

Citizen Science Fish Kill Investigation Guide



Windrush Against Sewage Pollution



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Background

Fish kills, where a significant number of fish suddenly die in the wild, are all-too-familiar in the UK today. With only 16% of surface water bodies in England meeting good ecological standards (Environment Agency, 2021), it is no surprise that fish are often unable to survive. Due to pollution from sewage, agriculture and urban run-off, many rivers and lakes are already lifeless. In the aquatic environments where fish cling on for survival, sudden acute pollution events can lead to fish kills which devastate the remaining population.

How to use this guide

The background section (pages 2-4) provides some context for this guide, explaining why citizens are needed to hold polluters to account after fish kill incidents.

We recommend reading through the whole guide to assist with your investigation, and printing, or downloading it to your mobile device for access in the field. The most accurate and straightforward method of data entry is via Epicollect on your mobile device. If using this software, then pages 5-12 are essential to have access to in the field (downloaded or printed). This includes step-by-step guidance on performing the investigation (pages 5-9) and a visual fish ID guide (pages 10-12).

The appendix includes a paper method of data entry (pages 13-18), should you not be able to use Epicollect, and links to live sewage maps (page 19).

Objectives of the citizen science fish kill guide

Immediate investigations are needed to identify the cause of fish kills and hold polluters to account. This is, in theory, the responsibility of the Environment Agency (EA). As a series of failed investigations have demonstrated, the EA have been unable to respond effectively. The result being that polluters who might have been found culpable by an effective investigation are let off the hook.

One consequence of the EA's budget being cut by over 50% in the past decade (The Independent, 2022) and associated internal policy decisions is that the threshold for EA staff to be called to investigate a fish kill on the ground has increased. Our environmental watchdog is stretched thin and lacks the budget to investigate many aspects of pollution, including fish kills.

This guide has been produced so that citizens can collect vital evidence through a clear, scientifically rigorous process. Time is of the essence in fish kill investigations, and local citizens as first responders, armed with an understanding of what evidence to collect, can obtain on-site evidence much faster, and more widely than EA teams are able to.

This guide has been produced in line with scientifically rigorous guides produced by the central authorities of South Africa (Grant, Huchzermeyer, & Hohls, 2014), Australia (The Australian Government Department of Agriculture, Fisheries and Forestry, 2007), and the United States (Meyer & Barclay, 1990). Following clear guidelines, citizens can perform the on-site observations, and take water samples in a similar manner to official investigators. The collection of fish samples has been omitted here, in order not to interfere with evidence salient to potential EA investigations, and due to the complexity of the collection, submission, and testing required.

Common causes of fish kills

Fish kills can occur naturally, due to droughts, or natural algal blooms which, in many cases, are made worse by artificial and sometimes unpermitted inputs of damaging nutrients. As the UK gets hotter with climate change, we expect to see more extreme weather events and therefore, more fish kills (New Scientist, 2023). The primary mechanism behind fish kills of this sort is an event leading to a decline in dissolved oxygen in a water body, leading to death by asphyxiation. In other cases, blue green algae can also cause death due to poisoning by toxins. Climate-induced extreme weather events may also be implicated in sudden drops of dissolved oxygen, but pollution also plays a significant role.

Pollution, primarily from sewage and agricultural runoff, contains nutrients such as nitrogen and phosphorous. Algae, which naturally occurs in waterways, receive far more nutrients than they would naturally and so proliferate. Nighttime, alga respiration depletes the dissolved oxygen level in the water. In acute cases, the dissolved oxygen level drops so low that fish and other aquatic life cannot breathe, and so a fish kill occurs.

Dissolved oxygen depletion can have multiple causes, including agricultural runoff, sewage pollution and extreme high temperatures. This makes pinning the exact cause of a fish kill challenging. However, investigations can shed light on the possible causes and in some cases, lead to convictions. Thames Water was fined £3.3m after discharging millions of litres of undiluted sewage, killing more than 1,400 fish, following an EA investigation (BBC News, 2023).

Unfortunately, these prosecutions are rare. They demonstrate that fish kill investigations, using a rigorous scientific method deployed promptly following identification of the event can lead to prosecutions for those responsible. However, many investigations fail, or are never undertaken.

How not to investigate a fish kill: The EA's response at Cunsey Beck

On the 21st June 2022, over 1000 fish were killed in Cunsey Beck, a tributary of Lake Windermere, which is a designated Site of Special Scientific Interest (SSSI). The EA's investigation concluded that they were 'unable to identify the source or cause of the incident' (Panorama, 2023). Through Environmental Information Requests, Save Windemere (Staniek, 2023) and WildFish (Overington, 2023) have exposed the gross failures of the EA's investigation.

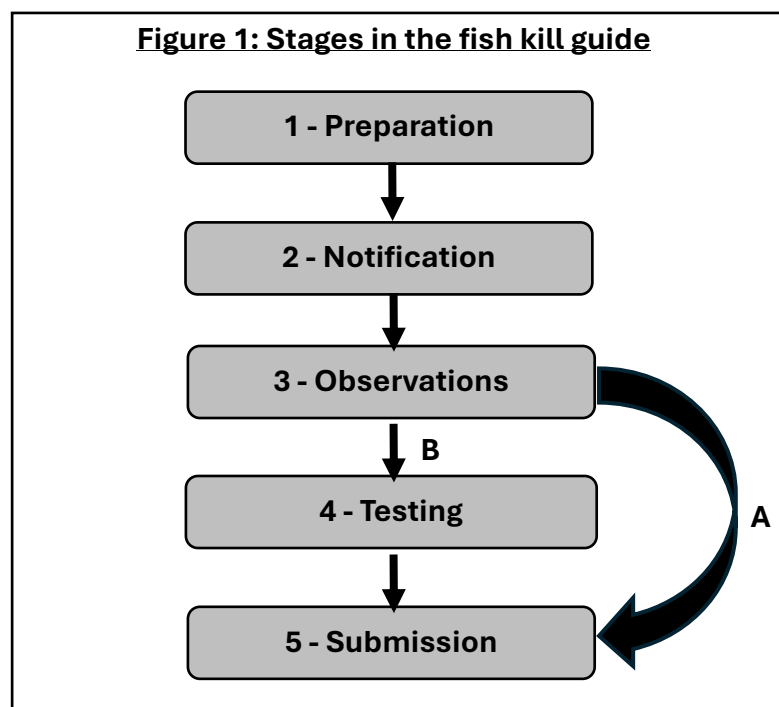
The landowner who first reported the fish kill identified the Sawrey wastewater treatment plant as a likely source of the pollution incident, with 1 fish found upstream and 1000+ fish found downstream of the work's discharge pipe. On the day of the event, the EA officer took 1 water quality sample upstream of the works, and 0 downstream. The next day, they collected a sample 50m upstream of the works, whilst collecting the downstream samples over 1km away.

Both Wildfish and Save Windermere's findings culminated in a BBC Panorama documentary (Panorama, 2023), which details the litany of errors in the EA's investigation. Ultimately, their conclusion which ruled out United Utilities sewage works as a cause lacked scientific reasoning.

The EA suggests that upon seeing a fish kill event, the public should contact their hotline to report it, and let the EA investigate. As the failed Cunsey Beck investigation demonstrates, the EA cannot always be trusted to fulfil their responsibilities. This guide emerges so that we can take control of the process and prevent similar failures in the future.

Field Investigation

Figure 1 demonstrates the different stages in the fish kill guide. The next sections provide details on each of these stages. Whether path A or B is followed depends on local expertise and equipment. Whilst many groups have the capacity for water quality testing, some do not, and valuable evidence can be collected without water quality measurements. This guide is produced in the hope that any citizen armed with it can produce meaningful and scientifically rigorous evidence. It is purely advisory and makes clear the options which are open investigators depending on the expertise and equipment available.



1 - Preparation

The preparation stage has 3 key components: sharing, familiarisation, and monitoring equipment checks and accessibility.

- a) **Sharing** - This guide can only be used if people know it exists. Whether you are an individual or an organisation, the wider this guide is shared, the more hope we have of achieving a rapid local response capable of holding polluters to account. Please share it via any channels that you can.
- b) **Familiarisation** - This guide is intended to be accessible to an individual to use it upon first reading once an event has occurred. However, being familiar with the

stages of the response before a fish kill event will speed up the process. Time is of the essence once a fish kill has occurred or is occurring. Familiarizing yourself with the incident log and the accompanying notes will be particularly useful.

- c) **Monitoring equipment checks and accessibility** - Many individuals and groups across the country possess water quality monitoring equipment. There is a huge range of devices used across the country. Whatever methods are at your disposal, ensuring that they are ready to go at short notice is essential. Firstly, the equipment itself must be well maintained. Secondly, it should be accessible to as many people as possible who are trained in its use. Few are available at the drop of a hat to respond to a fish kill, so the more people who can respond and have access to monitoring equipment, the better the chances of a response.

2 - Notification

This guide is intended to supplement, not replace any EA response. The first action for anyone coming across a fish kill event is to notify their relevant government body. The relevant contact numbers are as follows:

- England – Environment Agency - 0800 80 70 60
- Wales – Natural Resources Wales - 0300 065 3000
- Scotland – Scottish Environmental Protection Agency - 0800 807 060
- Republic of Ireland – Inland Fisheries Ireland - 0818 34 74 24
- Northern Ireland – Northern Ireland Environment Agency – 0800 90 70 60

Once the fish kill event has been observed and the relevant agency contacted, the initial assessment phase should be triggered. At no point does this investigation conflict with any possible Environment Agency response. In the case of fish kills, good evidence is rapidly obtained evidence, and so citizens armed with this guide can be integral in the investigation.

Observations and water quality samples obtained in this guide are entirely compatible with the Environment Agency's own investigation (if launched). The only phase which would interfere is the collection of dead fish samples, which is omitted for this reason.

2 - Observations



Epicollect

The most straightforward and accurate method of recording your observations and measurements is through the epicollect app by searching 'epicollect5 data collection' on android and IOS devices. Epicollect is a free and easy-to-use mobile data-gathering platform, produced by Oxford University, which is widely used in the water industry.

You can find a step-by-step guide to carrying out a fish kill investigation by searching on Epicollect for 'Citizen science fish kill investigation guide' or by clicking the following link: <https://five.epicollect.net/project/citizen-science-fish-kill-investigation-protocol>

It is strongly encouraged to use this app to complete the observation stage. It makes data collection straightforward, and takes you through the process step-by-step in the field. It also allows for accurate GPS location of observations and filming, which is crucial to identifying the key sites of the fish kill. In the case that you do not have access to a compatible mobile device, then you may use the paper version, found in appendix B.

General guidelines

- Having found a fish kill, take a **walk up and downstream to try to locate a source of the pollution**. This could be from a sewer overflow, sewage works, agriculture, chemical leak or another source.
- During the entire investigation, you **must ensure that you have the right to access the site**, whether through public right of way or obtaining landowner permission.
- You can **check live sewage maps** for sewage works nearby which may be responsible by following one of the links in Appendix D.
- Follow either **Epicollect**, or stages in Appendix B for step-by-step instructions to make and **record observations**.
- **Keeping a clear record** whilst at the site is essential. Wherever possible, please fill in every question on Epicollect. If without a suitable device, then use the Appendix B to keep a clear log of locations.
- **Drawing a map** whilst on site can be useful to clarify the locations at which you have made observations, which can be labelled on the map. This need not be a work of art, but may be useful to keep track of the observations you have made.
- For the fish identification, use **the fish ID guide** in appendix A.

3 - Testing

Water quality testing does not offer a silver bullet for determining the cause of fish kills. It provides information about water quality at the time of testing. The causal agent may not still be present, or may be significantly diluted, depending on how quickly samples are obtained.

In conjunction with other factors such as weather, adjacent land use or known sewage spills revealed by Event Duration Monitors (EDMs), rapidly obtained water quality samples can be a key piece of the puzzle when determining the cause of a fish kill. Water quality testing forms a key part of all official state fish kill guides which have informed this one and so is represented for citizens here.

As stated in Figure 1, water quality testing may not be possible in all cases. Individuals without access to sampling equipment or expertise may feel unable to perform water sampling. However, individuals are encouraged to reach out to local river groups with for assistance with all stages of the response, including sampling.

If you are reading this guide and do not know of any local river groups in your area, then please send us an email at info@windrushwasp.org with the subject line 'FISH KILL' and we will do our best to put you in touch with a group with water quality testing capacity.

Safety Advice

Anyone performing a fish kill investigation must take time to identify potential hazards. This includes risks such as riverbank collapses, falling into the water, contact with contaminated waterways, and exposure to extreme weather conditions like heat, wind, and rain. Additionally, hidden hazards such as broken glass, sharp metal fragments (including fishhooks), may be buried in the sediment of rivers and dams, posing a risk of serious injury if proper caution is not taken.

To ensure the investigator's safety, appropriate precautions must be implemented. These may include wearing waders in streams suitable for wading, using lifejackets during sample collection, and wearing latex examination gloves. Additionally, suitable clothing should be worn to prevent conditions such as hypothermia, heat exhaustion, sunstroke, or drowning.

Location of water testing

- In all cases, water samples should be collected from the immediate area of the dead or dying fish.
- In all cases, water samples should be collected from any potential source of pollution identified through observation.
- In rivers, samples should also be collected upstream and downstream. Ideal locations are: 25m upstream, the immediate area, 50m downstream, and 300m downstream. The distance possible will depend on accessibility, and people should use their own discretion to select locations around these guidelines which can be accessed safely and legally.

In-situ water quality assessment

Many groups have access to in-situ water quality testing kit. A wide range of devices are available, for testing a wide range of parameters. Producing a user guide for all the testing methods available is intractable, so we will instead provide some guidelines for ensuring you get the most out of whatever equipment is at your disposal.

When it comes to water quality monitoring, the more parameters we can test accurately the better. Responding to fish kills, the parameters which are of particular concern include:

- pH
- Temperature
- Dissolved oxygen
- Conductivity
- Turbidity
- Nitrate
- Ammonia

Where groups have the capacity to test any of these parameters in-situ, it is encouraged. Following the manufacturer-recommended guides for all sampling and ensuring maintenance of kit is essential for the collection of reliable data.

A detailed log of any in-situ testing must be taken. In some cases, this occurs through a mobile software. In others, it must be recorded on paper. Appendix C contains a useful logging tool for use if needed. Ultimately, individuals and groups should follow the best practice as defined by manufacturers of their equipment to obtain a scientifically rigorous set of results.

4- Submission

During the notification phase, you will have established a line of communication with the relevant environmental agency. They may or may not respond to the event you have notified them about. In any case, all findings must be shared with the relevant environment agency. In order to do so, you will need to call back the relevant environment agency, and request an email address to send your completed report to.

Please also share the report with WASP and your local group so that we can help to ensure that it gets the consideration it deserves as the investigation progresses. You can find us at info@windrushwasp.org. Please notify us via this email once you have completed the fish kill guide, whether on paper or epicollect and we will ensure it is shared with the relevant environment agency.

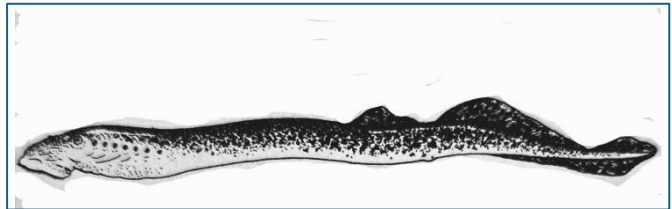
Appendix

A – Fish ID guide

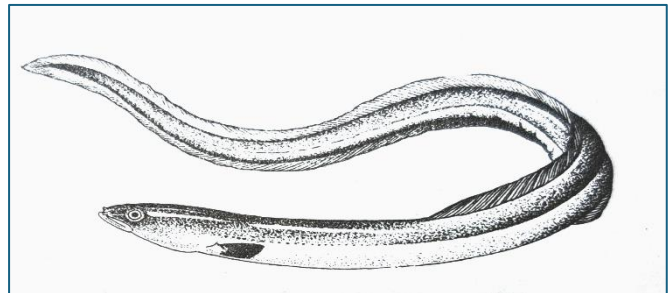
There are around 50 species of fish found for at least part of their lives in the freshwaters of the British Isles. Of these only 42 are classed as native and a number are classed as naturalized e.g. common carp or non-native species e.g. wels catfish and zander.

Many of these fish superficially look quite similar and are sometimes difficult to tell apart, but of course the more detail that can be collected during a fish kill investigation the better. This guide is set up to give simple guidance to the main species you can expect to find during a fish kill. However, the two most important details to collect are a total count of the dead fish seen and for high quality photographs of the situation and the fish killed.

1. Body elongated and rounded – rounded disc like mouth and holes in the side of the head – **Lamprey**

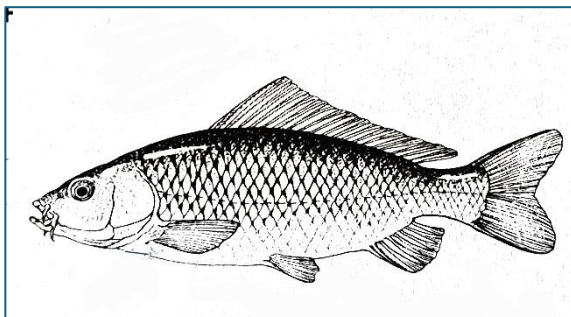
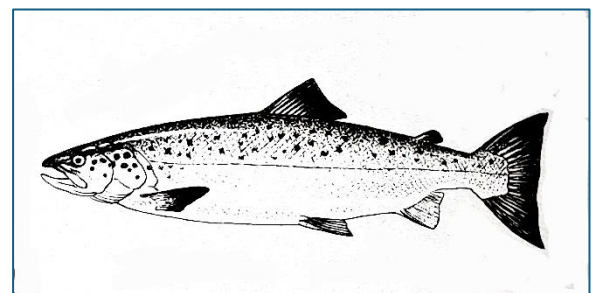


2. Body elongated and rounded. Normal two-part jaw with normal mouth – **Eel**



3. Two sets of paired fins and dorsal fin on back, anal fin and tail fin.

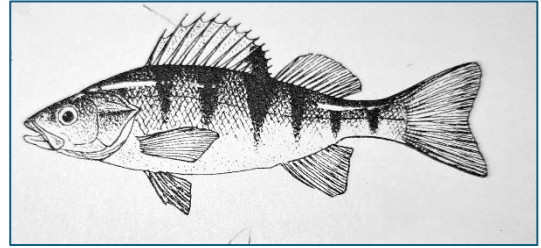
4. Two sets of paired fins – dorsal fin on back, anal fin and tail fin but with a further small fleshy fin toward the tail. This group are the **Salmonids** and the two most likely are **Brown Trout** or **Grayling**



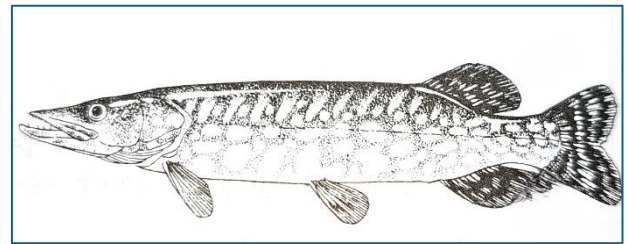
5. Body fully scaled, pelvic fins on belly halfway between head and tail. **Cyprinids**

6. Body appears scaleless and pelvic fins are formed into a sucker like formation – **Bullhead**

7. Pelvic and pectoral fins close together near head. **Perch** and **Sticklebacks**.



8. Dorsal fin placed far back near tail. Large head and mouth. **Pike**



Note: Line drawings redrawn from Wheeler. A (1998) Field key to the Freshwater Fish and Lampreys of the British Isles.

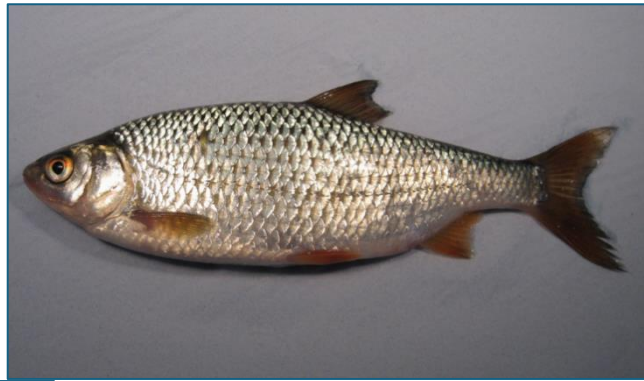


Lamprey. There are three species found in the UK – brook, river and marine lamprey. These are very difficult to differentiate when young. They all undergo dramatic changes through their lives, but the small holes along the side of the head and sucker-like mouth make them easy to identify as a group.

Brown trout – A very common species throughout UK rivers. The red spots along the flanks are highly characteristic of this species but will fade after death. Always look for the adipose fin between the dorsal and tails fins.



Roach – another very common species throughout UK rivers and stillwaters. A silver fish with red fins



Perch – The most obvious characteristic for this species is the two dorsal fins and the marked stripes down the back. The first dorsal fin is very spikey.

Pike – A dramatic and often very large fish – often over 30cms (1foot) in length. They are characterised by a very large head and mouth. The dorsal tail and anal fin are also set well back on the body.



This is a simple guide to give simple steps to some of the more common species found in UK rivers. There are also two excellent guides available to allow a bit more in depth study of the fish species and potentially better identification of the species seen.

Wheeler. A (1998) Field key to the Freshwater Fish and Lampreys of the British Isles. Field Studies No9.

Croft & Roberts (2006) Field Studies Council Fish Guide, British Freshwater Fish. ISBN – 9781851532193

More images available at: <https://canalrivertrust.org.uk/things-to-do/fishing/caring-for-our-fish/freshwater-fish-species>

B – Observations log

Timeline		
First observation	Date:	Time:
Relevant environment agency contacted	Date:	Time:
Start of investigation using this form	Date:	Time:
Completion of investigation	Date:	Time:
Investigation submitted to relevant environment agency	Date:	Time:
Investigator(s) details (Group and/or individual)		
Name/contact details of original observer(s) (add as many as relevant/consent to contact via details shared)		
Observations		
Type of water body (tick all that apply): Marine Fresh Running Still Estuarine		
What did you see? (Clarity/colour of water, smell, foaming, and any general observations of the site)		

Location of fish kill: (provide what3words, accurate grid reference points, or any method preferred for identification of location)

How to access fish kill location:

Adjacent land use:

Potential sewage source nearby: (identified via observation, or live sewage maps linked in appendix D)

Draw or insert map of fish kill location: (include landmarks, location of photographs taken and direction taken from, location of water samples if taken, north arrow, direction of water flow, any discharges into or out of the water flow, and any other relevant details)

Note: if attaching satellite map after on-site investigation then it is recommended to draw one whilst on site.

Current weather conditions: (wind, rain, temperature)

Weather conditions in the past 24 hours: (wind, rain, temperature)

Number and condition of fish		
Length of river covered:	Number dead:	Species: (use fish ID guide in appendix A)
		TOTAL
If live animals are present, describe their behaviour:		

D - Links to live sewage maps

Since May 2024, live sewage spill maps are now available. These can be used to check for any nearby sewage spills which may be responsible for the fish kill. The links for each company are as follows:

- Anglian Water – <https://www.anglianwater.co.uk/environment/storm-overflows/storm-overflow-map/>
- Northumbrian Water – <https://experience.arcgis.com/experience/38baf2cf48d74b8196539ef315bea6b5>
- Severn Trent – <https://www.stwater.co.uk/in-my-area/storm-overflow-map/>
- Southern Water – <https://www.southernwater.co.uk/our-region/clean-rivers-and-seas-task-force/beachbuoy/>
- South West Water – <https://www.southwestwater.co.uk/waterfitlive>
- Thames Water - <https://www.thameswater.co.uk/edm-map>
- United Utilities – <https://www.unitedutilities.com/better-rivers/storm-overflow-map/>
- Welsh Water – <https://corporate.dwrcymru.com/en/community/environment/storm-overflow-map>
- Wessex Water – <https://www.wessexwater.co.uk/coast-and-rivers-watch-map>
- Yorkshire Water - <https://experience.arcgis.com/experience/45b567b9b39d4ceea64c22c19366d118/page/Page/>

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