WATER RESOURCES MANAGEMENT CONSULTATION

Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

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Water scarcity impacts

Summary

Scotland's water business sector is expanding quickly compared with other sectors (Scottish Enterprise 2019). However, these businesses saw impacts during the summer of 2018 ranging from extended summer shut-down periods for whisky distilleries to reduced water storage for hydropower electricity generation. Impacts on the crop sector included reduced production (cereals down by 12% - Scottish Govt. 2019) and higher wholesale prices for vegetables e.g. carrot prices increased by 80% (CEBR 2019). It has been estimated that the combination of the cold winter/spring and hot, dry summer of 2018 cost Scotland's agriculture over £160 million (WWF 2019).

In 2018, severe ecological impacts were seen on a number of rivers, including some without abstractions, indicating that a critical threshold had been reached in which any further abstraction would exacerbate the impact. Impacts included:

- distressed and dead fish and invertebrate animals;
- dead fresh water pearl mussels;
- severely shrunken channels and low river velocities;
- fragmentation of aquatic habitat and absence of water;
- smaller watercourses drying up;
- high river temperatures;

- low dissolved oxygen (although not measured this was very likely to have been the cause of at least one substantial fish mortality event).

Ecological impacts of water scarcity

River animals and plants have evolved to live under a highly variable flow regime. This includes short periods of naturally low flow, which animals and plants are better able to survive than more prolonged periods of low flow resulting from water scarcity and/or abstraction. The scale of water scarcity event arising from a dry period spanning multiple seasons, or years, is much more likely to impact river ecology than a single season event (Lake 2003).

A recent review (APEM 2017) has confirmed that flow reductions lasting less than one month had low impacts on aquatic life forms, provided some flowing water remains in the channel. As a drought develops, there is a 'ramp' effect of gradual impacts (Boulton 2003). For example, fish and invertebrates will move from areas where habitat is lost, or becomes unfavourable, to more favourable areas, such as deeper pools, or into river bed gravels. Whilst this may lead to increased densities and potentially greater predation, the evidence suggests that there is generally no change to the range of species present during these shorter flow impacts, provided flow connectivity is maintained (APEM 2017). The river ecology can recover relatively quickly from these conditions, provided they do not last too long. If flows reduce further, there are critical thresholds beyond which disproportionately severe effects occur. A key threshold is loss of flow, leaving isolated pools. Under these conditions significant ecological impacts can arise rapidly, and recovery may be much more prolonged.

For severe low flows lasting longer than one month (with some flow remaining) the evidence on impacts is sparser and less clear.

Other work (REF CREW/CEH) has confirmed that by the time flows get down to Qn98 the majority of rivers are in a zone of high sensitivity for the relationship between wetted perimeter and flow. In other words, as flow decreases below this point the extent of wetted habitat in the river decreases rapidly. This confirms that further reductions in flow below this point have the potential to be ecologically harmful.

Considering the evidence, SEPA considers that 20 days of flows below Q98 is an appropriate threshold beyond which to restrict abstractions in order to prevent severe environmental impact. However, measurement of flows as low as Q98 has a high level of uncertainty because such low flows are rarely encountered and are under-represented in the flow rating curve (routinely, flows are calculated from water level, with regular flow gauging to establish and update the level-flow relationship). For this reason, SEPA plans to use flow below Q95 for more than 30 days as the actual, working threshold. Q95 measurement is much more reliable, and events where flow is below Q95 for 30 days occur with similar frequency to events of less than Q98 for 20 days. Although the two events occur with similar frequency, evidence suggests that the total number of days exceeding the Q95 condition is fewer than for the Q98 condition (so abstraction restrictions would tend to be shorter). This is because during prolonged low flow events, flow usually continues to gradually reduce.

Evidence from 2018 indicates that the above threshold is not over-precautionary. The four major fish kills recorded were all at flows of Q98, or in once case Q99, and for three of them flow had been below a five-day moving average Q95 for 18-25 days (a moving average is used to smooth out blips where flow rises very briefly after a small amount of rain but with little or no recovery benefits).

Severe water scarcity is usually associated with hot, sunny weather. This leads to increased water temperatures, and can also cause reduced oxygen concentrations, particularly at night when water plants take up oxygen. Often it is high temperature and/or low oxygen that causes fish mortality during water scarcity events. This is a further reason to limit any reduction in already very low flows, as the more the flow reduces the more prone the water is to heating up and suffering from oxygen depletion. Similarly, any pollutants present are increasingly likely to cause an impact as dilution reduces.

Understanding of recovery from drought is limited. Recovery from single season droughts is generally rapid but recovery from multi-season droughts is much more variable and can be prolonged (Lake 2003). Fish, invertebrate and macrophyte communities may take several years to recover from the conditions arising from multi-season drought (references in Environment Agency 2013).

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