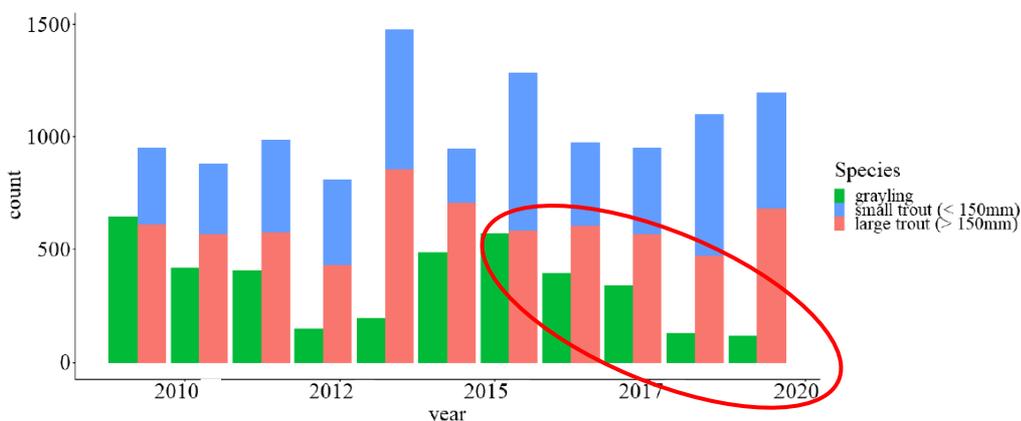


# Grayling as an early warning system of climatic pressure on salmonids

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In 2019 we received several reports of low grayling numbers from anglers on various local rivers, including the Itchen, Meon and Western Rother. These observations matched the findings of a recent report from the Wylde Grayling & Trout Study – a long-term project (24 years) monitoring grayling and trout populations on the river Wylde in Wiltshire (a major chalkstream tributary of the Hampshire Avon). Annual fish population surveys have revealed a steady decline in grayling abundance since 2015, as shown in Figure 1 below. The project has now expanded to collect and collate additional data, such as water temperature and flow, to understand drivers of population abundance.



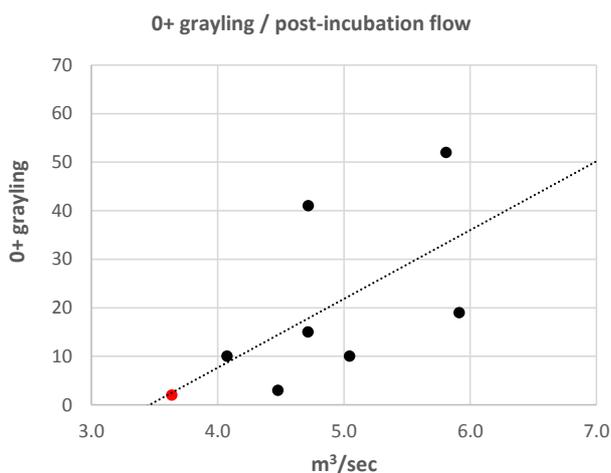
**Figure 1: Grayling & trout survey catches, R. Wylde Grayling & Trout Study.**

(Graph courtesy of: Game & Wildlife Conservation Trust; Piscatorial Society & Natural Resources Wales).

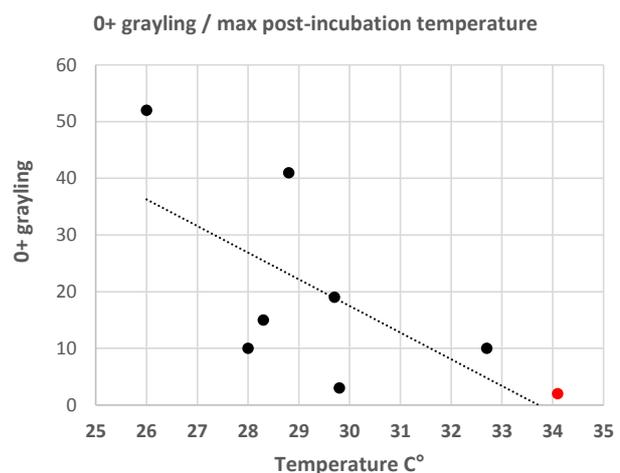
A paper based on the results of the study between 2009 and 2016 looked in detail at the primary environmental drivers of grayling recruitment (successful production and survival of juveniles) and highlighted the importance of two key factors (Bašić, 2018). The first was water temperature in the months following hatching (April-Aug), where temperatures up to 13.5c° had a positive effect but above that threshold, a negative one. The second was that low flow in the same period had a consistently negative impact on juvenile grayling abundance. The paper rightly emphasises the importance of grayling as early warning indicators of climatic pressures on salmonids.

We hold a great deal of grayling data for various sites in Solent and South Downs Area but the most suitable one for analysis is Bishopstoke Barge on the Itchen, which has a higher average juvenile grayling catch than any other site and has been surveyed frequently since 2004. In general, the Bishopstoke data accords with the Wylde study findings: abundance of young of the year grayling at this site is strongly, positively correlated with average flow in the post-hatching period (Apr-Aug, measured at nearby Allbrook / Highbridge gauging station). However, we do not have access to detailed, long-term water temperature data for the Itchen, so analysed air temperature records derived from the Met Office's Central England Temperature dataset, with interesting results. An even stronger, negative correlation exists between juvenile grayling abundance at Bishopstoke and the maximum air temperature recorded each summer, suggesting that harm that can be done to grayling recruitment as a result of acute periods of hot weather.

Figure 2 below illustrates the positive relationship between flow in the April to August period and the number of juvenile grayling caught in late summer surveys at Bishopstoke Barge. Figure 3 shows the negative relationship between juvenile grayling abundance and peak summer air temperature. In both graphs, the data points for 2019 are shown in red, highlighting the acute combination of low flow and high air temperature that was the context for the lowest grayling catch ever recorded at this site.



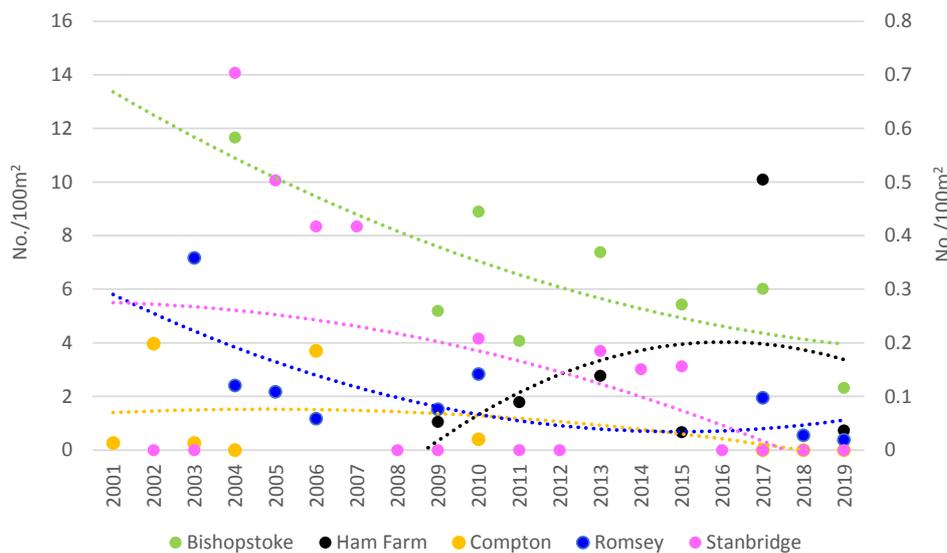
**Figure 2: 0+ grayling abundance and post-incubation flow**



**Figure 3: 0+ grayling abundance & max post-incubation air temperature**

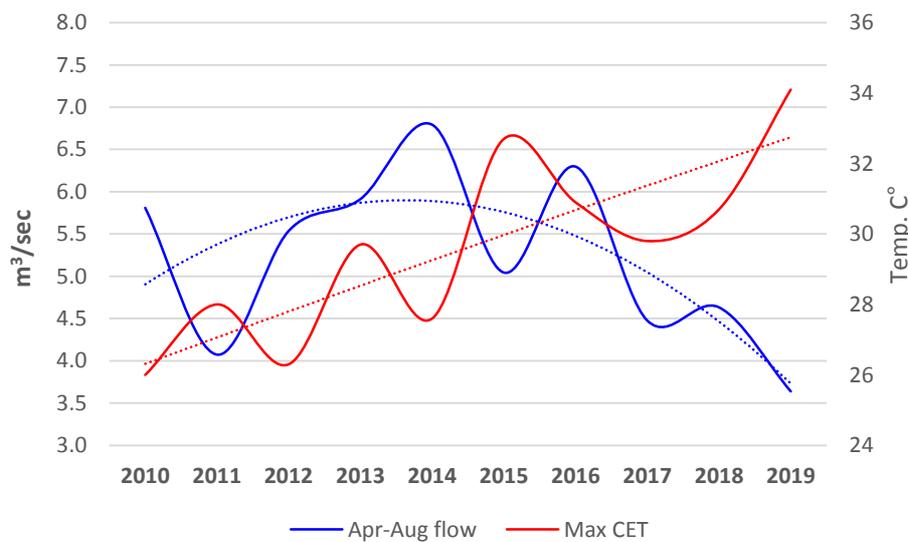
What about other rivers in Solent and South Downs Area? Figure 4 shows grayling density (number per 100m<sup>2</sup>, all ages) for Bishopstoke and Ham Farm on the Itchen; Compton and Romsey on the Test and Stanbridge on the Western Rother, for all surveys conducted since 2001: note that Compton was surveyed annually between 2001 and 2019 but yielded no grayling.

Polynomial trendlines are given for each dataset, which indicate two notable points: firstly, that all sites except Ham Farm have exhibited a declining trend in grayling abundance during this period (Ham Farm produced a remarkably high catch in 2017, which bucked the trend there); and secondly, that 2019 saw particularly poor catches at every site.



**Figure 4: Grayling catches at several sites, 2001-2019**

What about the general trends in summer flow and temperature in recent years? Figure 5 below covers the past ten years and shows average flow on the Itchen for the period 1st April-30th August (blue line) and maximum Central England Temperature (red line), both with polynomial trendlines. With low April to August flow and high maximum summer temperature being associated with poor grayling recruitment, the climatic conditions responsible for the exceptionally poor juvenile grayling abundance in 2019 are plain. Of broader concern is that the trendline for maximum temperature indicates an upward trajectory, while the trendline for April to August flow shows a declining trend since 2014 and remarkably low flows for the past three years. However, rainfall and groundwater levels in winter 2020 should result in reasonable chalkstream flows during the critical period for grayling in the summer ahead, potentially disrupting this particular trend to a degree.



**Figure 5: Max. Central England Temperature and Apr-Aug Itchen flow, 2010-2019.**

The results of these analyses shed light on what needs to be done to conserve grayling in their own right, as a unique species valued by anglers and anyone with an appreciation for wildlife. Equally importantly, if we regard thermally-sensitive grayling as an “early warning system” for salmonid conservation as whole, then the alarm has been triggered. On both counts, there are three principal tools to counteract these mounting climatic pressures: to protect flows; to keep rivers cool with carefully considered shading projects and to protect and restore the natural, physical complexity of river channels in order to ensure areas of thermal refuge and population resilience.

There is a positive perspective in the sense that, as long as there are sufficient broodstock available, grayling do have the capacity to bounce back: under optimal conditions, they can reproduce prolifically and grow rapidly – note the recovery indicated for the period 2012 to 2015 in Figure 1.

Of course, the primary focus here is on wild fish populations, but commercial fisheries with a stocked-trout dependent business model, should keep a watchful eye on the trend towards climatic conditions that challenge the thermal tolerance of their stock and the management measures that they might consider in mitigation.



An adult grayling from Bishopstoke Barge on the Itchen, 2019

**Reference:** Bašić T, Britton JR, Cove RJ, Ibbotson AT, Gregory SD. Roles of discharge and temperature in recruitment of a cold-water fish, the European grayling *Thymallus thymallus*, near its southern range limit. *Ecology of Freshwater Fish*. 2018; 27:940–951. <https://doi.org/10.1111/eff.12405>