Coarse fishing close season on English rivers

Appendix 3d – Grayling (Thymallus thymallus) - Feeding and spawning behaviour in the context of the close season debate

Background

In preparation for the close coarse fish season consultation, we need to appraise in more detail the potential risks associated with option 2 - a partial change with the proposed close season being from 15th April to 15th June. With regards to option 2, three early season spawning species (dace, pike & 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 Grayling. In our appraisal of option 3 risks, key questions to ask are:-

- What are the UK grayling spawning times?
- Do UK grayling show spawning migratory behaviour?
- Do UK grayling feed at or around spawning?
- What are the likely impacts of fishing pressure on breeding grayling in early spring?

General ecology

The distribution of grayling in salmonid, mixed coarse & game and coarse fish only rivers in England have been mapped and are illustrated in Ibbotson et al., (2001). Grayling are found in all of the Environment Agency's regions, but they inhabit few rivers in Anglian region. In southern England, grayling are most densely populated in the chalk streams, particularly the Rivers Test and Avon. In the north, the largest population exist in the Rivers Trent, Severn, Ouse tributaries, Wharfe and Ribble.

The ecology of grayling has been extensively reviewed by Ingram et al., (2000). Grayling favour certain physico-chemical conditions which vary according to the life-stage. Their water quality requirements of grayling are similar to brown trout; cool, well oxygenated with a good sequence of pool, riffle, glide and run (Woolland, 1986a). Grayling reproduce later than other salmonids, generally in spring when temperatures are warmer (Charles et al., 2006). They also lay their eggs relatively shallower in gravels (Bardonnet & Gaudin, 1990) than do salmon and trout. A high degree of microhabitat segregation occurs between European grayling and brown trout (see chapter on "Comparison of grayling with other species" in Ingram et al., 2000). The grayling's typical habitat of cool, well-oxygenated waters in swiftly flowing streams and rivers, usually characterised by stony substrate, is often associated with an intermediate river gradient (usually 2-5 m km–1) that generates these physical conditions, thus coining the term 'grayling zone' in Huet's classical work, used to describe longitudinal biological zonation in European rivers (Huet, 1949). Huet's fish biological zones are related basically to longitudinal section (slope of the stream bed) and to the cross section of the stream and its valley. Other distinct riverine fish zones include the trout zone, the barbel zone and the bream zone.

Growth

In older T. thymallus, growth was most rapid from April to June with no further growth until November. Other studies have shown that growth was optimal from spring until autumn with little occurring in winter (Hellawell, 1969; 1975; Woolland, 1987b). In a Danish River, it has been shown that immature year-class growth starts in mid-April, whereas in mature graylings the real growth season starts after spawning in mid-May (Ernst and Nielsen, 1982). In the same study, it was shown that growth stops in Sept/Oct when water temperature decreases and the photoperiod shortens. During winter growth expressed as length is negligible for all year-classes, whereas weight and condition factor increase considerably in mature individuals, caused by the formation of sexual products in these year-classes.

Grayling exhibit a relatively short life span, in most cases reaching three or four years maximum (Witkowski et al., 1989). The oldest grayling found at Llyn Tegid and the River Dee in Wales were 6+ and 7+ (Woolland 1987b). The reported maximum ages of T. thymallus are highly variable and dependent on geographical location and environmental conditions. Davies et al. (2004) reported that most of the T. thymallus in southern waters of Britain die by their fifth (4+ years) or sixth year (5+ years). However, Horka et al., (2010) suggests that T. thymallus in lowland, southern chalk rivers in the U.K. live longer at around 6-7 years. Growth rate is most rapid in the first year (Hellawell 1969; 1971; Wooland, 1972). Growth is reduced to a much lower, stable rate at around 3-5 years which coincides with attainment of sexual maturity (Hellawell, 1969; Witkowski et al., 1989)

Natural diet

Generally adult grayling become predominantly bottom feeding with increasing age and the contribution of aerial prey to their diet falls correspondingly (Dahl, 1962, Jankovic, 1964, Peterson, 1968; Wooland, 1972). The maximum feeding activity of grayling is at dawn and dusk although they also feed continuously during the day and not at all during the night (Scott, 1985). The type of prey consumed by grayling varies with age. In general, juveniles feed on chironomids larvae and microcrustacea such as copepods, whilst adults feed on chironomid pupae, ephemeroptera, simulidae and trichoptera (Scott, 1985). Terrestrial invertebrates have been found to be an under utilised resource by grayling in the River Frome in England, with 4.3% by volume being consumed by 0+ grayling and 0-0.1% by volume in older age classes (Keay, 1990). Fish were generally not eaten but cyprinid and salmonid eggs were eaten during certain seasons (Hellawell, 1971). Studies carried out on the stomach contents of grayling from the River Test and Itchen, provided no evidence of predation on other fish species (Lemen, 1994).

Seasonal variation also plays a significant role in the diet (Hellawell, 1971). Woolland (1987a) found the greatest feeding activity at intermediate temperatures with maximum and minimum temperatures resulting in low feeding intensity. In the River Dee (UK) during winter, the most common foods consumed were caddis larvae, crustacea, true fly larvae and plecopteran (stone fly) nymphs (Woolland, 1972). By comparison, the summer contents consisted mostly of caddis larvae, aerial insects and ephemeropteran (mayfly) nymphs, in addition blackfly larvae which were washed out when increased water levels followed high rainfall (Hellawell, 1971; Woodland 1972; Crundwell, 1991, Leman, 1994). This would indicate that grayling are opportunist feeders exploiting seasonal prey (Ibbotson et al., 2001).

Spawning behaviour and timings

The age at which grayling attain sexual maturity depends heavily on geographical location. For example, in the River Lugg, Herefordshire (UK), European grayling did not reach sexual maturity until the end of the third year (2+ fish) (Hellawell, 1969). Males arrive on the spawning ground several days before the females downstream (Fabriciuus & Gustafson, 1955). The males adopt and defend their territories, courting females approaching from downstream (Fabriciuus & Gustafson, 1955; Parkinson et. al., 1999; Persat & Zakariah, 1993; Poncin, 1994). For males size has been shown to positively correlate with reproductive success in some cases, probably due to higher competitive abilities of larger males to secure high quality spawning territories (Haddeland et al., 2015), but was not the case under conditions of low density (Poncin, 1996). The oldest and largest grayling spawn first (Witkowski & Kowaleski, 1988). The sex ratio for European grayling has been found to change over the spawning season. During the first three days at the spawning sites, males dominate females by 3:1, decreasing midspawning to 1.5:1 (Witkowski & Kowaleski, 1988). Towards the end, the ratio equals out as fewer males ascend the river, until eventually the females are dominant (Witkowski & Kowaleski, 1988). An unequal ratio of 6:1 (males: females) exists in all grayling populations and it has been inferred that sex ratio could well be strongly influenced by angling pressure on females during the summer (Libosvarsky, 1967). More recently, studies by (Wedekin et al., 2012) has shown that grayling sex ratios changed from approximately 65% males before 1993 to approximately 85% males from 1993 to 2011 in a Swiss lake and suggests that temperature affects the population sex ratio of grayling which has lead in part to a population decline with this lake.

The onset of spawning in both grayling genera, significantly correlates with climatic conditions (Witkowski & Kowalewski, 1988). Water temperature has been shown to affect the duration of migration and spawning (Witkowski & Kowalewski, 1988). With regards to T. thymallus, such temperatures range from 3 - 11°C, although temperatures as high as 14°C have been recorded in The Frome, Southwest England (Scott, 1985). Grayling belong to a group of lithophils which hide their brood under gravel and do not guard the deposited eggs (Balon, 1975). European grayling differ from salmon and trout in that the red (nest) is excavated by the male rather than the female (Warner, 1955). Site selection also differs in that salmon/trout choose redds towards the downstream end of pools (Hobbs, 1937; Stuart, 1953a) whereas in grayling, spawning takes place at the upstream end of a pool (Fabricius & Gustafson, 1955).

European grayling are spring spawners. Spawning occurs from the end of March (Parkinson et, al 1999) to the first half of June, (Eloranta, 1985; Gonczi, 1989; Kristiansen & Doving, 1996; Linloekken, 1993; Scott, 1985) or just after snowmelt in European countries (Peterson, 1968; Witkowski & Kowaleski, 1988). In the River Aisne (Belgium) graylings spawn in spring, usually from February to May, depending on annual variations of hydroclimatic conditions (Ovidio et al., 2004). Spawners remained approximately 10 days at the spawning grounds and later performed a post-spawning homing to the pool-riffle sequences inhabited outside the spawning season (Ovidio et al., 2004). In the UK, grayling are thought spawn in the Upper River Dee during late April and Mid-May (Wooland, 1972) or as early as late February in Southern England (Ibbotson, Personal Observations). On the River Rye (North Yorkshire) in early to mid-March, a high proportion of grayling being radio-tracked started to move upstream into shallower, faster water with more gravel,

pebble and cobble; this behaviour was apparent across all groups studied within the catchment. Not all fish moved upstream and some fish spawned close to where they overwintered, but the greatest distances moved during the tracking period mostly occurred immediately before and after the period during which courtship and spawning was observed. Fish moved between 0.2 and 3.5 km during the course of the study, but most upstream movements to spawning sites were less than 1.5 km. Courtship and/or spawning activity in grayling were observed on the River Rye (North Yorkshire) between 5 and 18 April in 2004 (Environment Agency., 2005).

The European grayling is extremely fecund producing an average of 10000-31000 eggs/kg/hen. (Janovic, 1964). In general, grayling egg size ranges between 2.5 and 3.5mm (Northcote, 1995). After spawning, the fertilised T. thymallus eggs remain in the gravel for approximately 177 degree-days (or 22 days at 8.05°C) after which they hatch (d'Hulstere & Philippart, 1982) and hatching time decreases with increasing temperature (Humpesch, 1985). Following spawning, river-resident grayling may return (home) to the areas they inhabited previously, with the proportion of fish confirmed as homing varying between 57 per cent and 100 per cent in several studies (Parkinson et al., 1999; Meyer, 2001; Ovidio et al., 2004, Environment Agency 2005).

Angling pressure

Angling pressure is known to exert an influence on the grayling populations of different rivers (Ingram et al., 2000). A negative correlation has been found between angling pressure and quotient of grayling/brown trout in catches. Grayling appear to be easier to catch than brown trout (Linloekken, 1995). Angling pressure on females during the summer may produce a sex bias favouring males (Libosvarsky, 1967). Lennox et al., (2016) has assessed using physiological and reflect behaviour observations the impact of angling in Grayling in a Norwegian river caught at midsummer temperatures (i.e., 17–18 °C). Reflex impairment was determined with orientation and tail grab reflex action assessments immediately after landing, after air exposure, and after 30 min holding. Blood physiology did not indicate an exacerbating effect of air exposure relative to just angling-induced exercise, but significant and prolonged reflex impairment was associated with the 120 s air exposure interval. It was concluded that anglers must take care to minimize air exposure to adhere to best handling practices.

A study on the status of River Dee (UK) grayling population, considered the potential impacts of angling pressure (Environment Agency, 1997c). The report concluded from the number of trips and time spent fishing, that there was a high demand for grayling angling. However, such demands was not thought by local anglers to have affected the grayling population. Anglers were asked to record all grayling that were killed, indicating a low angling impact (Environment Agency, 1997c), although these fish were not angled during the close season when grayling were in breeding condition. Currently the Environment Agency imposes a number of restriction on the exploitation of grayling. National byelaws exist for grayling, anglers can take a maximum of two fish per day within the size range of 30 and 38 cm, and the current close season is 15th March until 15th June, inclusive.

Conclusions

On mixed game and coarse fish water, one could argue that grayling are already exposed to angling pressures during their breeding season in early spring, as the brown trout season on most rivers starts in mid to the end of March. So trout anglers

using bait (worms) or fly fishing could accidently catch grayling. In some southern UK rivers, there is evidence of grayling spawning occurring as early as February (Ibbotson et al., 2001), which could expose them to angling pressures from coarse fishermen as well but to date, the Environment Agency is not aware of any local fishing clubs reporting angling related pressures as an issue on grayling stocks and they could be good reasons for this in part, namely biological zonation.

The biological zonation of river sections in to distinct fish habitat zones may reduce contact between coarse fishermen and grayling, for example barbel and bream anglers are likely to be fishing in other sections of the river and the same can be said of brown trout fisherman, although it is acknowledged that there are big overlaps between trout, grayling and barbel zones on many UK rivers, in particular on southern chalk streams and some of the bigger rivers in Yorkshire. Furthermore, preference differences in the diet of brown trout (more terrestrial insects and mid water drift prey items) compared those of bottom feeding adult graylings are further likely to reduce the chances of grayling being caught by trout fly fishermen. Although, it is acknowledged that game fly fishermen value grayling sport, especially during the close season for salmon and trout, where they can extend their sport fly fishing season by actively targeting grayling. However, during this period sport fly fishermen will use different tactics to pursue grayling than those for trout and salmon, for example using heavily weighted Czech nymphs fished deep, as opposed to traditional dry and wet flies fish higher up in the water. Although it is only speculation, one would assume if the coarse season started later (April 15th as opposed to March 15th) during that extra month of potential grayling fishing, most game anglers would switch back to target their game fish which would be back in season.

As grayling are opportunist feeders, they could also take castor and maggot baits from coarse fish anglers if the close season changed, but the real question is how likely are they to feed around spawning time? Woolland (1987a) found the greatest feeding activity at intermediate temperatures with maximum and minimum temperatures resulting in low feeding intensity, which may suggest low feeding activity around the spring and spawning time, however the scientific literature on this subject is unclear.

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