age and growth of northern pike have been intensively studied, using evidence from scales, opercula, cleithra (small pectoral bones) and otoliths (Casselman 1996). Pike reproduce in shallow waters during spring (March–May) in water temperatures ranging from 4 to 14 °C. Pike can occasionally become up to 20 years old, but generally 5–10 years of age, and they become mature at age 1–4 years depending on size (rapid growth favours early maturation) and sex (males mature earlier than females) (Raat 1988; Craig 1996). Opercular bones of 261 pike from the River Stour and 117 from the River Frome were used for age and back-calculated growth determinations. The annuli were laid down during late April and early May and most growth occurred between May and September. Pike growth in the two rivers was comparable with the fastest growth in other waters, though Frome pike grew slightly faster than Stour pike (Mann, 1976).

In early spring pike migrate to spawn in areas of shallow water containing decomposing vegetation (Carbine and Applegate 1948, Miller 1948, Franklin and smith 1963, Bregazzi and Kennedy 1980). Except for the spawning season and the period of intense feeding immediately following it, most authors have found no evidence of well-defined seasonal patterns in behaviour (but see Dymond 1926, Casselman 1975, Headrick 1985 - references in Michael, 1989). Pike activity levels and feeding intensity may vary seasonally, although few patterns are consistent among past studies. However, it is agreed that fasts occur at spawning time (Frost 1954, Christiansen 1976, Diana 1979), while high foraging rates occur from May to October, peaking in June, in Lac Ste. Anne, Alberta (Diana 1979).

In river migration

The movement of ten radio-tagged adult pikes (57-113 cm) in the River Gudenå, Denmark, was investigated from by Koed et al., (2006). The movements of pike were characterised by long resident periods in the submergent vegetation, interrupted by short excursions to nearby areas. Two periods with more intense movement were observed; one period during early winter; and one period during spring from mid-March to mid-May. The increased movement during early winter may have been initiated by a slight temperature increase at this time, whereas the increased movement during spring coincided with the spawning of pike.

Northern pike, Esox lucius, needs different habitats to survive and reproduce and thus depends on the availability and accessibility of these habitats. The River Yser (Belgium), a typical lowland river characterised by anthropogenic impacts such as artificial embankments. Pike migrated most in February and March, which could indicate they frequented spawning habitat in this period. Increasing water temperature triggered migration for both sexes, and males started migrating at lower temperatures than females, which suggests that males start migrating earlier. This was the only substantial difference observed between male and female pike migration. The results suggest that migration was inhibited by high flow, as no migration was observed at high flow (Pauwels et al., 2014).

Rosell and Macoscar (2002) tagged pike on their spawning sites in Lower Lough Erne, Northern Ireland. Distance from tagging to recapture site ranged from 0 to 16 km, with most recaptures within 10 km. Pike dispersed widely after spawning, an observation supported by netting survey data, and tended to return to the same spawning sites year after year. In a 6-year mark-recapture study of breeding migration in pike (Esox lucius), Tibblin et al., (2016) repeated sampling across years at a breeding site in a small Swedish river. In this study it was shown that males arrive before females; that large males arrive later than small males; that the timing of breeding migration varies among years; and that individuals are consistent in their timing across years relative to other individuals in the population. Riverine pike have been shown to be capable of extensive movements, with mean upstream spawning migrations of 7.7 km reported for pike in the Ourthe and Amblève rivers (Ovidio and Philippart, 2002).

Spawning

Pike reproduce in shallow waters during spring (March–May) in water temperatures ranging from 4 to 14 °C. Gonadal development for the next season's spawning begins the previous fall and continues over the winter (Lenhart and Cakic 2002). The age at first spawning is variously reported as two years (males) and three years (females) in Scotland; it may be later in more northerly populations (Treasurer 1990). In the England on the rivers Frome and Sour, spawning occurs from the end of March into May. Elaboration of the ovaries commenced in September and was virtually completed by February, whereas the testes reached their maximum weight in October and maintained it until spawning (Mann, 1976).

Observations of spawning activity suggest participation of several males per female, with many matings over a period of several days (Scott and Crossman 1973; Billard 1996). Females scatter the eggs in small batches (less than a hundred), which sink and stick to vegetation or the bottom, hatching around two weeks later without parental care (Billard 1996). Hatching success is higher in eggs deposited on sand or silt, compared with those laid on aquatic plants (Wright and Shoesmith 1988). Fecundity increases with size of the female; Inskip (1982) cites an average fecundity of 32,000 eggs per female, although

much larger numbers have been reported. Fecundity for several populations of pike in the British Isles varied between 10-24 eggs/g (Treasurer 1990).

Esox lucius are batch spawners that move inshore or upstream to flooded or marsh areas to spawn (Scott and Crossman, 1973). Spawning normally occurs during daylight hours, in areas of vegetation and in shallow water <17.8 cm). Eggs and sperm (5 to 60 eggs/spawn) are released simultaneously, with the eggs deposited in the flooded areas on submerged vegetation over a period of 2-5 days. Spawning takes place every few minutes, for up to several hours, over a period of several days until all eggs are extruded.

Selective use of fishing gear

Arlinghaus et al. (2008) examined the relationship between bait and lure size and type and body size, injury, and handling time for pike, Esox lucius. Bait type and size were significantly related to the size of fish captured and hooking location. Hooking in critical locations (i.e., gills, gullet) was more likely to occur with natural bait, soft plastic shads and jigs, and spoons than with spinners and wobblers (i.e., plugs). Frequency of bleeding was related to depth of hooking but was unrelated to fish size, bait type, bait size, or fishing method. The results of this study suggest that using large artificial lures and large natural baits can effectively reduce the incidence of hooking small pike. However, the use of natural bait can also result in a higher incidence of deep hooking, which in turn increases the likelihood of injury and bleeding (Arlinghaus et al., 2008).

Some fish break the line and are confronted by the potential impediment of a lure lodged in the jaw, buccal cavity, or throat. Pullen et al., (2019) simulated break-off events by releasing northern pike (Esox lucius) into Lake Opinicon, Canada with custom-built lures that were manufactured to contain radio transmitters. Treatment groups combined hook placements (lower jaw, upper and lower jaw, throat) and hook types (barbed and barbless) to investigate the effects on pike survival, movement, and lure shedding. All fish except for one shed the lures within 14 days of release, and barbed hooks and lures lodged in the lower jaw significantly increased the time required for pike to shed lures.

Appropriate gear choice and bait type and size might reduce injury and enable more selective exploitation of the target species, thereby contributing to more effective fisheries management (Wilde et al., 2003) and improved fish welfare (Cooke and Schramm 2007; Arlinghaus et al., 2007b) Mixed predator (pike, perch, zander) and game (trout) reservoir waters often use selective temporary bans on and enforcement of the use of certain fishing gear to protect breeding pike and to avoid trout being caught by pike fishing methods e.g. at Rutland Water, UK. This concept could be used to give pike some protection during their spawning period, if option 3 of the close season review was adopted.

Conclusions

Pike are early spawners and could be exposed to extra risk if a month was trimmed of the start of the current close season for coarse fish. However, it is well documented that although pike migrate to selective breeding grounds, during the spawning periods they often fast. To avoid pike being actively targeted during their breeding cycle, byelaw restrictions on the use of pike gear could be put in place to further reduce the likelihood of them being caught. If such mitigation measures were put in place, then this could alleviate our concerns about this species to an acceptable risk and open up the close season by one month.

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