

British Wildlife freshwater fishes report 2022

Professor Mark Everard

Successive heatwaves driving temperatures in Britain above 40°C for the first time defined summer 2022, with drought extending into autumn. The Environment Agency blogged on 11th August, “Already this year we have received reports of over 200 dry weather incidents, and we expect this figure to increase”ⁱ.

Media widely reported Atlantic salmon (*Salmo salar*) dying in unprecedented numbers on the River Wyeⁱⁱ with more tolerant species, such as barbel (*Barbus barbus*), also succumbing. Low rainfall and extreme heat were perceived primary causes, exacerbating pollution linked to proliferation of chicken farming in the catchment. Brown trout (*Salmo trutta*) mortalities were reported from across Britain, from Cornwall to Lincolnshire.

No single meteorological incident is directly attributable to climate change. It is also regrettable that light rains and declining temperatures in September 2022 pushed climate off the headlines, despite making no impact on river and groundwater levels. ‘Climate attribution’ research, coordinated by the World Weather Attribution (WWA) initiativeⁱⁱⁱ, compares robustly peer-reviewed and risk-assessed modelling of severe events, such as major drought, heat and flood, both including and excluding climate change factors^{iv}. These comparisons inform attribution statements about the relative contributions of normal variability and climate forcing. Climate forcing attribution isn’t detected in many cases, but in others it can be a significant though never sole cause. This nuanced approach better supports more intelligent debate about threats facing aquatic and other ecosystems, many manifestations of climate change occurring through the water cycle.

Low water levels compounded by extreme heat have multiple implications for freshwater ecosystems, with fishes amongst the most sensitive and charismatic indicators. Reduced flows cease to flush gravels already impacted by siltation, and concentration of fish into residual pools increases vulnerability to predation and disease. Shallow waters amplify the effects of solar radiation, particularly for colder-adapted species like pike (*Esox lucius*), grayling (*Thymallus thymallus*), brown trout and Atlantic salmon.

Low rainfall and high evaporation also depress standing waters, with many ponds drying up. Fish rescues I was involved in near my home were repeated across the country.

Some freshwater fish species thrive in smaller, often overgrown ponds. One such is the ten-spined stickleback (*Pungitius pungitius*), also known as the nine-spined stickleback (dorsal count is variable). Ten-spined sticklebacks, the smallest native freshwater fish in Britain typically growing 5-6 centimetres long, are smaller relatives of the more widespread three-spined stickleback (*Gasterosteus aculeatus*). They favour small ponds and the margins of well-vegetated canals, streams and creeks. During prolonged spring and early summer spawning season, the eyes of male ten-spined sticklebacks turn shiny blue and the otherwise dull back turns shiny green, though never rivalling the gaudiness of male three-spined sticklebacks. Males of both species build nests of vegetation, stuck together with spigin secretions from the kidneys. Males entice a female into the nest to deposit eggs

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before driving her off and fertilising the eggs, repeating the process with several females. Male sticklebacks then guard and fan the eggs, removing dead ones, and nurture the emerging fry until free-swimming. Spawning occurs multiple times throughout the season. 'Improvement' of these habitats – vegetation clearance or stocking with other fish – can be detrimental to or entirely eliminate this small pond specialist. Greater risks occur in exceptionally dry and hot years when habitats dry out.

Crucian carp (*Carassius carassius*) are another small pond specialist. Unlike larger, introduced common carp (*Cyprinus carpio*), crucian carp compete poorly with other fish but can proliferate in suitable small ponds and abandoned canals. However, crucian carp have declined with the estimated 50% loss of farm ponds over the past 50 years^v, exacerbated by agricultural, urban and other encroachment and pollution. The February 2021 Wildlife Report described crucian carp conservation action, highlighting their lack of adverse impacts on other pond biota. A breeding crucian population in one of this author's garden ponds enabled the seeding during 2022 of yearlings into three suitable local ponds.

Genetic analysis now suggests that crucian carp may not, as formerly believed, be native to Britain, or at least may have been reintroduced during the 15th century^{vi}. This raises interesting questions about the objectives of conservation initiatives, which increasingly recognise difficulties inherent in re-creating past ecosystems given climatic shifts and massive landscape change. There is consequently a refocusing on ecosystem complexity and functioning, working with natural processes rather than expected species as a foundation for ecosystem restoration, better addressing biodiversity and climate crises and degradation of ecosystem services. Non-invasive species such as crucian carp with charismatic and heritage attributes, benign to other wildlife and characteristic of vulnerable and formerly significantly declining pond habitats rich in invertebrates with extensive macrophyte cover, can foster greater conservation support from and involvement of local communities including roll-out across private land. Maintaining crucian strongholds is also important as the species continues to decline nationally and is threatened across Europe.

Deepening evidence of climate change impacts emphasises the need for greater investment in the resilience of freshwater bodies, including rehabilitation or restoration of lost or degrading habitats. Pond conservation increases overall landscape-scale diversity. Phenological impacts can potentially break important ecological links such as timely availability of fine food items for emerging fish larvae, and adequately high water levels enabling anadromous species and those undertaking more localised migrations to access linked habitats essential for breeding, feeding, refuge and other needs.

Habitat protection and enhancement can play key roles in rebuilding resilience. During 2022, the presence of fry indicated the return of Atlantic salmon after an absence of 100 years to the Garrell Burn, a tributary of the River Clyde, enabled by channel re-naturalisation, installation of two fish passes and wetland habitat improvements. Juvenile salmon were also found in the rivers Dearne and Don near Sheffield for the first time in 250 years, attributed to installation of fish passes in addition to water quality and other environmental improvements. Improved fish passage can enable natural recovery even on better-quality and known salmonid rivers, with salmon found spawning in an upstream

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reach of the River Test in Hampshire following weir removal that also exposed spawning gravels as silt was flushed out by enhanced flows.

Riparian trees are particularly significant: their canopies provide shade, a cool microclimate, dissipation of storm energy and the recapture of evaporation recycling water locally. Falling leaves, seeds and fruits nourish aquatic food chains. Submerged roots and fallen wood constitute important physical structure, creating slack refuge areas and local scour, whilst also serving as a larder. Living and dead woody matter stabilises banks and resists strong flows, buffering flood and drought risk at whole-catchment scale. These processes support multiple fish species, including their diverse life stages from egg through larva, juvenile and adult.

2022 also saw increased NGO campaigning about under-investment in sewage treatment infrastructure, exacerbating fish deaths and contributing to poor environmental quality with wider ecological and human health ramifications. A testing year for freshwater fishes and wildlife alike.

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ⁱ Environment Agency. (2022). *Blog: Environment Agency takes action to rescue fish during dry weather*. Environment Agency, 11 August 2022. [Online.]

<https://environmentagency.blog.gov.uk/2022/08/11/environment-agency-takes-action-to-rescue-fish-during-dry-weather/>, accessed 23 September 2022.

ⁱⁱ WalesOnline. (2022). Distraught fishermen finding dozens of salmon dead in the Wye river during extreme heat. *WalesOnline*, 12 August 2022. [Online.] <https://www.walesonline.co.uk/news/distraught-fishermen-finding-dozens-salmon-24744181>, accessed 23 September 2022.

ⁱⁱⁱ World Weather Attribution (WWA) (no date). *World Weather Attribution initiative*. [Online.] <https://www.worldweatherattribution.org/about/>, accessed 3 November 2022.

^{iv} van Oldenborgh, G.J., van der Wiel, K., Kew, S., et al. Philip, S., Otto, F., Vautard, R., King, A., Lott, F., Arrighi, J., Singh, R. and van Aalst, M. (2021). Pathways and pitfalls in extreme event attribution. *Climatic Change*, 166, 13. DOI: <https://doi.org/10.1007/s10584-021-03071-7>.

^v WWT. (2022). *Restoring lost farmland ponds*. Wildfowl and Wetlands Trust (WWT). [Online.] <https://www.wwt.org.uk/our-work/projects/restoring-lost-farmland-ponds>, accessed 23 September 2022.

^{vi} Jeffries, D.L., Copp, G.H., Maes, G.E., Lawson Handley, L., Sayer, C.D. and Hänfling, B. (2017). Genetic evidence challenges the native status of a threatened freshwater fish (*Carassius carassius*) in England. *Ecology and Evolution*, 7, 2871–2882. DOI: <https://doi.org/10.1002/ece3.2831>.