

## **A consultation on NRW's salmon stocking, third party salmon stocking and the future of NRW's hatcheries**

Wales' environment is one of our greatest resources. Cherished by the people of Wales and beyond for its wildlife, landscapes and seascapes, it is vital for the range of services it provides – food and water, energy, recreation and even the air that we breathe. Our environment contributes to our economic prosperity and our sense of community.

The Welsh Government is committed to ensuring that we use and manage Wales' natural resources in a way that will deliver lasting economic and social as well as environmental benefits.

As a new organisation, Natural Resources Wales (NRW) is reviewing many aspects of the work we do to make sure they are as effective as possible in delivering for people, the economy and the environment. One programme of this work is the 'Agenda for Change' which looks at how NRW works with partners towards achieving sustainable inland fisheries for Wales.

As part of this we are considering all of our fisheries activities. This includes a review of our own existing salmon stocking activity and associated hatchery operations. In the review we are considering the rationale, justification and implications of NRW's activities in rearing and stocking salmon into Welsh rivers, the implications of our considerations for others wanting to do this, and our own capacity in this work.

The review reported to our Executive Team just before Christmas. To assist NRW in making any final decisions as to the recommendations set out in the review, we are now carrying out this full public consultation and we would now like your views on the recommendations and any other comments you would like to make.

We particularly welcome evidence in support of your response.

## Natural Resources Wales and inland fisheries

Inland fisheries are of great importance to the environmental, social and economic well being of Wales. It is appropriate that we identify the relevant successes, challenges and specific issues and concerns so we can influence the development of a more integrated shared approach to the sustainable management of natural resources to deliver for inland fisheries alongside other outcomes.

Overall policy responsibility for Welsh fisheries is devolved to the Welsh Government. NRW is responsible for regulation of inland fisheries in Wales (including salmon, sea trout, eel, smelt and lamprey out to 6 nautical miles) and has a general duty under the Environment Act 1995 to “maintain, improve and develop fisheries”. This is achieved through implementation of legislation and externally funded work based on actions agreed with Welsh Government.

Although much has been achieved in Wales for inland fisheries there are challenges, now and in the future, that current evidence, approaches and resources cannot adequately address. NRW has a wider range of duties and functions than the EA previously worked with. These functions are identified in The Natural Resources Body for Wales (Functions) Order 2013. The general effect of this Order is that the Welsh devolved functions of the Environment Agency and the Forestry Commission and nearly all the functions of the Countryside Council for Wales have transferred to NRW. Consequently, we will need to work more collaboratively with a wide range of partners, some new to us, to develop a more integrated approach to natural resource planning that delivers the actions for sustainable fisheries on the ground. Some of the actions we take may be different to our historic approaches.

We must be clear that the programme of actions we develop is aligned to the principles of sustainable development from the outset, and that climate change adaptation principles are embedded into all our work.

We have set out our approach for agreeing the strategic direction for the future management of inland fisheries in Wales in our document 'Sustainable inland fisheries - an agenda for change'

A key component of this agenda is the use of management approaches both directly for fish, but also for the wider environment that supports fish. We need to weigh up the potential benefits against the potential costs of different approaches to determine the most cost-effective forms of fisheries management, and develop work with our partners to put this into practice.

As part of delivering this change, we are reviewing the role and effectiveness of fish stocking for sustainable fisheries management and along side this, the future role our hatcheries could play in this.

## Overview of NRW salmon stocking & hatchery activity in Wales

NRW and its predecessors have been undertaking salmon stocking operations in Wales for many years. For example the Wye has been stocked intermittently since the early 20<sup>th</sup> century. More recently, since the 1960s, our predecessors carried out stocking activity in the understanding that hatcheries could produce a greater number of adult fish than would occur if the parents were left to spawn naturally. Stocking was therefore an obvious candidate to mitigate for lost habitat due to reservoir impoundments built in the second half of the 20<sup>th</sup> century and pollution incidents,, but it was also used more widely by fisheries owners seeking to enhance the abundance of adult fish.

Hatcheries generally function on the basis that taking adults from the wild, and caring for eggs and fry in a hatchery, leads to increased overall survival compared to that expected in the wild. The expectation is therefore an increased number of adults than would have arisen naturally. Understanding of potential population-scale harm through adverse genetic effects and the ability to test the effectiveness through genetic fingerprinting has developed since these programmes commenced, and notably within the past 5 to 10 years. We now have an opportunity to take account of this rapidly developing body of research and use it to inform our approach to implementing the full range of statutory functions and duties from the predecessor bodies in a more integrated way than could previously be achieved.

The list below describes the main salmon stocking programmes that NRW either leads on or contributes to alongside partners, and the reason for each programme's existence. It also identifies the hatchery responsible for producing the fish. NRW's hatcheries have also, in the recent past, been involved in work to study and restore populations of pearl mussels and white-clawed crayfish and have worked on other rare fish species such as Arctic Char and Gwyniad.

*Salmon stocking directly undertaken or contributed to by NRW*

<b>River:</b>	<b>Reason for programme</b>	<b>Organisation responsible</b>	<b>Hatchery supplier</b>
Dee	Celyn reservoir mitigation	NRW	NRW Maerdy
Wye	Elan reservoir mitigation	NRW and partners	NRW Cynrig
Tywi	Brienne reservoir mitigation	Dwr Cymru Welsh Water(DCWW) and NRW	Private source
Cleddau	Llysyfran reservoir mitigation	DCWW and NRW	Private source
Taff	Cardiff Bay Barrage mitigation	NRW and the Council of the City & County of Cardiff	NRW Cynrig
Seiont	Mitigation for Dinorwic power scheme	NRW and Central Electricity Generating Board	NRW Maerdy
Rheidol	Mitigation for a hydropower scheme	NRW and Powergen	Private source
Mawddach	Mitigation for pollution event	NRW and partners	NRW Maerdy (previously Mawddach)

## Effectiveness of salmon stocking

Although salmon stocking has been carried out in some form for almost 100 years in Wales, there is little evidence available to allow NRW to determine whether salmon stocking has been effective at achieving the objectives of mitigating for lost habitat or improving rod catches. Effectiveness can be defined in a number of ways, but since the majority of salmon stocking in Wales occurs on rivers designated as Special Areas of Conservation (SAC) under the Habitats Directive (some specifically for their wild salmon populations), our review defines effectiveness as “improving and safeguarding wild population fitness”. This is also the best guarantee of improving rod catches.

There are two rivers in Wales where stocking programmes have been monitored recently, the Taff and the Dee. Work undertaken on the Taff demonstrates that the salmon stocking programme implemented in the late 1980s did indeed make a significant contribution to restoring salmon runs to the river in the early phases of work. Prior to impoundment by the Cardiff Bay Barrage, hatchery smolt releases contributed 8.5-23.7% of the monitored return of one sea winter salmon, and 0 – 23.4% of the two-sea-winter run. In one later year (2004) hatchery fish contributed about 40% of the entire run of fish. However improvements to water quality and habitat and resolving migratory barriers then also made critical contributions, and as the salmon population has increased and successful wild spawning has expanded throughout the catchment, the contribution from stocked fish is decreasing, as we might expect. Recent estimates demonstrate that fish derived from natural spawning in the newly opened and improved catchment now dominates production with hatchery fish yielding about 6% of the annual run of salmon. We believe that the hatchery contribution played an important role in initiating and catalysing recovery of the Taff salmon population.

The great majority of stocking in Welsh rivers is to mitigate for reservoir developments but there is very little evidence available to demonstrate the success of these programmes. This applies to most of the stocking carried out previously by the Environment Agency, and now by NRW, and by others. The River Dee is one of the most important index rivers in England and Wales and extensive mitigation stocking and monitoring has taken place there. We know from our analysis of adult salmon returning to the river that there is a significant difference between the rates of return of wild and hatchery reared smolts. The estimated survival rates for wild smolts returning to the river is 4.6% (range 1.9-7.1%). This is significantly higher than the estimated 0.2% (range 0.06-0.5%) of hatchery reared smolts that survive to adult returner. The survival rate for stocked parr, 0.1% (0.00-0.5%) is lower still.

Further evidence is available from two other UK studies:

The report on the recovery of salmon on the River Tyne draws a similar conclusion. The hatchery made an early contribution to the restoration of salmon, however, once water quality improvements started to take effect and the population was able to increase

through natural recruitment, that contribution became less significant, as a proportion of the overall population.

In terms of restoration on rivers that suffered extinctions during the industrial revolution it appears that stocking, in conjunction with the removal of the problems causing extinction in the first place, is able to facilitate a recovery to the point at which the population can become self-sustaining. It appears that continued stocking beyond this point will not be cost effective and may potentially cause negative impacts.

More recently, in a wide ranging genetic study, the River Spey Fishery Board found that the contribution of their hatchery programme to the rod catch varied from 0 to 1.8%.. They used their estimated angler exploitation rate of 15% and, from the data they have made available, this means that the hatchery did little more than generate a similar number of returning fish as had been taken from the river for broodstock.

A related study published in 2013 compared catch statistics for stocked and un-stocked rivers in England and Wales. It found no evidence for a positive relationship between annual stocking efforts and catch statistics that would have occurred had the stocking been successful at significantly increasing the number of adult returners.

It is significant that a number of other salmon stocking programmes are being wound down or ended, partly on the grounds of lack of effectiveness and partly on the grounds of concern regarding potential adverse impact on wild population fitness.

Our review concludes that whilst there is evidence that stocking, in conjunction with habitat improvements, can help restore extinct populations, there is a lack of convincing evidence that mitigation or enhancement stocking of salmon is an effective way of safeguarding or maintaining wild populations or of increasing annual rod catches. Indeed in some cases, such as on the River Spey, despite a considerable investment of resources, returns of hatchery derived adult fish appear to perform little better than direct replacement for the broodstock used in the hatchery.

**Q1. Do you agree or disagree with the definition of effectiveness used for the review and with the conclusion that there is little evidence available to demonstrate that mitigation and enhancement stocking is effective? If you believe you have evidence, please provide it.**

## Potential environmental impacts of salmon stocking

There has been considerable debate regarding the impacts of stocking hatchery reared salmon into the wild. There is a wide ranging scientific literature based upon studies carried out in North America and parts of Europe on several salmon species and in a number of specific locations. It is possible to draw a number of broad conclusions about the potential impacts of releasing hatchery reared salmon into rivers that already have viable wild populations.

There is increasing and compelling peer-reviewed evidence that:-

- a) Hatchery reared fish have lower survival to adulthood than wild fish of the same age,
- b) Hatchery fish that survive to adulthood have lower fitness than wild fish,
- c) The presence of hatchery reared fish in wild populations can reduce wild population fitness.

This evidence has accumulated in Europe mainly over the past 5 to 10 years or so, although evidence for species of Pacific salmon – some with very similar life history strategies to those of Atlantic salmon – has been quite regularly reported over the past 20 years or more.

There are also studies in the scientific literature that demonstrate in some cases that stocking can result in less significant, but still negative, population effects. This therefore creates uncertainty around quantifying or predicting the degree of potential impact of stocking in any particular river.

The presence and extent of impact could be influenced by a range of factors, including environmental and hatchery effects and stocking management decisions. Whilst this uncertainty in the literature is reflected in the conclusions of the review, it is also this uncertainty that means it is difficult to predict how we can mitigate for or avoid potential harm..

The review concludes that there is now enough evidence available on potential impacts and concerns about effectiveness to influence a substantive change to our existing salmon stocking programme.

**Q2: Do you agree or disagree that there is enough evidence available to influence a substantial change to NRW's existing salmon stocking activity?**

## Salmon stocking on Rivers designated as Special Areas of Conservation under the Habitats Directive (92/43/EEC).

Atlantic salmon is listed within Annex II of the Directive.

Several of the rivers on which salmon stocking programmes exist are designated under this legislation, including the River Dee, River Wye, Afon Teifi, Afon Tywi, Afon Eden (A tributary of the Mawddach) and Afonydd Cleddau. Some are designated specifically for their wild salmon populations whilst in others salmon are noted as present, although not as a primary reason for designation.

The Habitats Directive is transposed into domestic legislation through the Conservation of Habitats and Species Regulations 2010 (the Regulations). These Regulations require that any plan or project not directly connected with or necessary for the management of the Special Area of Conservation (SAC) must be subject to an Appropriate Assessment. Our review shows that stocking of salmon is not an activity undertaken for the management of the SAC and should therefore be subject to an Appropriate Assessment. Through this assessment it must be demonstrated beyond reasonable scientific doubt that plan or project will not adversely affect the integrity of the designated site.

Some of the recent scientific literature demonstrates that stocking hatchery-reared salmon can potentially result in adverse impacts on the long term population fitness of wild salmon populations. There is a lack of clear evidence that negative impacts can be avoided, and our review therefore concludes that it cannot be demonstrated beyond reasonable scientific doubt (to the certainty required by the Regulations) that stocking salmon will have no adverse effect on the integrity of any site designated for a wild salmon population. This conclusion applies equally to all our own stocking and all third party stocking on the relevant SACs.

**Q3: Do you agree or disagree with our interpretation of the Habitats Directive as it may apply to all our own and third party salmon stocking on rivers designated under this legislation?**

## Ecosystem Approach and Cost-Effectiveness

The Welsh Government has asked NRW to apply the Ecosystem Approach to all our decision making. One aspect of this requires us to consider and regulate the environment and its health as a whole rather than dealing with individual aspects separately. We also need to take into account the Ecosystem Services (the wider benefits to people and society) we gain from our activities including that relating to salmon, salmon stocking and all other approaches to salmon management. This is partly why we have undertaken this review of existing salmon stocking.

Mitigation salmon stocking could be considered as a classic single sector response to a problem, in that although there are clearly multiple issues acting to reduce the population of salmon, we have intervened at the end of the process in a direct way and substituted the functionality of the environment with an alternative system (a hatchery).

Whilst the aims of mitigation stocking are clearly laudable, they reflect our understanding of the species and the environment into which hatchery-reared salmon are stocked that pertained in the 1960s. Recent evidence regarding effect, potential impacts on wild populations, the relative effectiveness of this activity and new policy including environmental designations and the ecosystems approach mean that NRW is now re-examining the desirability of this activity.

Salmon are in their own right a high value ecosystem service. Their existence in a river is of cultural, economic and ecological importance. They are also used to provide information about a whole range of other benefits, because of their dependence upon a high quality environment. Society extrapolates from the existence of salmon to draw conclusions about the quality of water, a lack of pollutants, and the way the wider landscape functions. Salmon is quite rightly considered to be an indicator species because of the services it provides and in turn relies upon, and because they are so easily recognised and understood by society.

NRW, like all publically funded organisations, has a limited amount of resource it can use and it must choose the best way of using those resources. One of the ways we can do this is by comparing the total benefits to society from salmon that arrive in the river from a hatchery, against the total benefits gained when salmon are recruited naturally in the river and assisted to do this by making improvements to water quality, physical habitat quality or removal of obstructions.

If we use our resources to make improvements to water quality and physical habitat for salmon, we know that we also achieve other benefits alongside the increase in salmon numbers, such as erosion control, and increased biodiversity. These additional benefits are achieved through the mechanism of the environmental improvements required to increase numbers of salmon. They will benefit the full range of species in the river and

enhance and improve processes such as nutrient management and habitat connectivity, assist in the adaptation to climate change, and can potentially reduce drinking water treatment costs. None of these additional benefits can be gained from hatchery generated salmon.

Our review concludes that whilst salmon stocking following an extinction event in an effort to restore a functional population is consistent with an Ecosystem Approach (providing the reason for the extinction is dealt with before or at the same time as stocking), both enhancement and ongoing mitigation stocking are not.

Our review also concludes that alternative measures (such as habitat restoration) are likely to be more cost effective at safeguarding wild population fitness and productivity than stocking. Improving and increasing the amount and quality of suitable spawning habitat will provide additional ecosystem benefits that do not have potential negative impacts to wild populations associated with them. The environmental improvements required to achieve the restoration of the spawning and juvenile habitat are also more likely to contribute to achieving favourable conservation status for other designated species and habitats.

There is a significant opportunity to develop an approach to mitigation that will provide multiple benefits to the Welsh environment and to all those that have a stake in ensuring salmon numbers are increasing or stable.

**Q4. Do you agree or disagree that mitigation and enhancement stocking are not consistent with an Ecosystem Approach?**

**Q5 .Do you agree or disagree that it would be more cost effective for NRW to improve habitats and thereby secure further reductions in mortality of wild fish as an alternative form of mitigation to stocking?**

## Recommendations

From the evidence available, the review concludes that on-going mitigation and enhancement salmon stocking deliver relatively poor outcomes for NRW and salmon populations, particularly given the lack of evidence for effectiveness and the evidence for potential impacts to wild salmon population fitness and productivity. It also concludes that the findings of the review regarding the effectiveness and potential impacts of salmon stocking are equally applicable to any stocking undertaken by third parties.

It concludes in addition, that stocking delivers fewer additional ecosystem services when compared with other measures we could take and advocate others to take and that NRW should focus its efforts and resources on habitat restoration, particularly removing obstacles to migration and improvements to the quality and extent of spawning and juvenile habitat.

The review makes four recommendations that are highlighted below;

1. That NRW should bring all our own on-going mitigation, population re-inforcement and enhancement salmon stocking in Wales to an end, This includes all third party stocking on rivers designated under the Habitats Directive for their wild salmon populations. A further component of this includes the development of a realistic and practical timetable for bringing all other third party salmon stocking in Wales to an end, and a start to the process of working and consulting with stakeholders and co-signatories to relevant agreements to put in place suitable alternative mitigation measures instead of stocking. Future restoration stocking should not be ruled out if needed, however there is currently no identified need for this in Wales.
2. In addition, given the benefits to salmon and the wider environment from a range of habitat restoration measures, NRW should work with all interested parties to further develop and focus effort on this approach, in particular on removing barriers to migration and increasing the quality and extent of spawning and juvenile habitat available in our rivers. There is a significant opportunity to develop an approach to mitigation and enhancement that will provide multiple benefits to the Welsh environment and to all those that have a stake in ensuring salmon numbers are increasing or stable.
3. It also recommends that in light of the recommendations above, NRW should reduce its hatchery capacity. Taking into account the patterns of hatchery ownership and the capacity and track record for working on other freshwater issues, it is recommended that operations at the Mawddach and Maerdy hatcheries are brought to an end as soon as practicable.

4. The final recommendation is that NRW should consolidate any residual salmon culture (whilst changes to agreements are negotiated and concluded) at Cynrig and carry out further work to assess the feasibility of adapting the site for additional freshwater and fisheries research capacity. In parallel, NRW should investigate the potential for partnerships with Welsh academic institutions or other research bodies for developing and funding work at Cynrig.

**Q6. Do you agree or disagree with the recommendation that NRW should bring all our own mitigation and enhancement stocking in Wales to an end and work with others to end all salmon stocking in Wales? What would you regard as a practical timetable for achieving this? Should we include sea trout in this recommendation?**

**Q7. Do you agree or disagree that NRW should focus its efforts and resources on improvements to habitat? What mitigation and enhancement measures would you suggest NRW and partners adopt as an alternative to stocking?**

**Q8. Do you agree or disagree that NRW should reduce its hatchery capacity and investigate the feasibility of adapting the Cynrig facility to develop a broad-based freshwater and fisheries research facility for Wales, in partnership with other interested bodies? We would particularly welcome suggestions from relevant organisations about potential collaboration opportunities at Cynrig.**