were recaptured the same summer as grilse, weighing from 3 lb upwards. It might be supposed that some smolts do not return as grilse till the summer following the year of their descent, the time of their stay in the sea being variable, as is the period spent by parr in the rivers. But all the evidence is against this supposi­tion ; grilse never commence ascending till late in summer; if they had been more than a year in the sea, some would probably ascend early in the season, as do the larger salmon. At the same time it must be borne in mind that a fish which remained in the sea a year after descending as a smolt might not be recognized as a grilse, having reached the size of a small salmon.

The grilse, after spawning in autumn, return again to the sea in the winter or following spring, and reascend the rivers as mature spawning salmon in the following year. Both salmon and grilse after spawning are called “kelts.” The following recorded experi- ment illustrates the growth of grilse into salmon :—a grilse-kelt of 2 lb was marked on March 31, 1858, and recaptured on August 2 of the same year as a salmon of 8 lb.

The ascent of rivers by adult salmon is not so regular as that of grilse, and the knowledge of the subject is not at the present time complete. Although salmon scarcely ever spawn before the month of September, they do not ascend in shoals just before that season ; the time of ascent extends throughout the spring and summer. A salmon newly arrived in fresh water from the sea is called a clean salmon, on account of its bright, well-fed appearance ; during their stay in the rivers the fish lose the brilliancy of their scales and deteriorate in condition. The time of year at which clean salmon ascend from the sea varies greatly in different rivers ; and rivers are, in relation to this subject, usually denominated early or late. The Scottish rivers flowing into the German Ocean and Pentland Firth are almost all early, while those of the Atlantic slope are late. The Thurso in Caithness and the Naver in Sutherlandshire contain fresh-run salmon in December and January ; the same is the case with the Tay. In Yorkshire salmon commence their ascent in July, August, or September if the season is wet, but if it is dry their migration is delayed till the autumn rains set in. In all rivers more salmon ascend immediately after a spate or flood than when the river is low, and more with the flood tide than during the ebb.

In their ascent salmon are able to pass obstructions, such as waterfalls and weirs of considerable height, and the leaps they make in surmounting such impediments and the persistence of their efforts are very remarkable. In a great many rivers anadromous Salmonoids have been excluded from the upper reaches by artificial obstructions, such as dams and weirs, constructed for the purpose of utilizing the water of the stream, or to obtain water power, or simply to facilitate the capture of the fish. Other rivers have been rendered uninhabitable to salmon by pollutions. The state of the Thames within the boundaries of London has since the beginning of the present century excluded Salmonoids entirely from the river; but every season salmon and grilse are taken in or near the Thames estuary, and there is no doubt that if the water could again be rendered moderately clear, and if fish-ways were provided at the impassable weirs, the upper waters of the Thames would again be frequented by salmon and migratory trout.

The life history of *Salmo trutta* and *S*. *cambricus* is very similar to that of *Salmo salar.* The river trout, *S. fario,* makes a redd in the shallower parts of streams in the same manner as the salmon, the only difference being that the mound of gravel forming the redd is smaller, the egg lying from one to two feet below the surface. The breeding period of the trout varies in different rivers, within the limits of September and March. @@1 The number of eggs produced by each female is about 800 for every pound of the parent’s weight; about 40,000 of the eggs make a gallon, so that they are considerably smaller than those of *S. salar.* The trout of Loch Leven, *S*. *levenensis,* ascend the streams feeding the loch, in order to spawn, at the end of September and beginning of October. The habits of other species of lake trout are similar to those of *S*. *levenensis.*

The charrs differ from lake trout in the fact that they do not ascend streams in order to spawn, but form their redds in the gravelly shallows of the lakes they inhabit. The spawning period of the charr of the Cumberland lake district is from the beginning of November to the beginning of December. The eggs of the charr have been found to hatch in from 60 to 90 days, the great majority in 70 days, at an average temperature of 40° F. The American species, *S. fontinalis,* breeds at about the same time as *S. fario*; its eggs are only half the size of those of the latter.

The smelt, *O. eperlanus,* is a gregarious fish and exhibits regular migrations in most estuaries. It is common in the Solway, the Firth of Forth, the rivers of Norfolk, and the estuary of the Thames. In most places where it is found it remains in the fresh and brackish water from August until May, spawning about the month of April, and afterwards descending to the sea for the

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summer. At Alloa on the Forth smelts are taken in large numbers by seine nets in spring, before and during the spawning period. There is a regular fishery for them at the same season on the Solway Firth and in Norfolk. The food of the smelt consists chiefly of young fish, especially young herrings, and crustaceans. The eggs are small, yellowish in colour, and adhesive, not adhering by the surface merely as is the case with those of the herring, but each egg possessing a short thread the end of which becomes attached to planks, stones, or other solid objects in the water. According to Mr Day the eggs are deposited near the high-water mark of spring-tides, so that they must be exposed to the air during the ebb. The smelt when in the sea is largely eaten by the picked dog-fish *(Acanthias vulgaris).* The species is absent from the southern coast of England and from Ireland, the smelt recorded as occurring on those coasts being probably the atherine *(Atherina),* often called the sand-smelt. *O. eperlanus* is abundant on the coast of Finland, and also is common there in freshwater lakes, in which it remains all the year round. It is also common on the Atlantic coast of France. It is of interest to note that the smelt in Britain and on other coasts, when not confined to fresh water, is, in its migration, intermediate between anadromous *Salmonidæ,* which ascend to near the sources of rivers, and such fish as the herring, which approach the shore to spawn but do not usually enter rivers. The smelt as a rule ascends estuaries only as far as the region of brackish water.

The various species of *Coregonus* resemble the charr in their habits, spawning in the autumn in the shallows of the lakes they inhabit ; their ova are small, and, as mentioned in Pisciculture *(q.v.*), are non-adhesive and of almost the same specific gravity as fresh water, so that they are semi-buoyant.

The grayling, *Thymallus vulgaris,* is in Britain exclusively fluviatile ; in Scandinavia it is found also in lakes. It is met with chiefly in clear streams with sandy gravels or loamy beds. It was introduced not many years ago into the Tweed by the marquis of Lothian, and thrives there. It is absent from the Thames, but is common in most of the rivers of England and Wales *—e.g.,* the rivers of Yorkshire, the Severn, and the Wye. It is absent from Ireland. It feeds on insects and their larvae, crustaceans, and small molluscs. It breeds in April and May, depositing its ova on the surface of the gravel in the shallows, not in a redd. The ova are smaller than those of the trout, and vary in colour from white to deep orange, and they hatch from the twelfth to the fourteenth day after extrusion. The fry grow to 4 or 5 inches in length by August, and by the following autumn to 9 or 10 inches.

*Salmon Fishery Legislation.*

In England and Wales the common law is that every person has an equal right to fish for salmon in the sea and in navigable tidal rivers, while the proprietors of the soil on the banks of rivers which are not navigable have the exclusive right of fishing in them. The erection of stake-nets, or other fixed engines for the capture of salmon in estuaries or on the sea-coast is necessarily incompatible with the maintenance of the public right of fishing, and has therefore from very early times been regarded as illegiti­mate. There has consequently been a constant conflict between legislation and private interest over this point. By Magna Charta all fishing weirs were abolished except on the sea-coast, but the object of this seems to have been rather the protection of the freedom of navigation than the advantage of the salmon fisheries or the maintenance of a public right. In later times fixed engines were repeatedly declared illegal and their erection prohibited by statute. Finally in 1861 they were definitively abolished in all cases except where legal right to maintain them could be conclusively proved. The Salmon Fishery Act of 1861, of which the prohibition just referred to was one of the clauses, was based upon the report of a royal commission appointed in 1860 to inquire into the condition of the salmon fisheries, and it forms the basis of the regulations at present in force, all previous legislation being by it expressly abolished and superseded. It prohibited the capture of unclean and unseasonable salmon, made a uniform close season for England and Wales, ordained a weekly close season of forty- two hours, provided for the erection of fish-passes and regulated the use of fishing weirs on non-navigable rivers, vested the central authority of the salmon fisheries in the Home office, and provided for the appointment of inspectors. In 1863 an Act was passed prohibiting the exportation of salmon during the close time. In 1865, as it was found useless to legislate without machinery to enforce the law, an Act was passed to constitute fishery districts under the control of local boards of conservators appointed by the magistrates in quarter-sessions. These boards were empowered to enforce a licence duty on fishing implements used in public waters. One or two minor salmon fishery Acts were passed in succeeding years, but the next important piece of legislation on the subject was the Act of 1873, the two most im­portant provisions of which are (1) that fishermen in public waters for every £50 of licence duty which they pay elect a member of the

@@@1 The average period between fertilization and hatching, as ascertained at Howietoun, is at 44·°1—*Salmo fario,* 71 days; S. *levenensis,* 72 ; *S. fontinalis.* 73; *S. salar,* 77.