



Definition of Favourable Conservation Status for White-clawed crayfish *Austropotamobius pallipes*

Defining Favourable Conservation Status Project

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About the DFCS project

Natural England's Defining Favourable Conservation Status (DFCS) project is defining the minimum threshold for thriving habitats and species in England.

We are doing this so we can say what good looks like, recommend actions to get them there and keep them that way.

Using Natural England's expert evidence and specialist knowledge, our DFCS definitions will set out our aspirations for these species and habitats in England.

We are publishing these tools so that you, our partners and decision-makers can do your bit for nature, better.

As we publish more of our work, the format of our definitions may evolve, however the content will remain largely the same.

This definition has been prepared using current data and evidence. It represents Natural England's view of FCS based on the best available information at the time of production.

All blocks of evidence within the definition should be given one of three confidence levels [High, Moderate, Low], based on the quality of the evidence, its applicability and the level of agreement.

Quality of evidence is defined as follows:

- Robust evidence is that which has been reported in peer-reviewed literature, or other reputable literature, from well-designed experiments, surveys or inventories that shows signs of being applicable generally.
- Medium evidence is that reported from well-designed experiments, surveys or inventories but from only one or a small number of sites, with uncertainty over its more general applicability, or is correlational or circumstantial evidence.
- Limited evidence includes 'expert opinion', based on knowledge of ecological factors that plausibly suggest an effect, but there is no circumstantial or direct evidence available.

Confidence levels are assigned as shown in the following matrix (after IPCC 2010):

High agreement Limited evidence	High agreement Medium evidence	High agreement Robust evidence
Medium agreement Limited evidence	Medium agreement Medium evidence	Medium agreement Robust evidence
Low agreement Limited evidence	Low agreement Medium evidence	Low agreement Robust evidence

Introduction

This document sets out Natural England’s view on Favourable Conservation Status (FCS) for **White-clawed crayfish *Austropotamobius pallipes*** in England. FCS is defined in terms of three parameters: natural range and distribution; population; extent and quality of habitat necessary for long-term maintenance of populations.

This section provides the summary definition of FCS in England. Section 2 provides contextual information, section 3 the metrics to be used whilst section 4 describes the evidence considered when defining FCS for each of the three parameters. Section 5 sets out the conclusions on favourable values for each of the three parameters. Annex 1 lists the references.

This document does not include any action planning, or describe actions, to achieve or maintain FCS. These will be presented separately, for example within strategy documents.

England contribution to FCS		
<p>The white-clawed crayfish is the only native crayfish in England. It is the largest, most mobile freshwater invertebrate, living in a variety of clean aquatic habitats, especially hard-water streams and rivers but it may also occur in canals, lakes, reservoirs and water-filled quarries. Crayfish are typically nocturnal and omnivorous, feeding on a wide variety of invertebrates, small fish, macrophytes and algae.</p>		
<p>The white-clawed crayfish was once an important part of freshwater food webs. It is an important food source for many predators including fish, mammals, birds and, in the juvenile stages, other invertebrates. Its foraging and grazing activities boost primary productivity and are important in nutrient and energy cycling.</p>		
<p>Much of its former and potential habitat in England has been rendered unsuitable following colonisation by invasive alien crayfish, particularly the North American signal crayfish (<i>Pacifastacus lenisculus</i>) and the associated crayfish plague (<i>Aphanomyces astaci</i>) a fungal-like disease, which is lethal to the white-clawed crayfish and causes mass mortality. There has been a catastrophic decline in the species’ population and a substantial contraction in its range and distribution. These losses continue, leading to a very bleak outlook for white-clawed crayfish in England.</p>		
<p>The species would be in favourable conservation status when the following are achieved:</p>		
Parameter	Favourable status	Confidence in the parameter
Natural range and distribution	Present within each of the 443 sub-catchments identified in the map at Figure 3, the total number of sub-catchments from which there are records of white-clawed crayfish.	High
Population	At least one self-sustaining population within each of the 443 sub-catchments of the natural range. Where there is more than one self-sustaining population, all existing populations are maintained.	Low
Supporting habitat	Whilst the type and quality of habitat required is known, the favourable extent of supporting habitat cannot yet be defined,	Moderate

	though it would need to be sufficient to support the favourable population throughout the favourable range and distribution.	
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Definitions and ecosystem context

Species definition

S1092 White-clawed crayfish *Austropotamobius pallipes*

Crayfish have 3 population centres, with distinct genetic variants, founded on glacial refugia: the Mediterranean coast (cluster I), the Atlantic coast (cluster II) and the Rhine (cluster III).

The close genetic relationships between English and western French populations is in accordance with a natural postglacial origin of English populations from individuals having survived in an Atlantic refugium.

Source: Gouin and others 2001

Threat status

Red list status

An assessment of the threat of extinction.

- **Global:** Endangered **Source:** Füreder and others 2010. *Austropotamobius pallipes*. The IUCN Red List of Threatened Species 2010.
- **European:** Not assessed
- **GB:** Not assessed

Conservation status

- Annexes II and V of the Habitats Directive
- Appendix II of the Bern Convention
- Species of principal Importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

Habitat for the species definition

White-clawed crayfish live in a diverse variety of clean aquatic habitats but especially favour hard-water streams and rivers. The species is typically found in watercourses 0.75 m to 1.25 m deep, but may occur in very shallow streams (about 5 cm of water) and in deeper, slow-flowing rivers (2.5 m) as well as canals lakes, reservoirs and water-filled quarries.

Crayfish can be found under submerged cobbles, rocks, logs, tree roots, and amongst fallen leaves. They can tolerate muddy habitats if tree roots or other woody material is available. Vertical banks, overhanging vegetation and tree roots projecting into the water have been highlighted as important features in determining crayfish abundance.

The white-clawed crayfish is intolerant of pollution and hydrological change. Waters containing this species tend to be in the pH range 7-9, with calcium levels at or above 5 mg l⁻¹, un-ionised ammonia levels less than 0.6 mg l⁻¹ and total nitrogen below 0.2 mg l⁻¹. The waters typically have a dissolved oxygen standard of >70% and an annual mean level of less than 25 mg l⁻¹ of suspended solids.

Much of the potential habitat in England is now unsuitable for white-clawed crayfish because of the presence of invasive alien crayfish, in particular the North American signal crayfish (*Pacifastacus lenisculus*), and crayfish plague (*Aphanomyces astaci*). Signal crayfish were introduced in the 1970s for the shellfish trade and soon escaped from commercial fisheries. They are larger, faster-growing and more aggressive predators than white-clawed crayfish, and often prey upon the white-clawed crayfish. They outcompeted the white-clawed crayfish for habitat and food and began to eliminate them from waterbodies. The signal crayfish carries crayfish plague, a fungal-like

disease, which is lethal to the white-clawed crayfish and causes mass mortality. The first known outbreak was in 1981. Now firmly established, crayfish plague spreads through transmission of spores directly between crayfish, in water, on fish, in mud on paws and boots, and on fishing equipment. In Ireland, for example, there have been several outbreaks of plague even though invasive alien crayfish are not present.

Sources: *Füreder and others 2010; Holdich 2003.*

Confidence: *High*

Ecosystem context

White-clawed crayfish were once found throughout western Europe from Spain, Italy and Montenegro in the south to Germany, France, Britain and Ireland in the north. The species reaches the northern limits of its natural range in northern England. As in England, invasive alien crayfish and crayfish plague have decimated populations across Europe.

It is the largest, most mobile freshwater invertebrate and the only native crayfish in England. Crayfish can live for more than 10 years, and breed after about three or four years. They are typically nocturnal and omnivorous, (but primarily carnivorous) feeding mostly on worms, insect larvae, snails, small fish, macrophytes and algae.

Where they are still to be found, crayfish are an important food source for a large number of predators including fish (such as salmonids), mammals (for example, otter), and birds (for example, kingfisher). In addition, juveniles may be preyed upon by insect larvae. The loss of crayfish may have negative impacts on predators and cascading effects on the predators' other prey. As crayfish constitute such an important part of freshwater food webs, their foraging and grazing activities boost primary productivity and are important in nutrient and energy cycling.

Sources: *Füreder and others 2010; Kettunen & ten Brink 2006*

Confidence: *High*

Metrics

Natural range and distribution
<p>Sub-catchment.</p> <p>The Environment Agency pre Water framework Directive sub-catchment layer (50 km national catchment layer).</p>
Population
<p>Number of self-sustaining populations.</p> <p>For definition of self-sustaining population see Annex 2.</p>
Habitat for the species
<p>Length of watercourse in km and area of standing water in hectares.</p> <p>White-clawed crayfish are typically found in watercourses and the metric for watercourses is consistent with the metric used for rivers.</p>

Evidence

Current situation

Natural range and distribution

The white-clawed crayfish is currently found within 93 sub-catchments where signal crayfish are absent, shown in blue on the map below. Signal crayfish are found in 465 sub-catchments and it is not known how many white-clawed crayfish populations may persist in these sub-catchments. The map was produced in 2018 for the Article 17 Habitats Directive reporting. It is based on a joint Environment Agency (EA) and Natural England (NE) dataset. The dataset was derived from NE licence application and return data from 2012 onwards and the EA crayfish records dataset which includes records from 2005 onwards for white-clawed crayfish and 1979 onwards for signal crayfish. The dataset was then verified and amended by the EA regional teams.

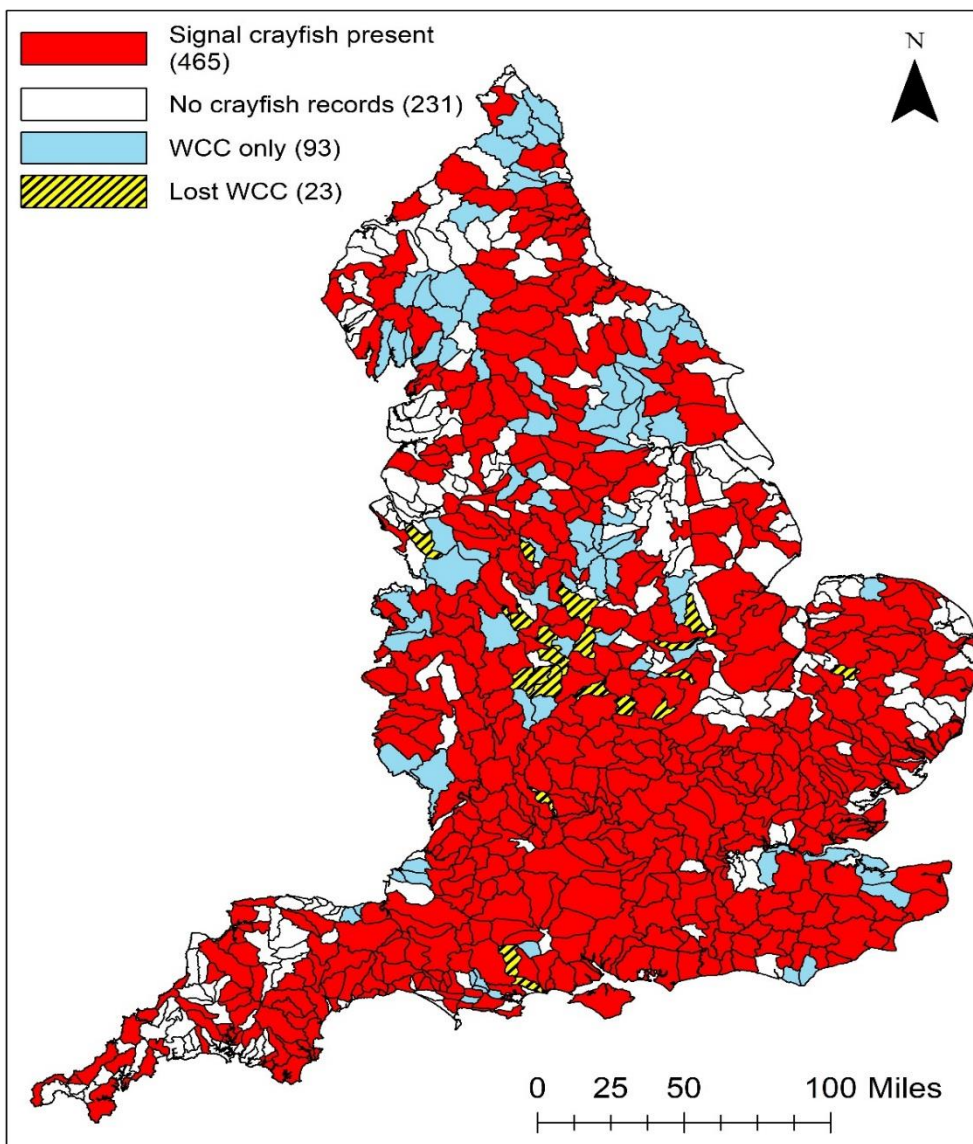


Figure 1: Occurrence of white-clawed crayfish and signal crayfish. Chadwick, Heaver, Marshall & Pritchard in prep.

Population

The number of self-sustaining populations within England is not known. There is at least one population within each of the 93 sub-catchments where the species is found and signal crayfish are absent (coloured blue in Figure 1) and there may also be relict populations within the catchments coloured red in the map above, as well as populations in established refuge (or ark) sites.

Habitat for the species

The current extent of habitat suitable for white-clawed crayfish is not known.

Source: Rees, Nightingale & Holdich 2011

Confidence: Moderate (range and distribution); Low – population and habitat

Historical variation in the above parameters

Until the 1980s, the white-clawed crayfish was a common and widespread species found in all watercourses, and many standing waters, with suitable water chemistry and habitat structures within the natural range.

Since then, the spread of signal crayfish and crayfish plague has rendered much of the habitat unsuitable and caused a dramatic contraction in range and distribution and decline in populations. The rate of spread and colonization by signal crayfish in sub-catchments previously occupied by white-clawed crayfish can be seen from the maps in Figure 2 below.

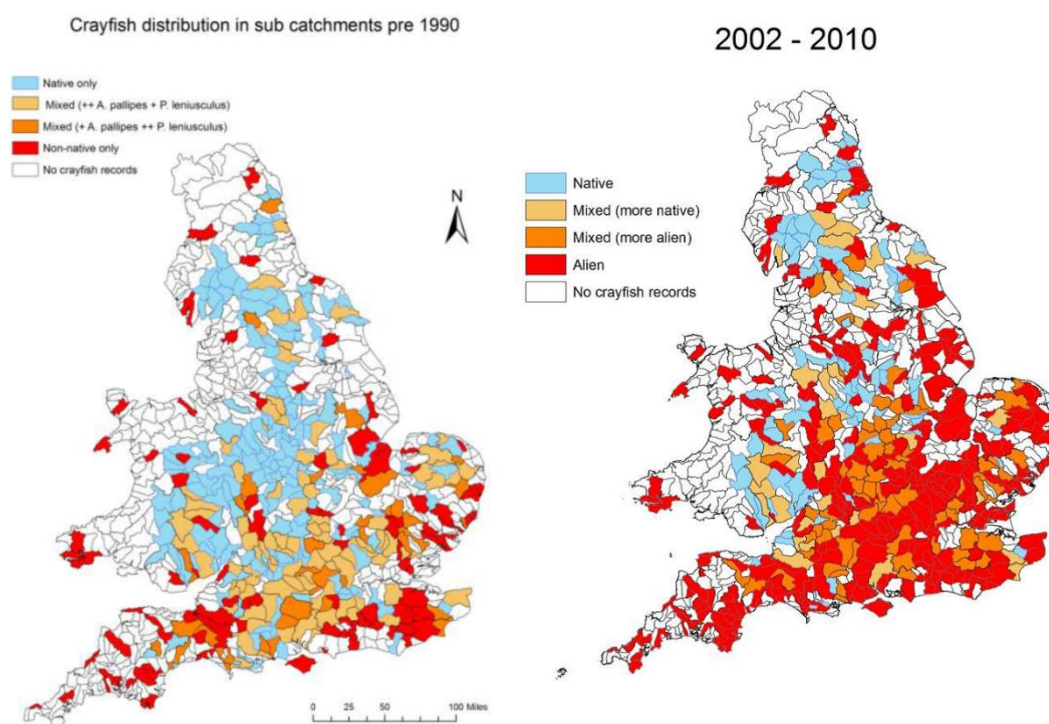


Figure 2: Distribution of crayfish. David Rogers and Elizabeth Watson. In Rees, Nightingale & Holdich 2011

Natural range and distribution

The map below shows the known historical range within England based on all records within the National Biodiversity Network (NBN). However, this may still not capture the full extent of the historical range and distribution. Comparing this map with the map in Figure 1 shows that white-clawed crayfish have almost certainly been lost from 350 sub-catchments.

**Defining Favourable Conservation Status:
Maximum potential range of White Clawed Crayfish in England based on all NBN records (n=14245)
Catchment Areas**

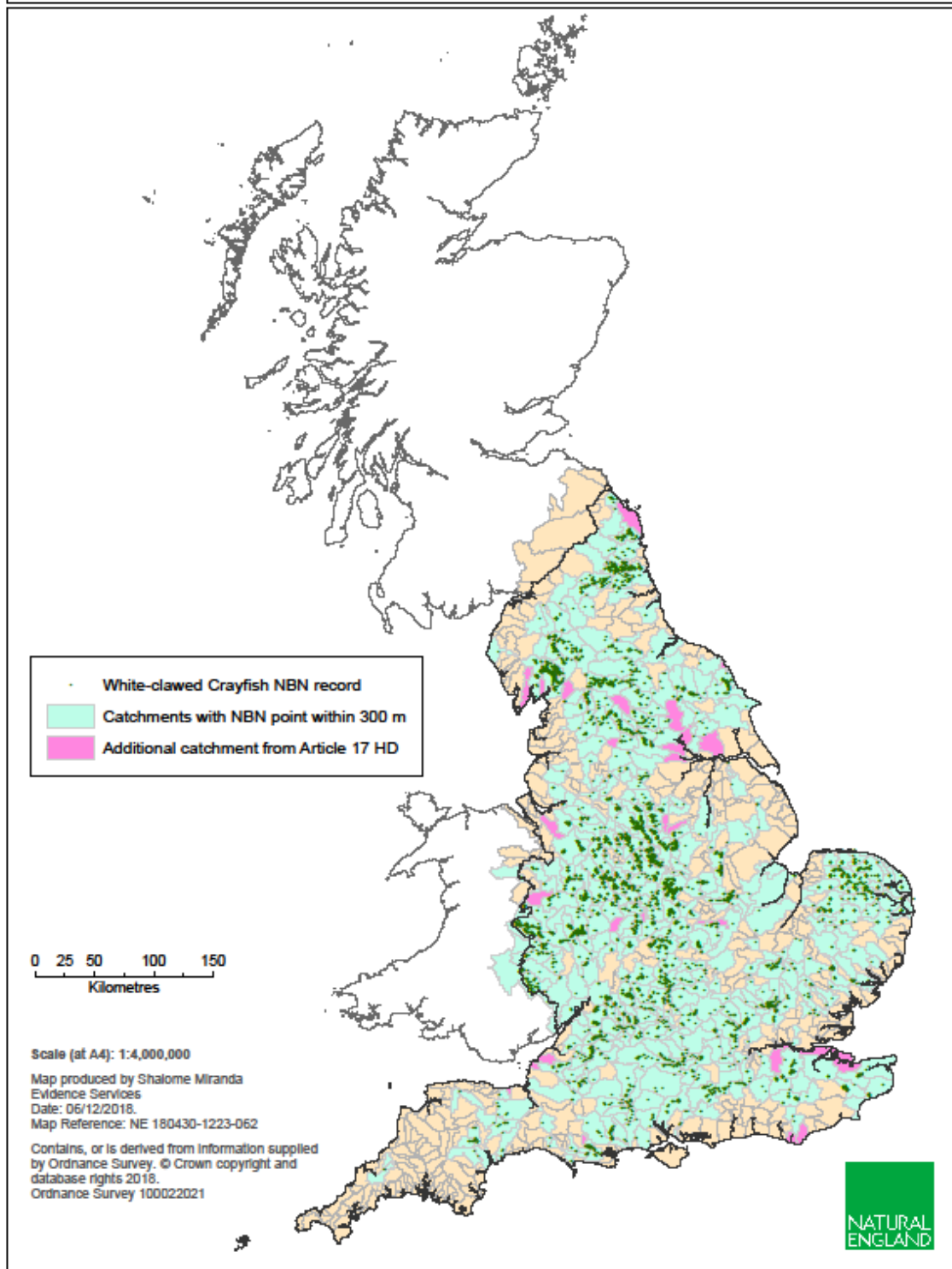


Figure 3: Maximum range of white-clawed crayfish in England. Natural England 2018

Population and habitat for the species

There is no information available to demonstrate how populations and extent of suitable habitat have changed, although there has clearly been a catastrophic decline. Before the advent of invasive alien crayfish and crayfish plague, populations and suitable habitat must have been reduced by historical declines in water quality and canalisation and construction of hard defences along rivers. However, there is no information on the extent of these impacts.

Sources: Rees, Nightingale & Holdich 2011; James and others 2015

Confidence: High (range and distribution); Low – population and habitat

Future maintenance of biological diversity and variation of the species

Range and distribution, population and extent of suitable habitat continue to decline through the combined effects of invasive alien crayfish and crayfish plague. The future of the white-clawed crayfish within England looks bleak and it seems only a matter of time before the species disappears from almost the whole country.

However, potential water temperature increases resulting from global warming, leading to reduced oxygen capacity in the water, may enable the range of white-clawed crayfish to extend northwards, providing alien crayfish and crayfish plague remain absent. But there is a great deal of uncertainty around the implications of rising temperatures and changes in water quality. Some waterbodies may become unsuitable for white-clawed crayfish as temperatures rise or water quality deteriorates and any which become suitable may simply be colonised also by signal crayfish and crayfish plague.

For favourable status, white-clawed crayfish would be expected to be found throughout its natural range and distribution. At a minimum this would be the 443 sub-catchments in which it occurred until relatively recently with the potential that the distribution could expand through a combination of rising temperatures and habitat quality improvements.

To occupy the natural range and distribution there would need to be at least one self-sustaining population within in each sub-catchment and, given the degree of threat the species faces, favourable status would require conservation of all existing self-sustaining populations.

To achieve self-sustaining populations within all the sub-catchments within the natural range and distribution would require a sufficient suitable habitat free of alien crayfish and crayfish plague.

Sources: *David Rogers Associates 2010; Environment Agency 2008; Grandjean, Souty-Grosset & Holdich 1997; Gouin and others 2001*

Confidence: *Moderate*

Potential for restoration

The species should occupy all its former range if the habitat could be restored by removal of competitive invasive non-native crayfish and crayfish plague. Since white-clawed crayfish have a broad diet, invertebrate community shifts as a consequence of signal crayfish occupation are unlikely to inhibit re-establishment. Populations would be expected to recover alongside a recovery in range and distribution.

Unfortunately, there is currently no fully effective and widely applicable method for the eradication of alien crayfish from otherwise suitable habitat. In addition, there is no mechanism for the control of the spread of crayfish plague within a watercourse. The potential for increased or sustained populations is currently within ark [refuge] sites isolated from alien crayfish and crayfish plague.

Sources: *Moorhouse and others 2014; Peay 2001; Stebbing and others 2012*

Confidence: *Moderate*

Conclusion

Favourable range and distribution

The natural range and distribution is the 443 sub-catchments where white-clawed crayfish are or were historically present.

Favourable population

For the population to be in favourable status there should be at least one self-sustaining population in each sub-catchment with suitable water bodies. Where there is more than one self-sustaining population within a sub-catchment, all populations should be maintained for favourable status.

Favourable supporting habitat

The extent of favourable supporting habitat cannot be defined at present but it would need to be sufficient to support the favourable population throughout the favourable range and distribution.

Annex 1: References

- David Rogers Associates, 2010. The control of crayfish plague in England and Wales - FC1196. <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16623>
- Environment Agency, 2008. Potential impacts of climate change on river water quality. Science Report – SC070043/SR1. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291500/scho0508bocw-e-e.pdf
- Füreder, L., Gherardi, F., Holdich, D., Reynolds, J., Sibley, P. & Souty-Grosset, C. 2010. *Austropotamobius pallipes*. The IUCN Red List of Threatened Species 2010
- Gouin, N., Grandjean, F., Bouchon, D., Reynolds, J.D. & Souty-Grosset, C., 2001. Population genetic structure of the endangered freshwater crayfish *Austropotamobius pallipes*, assessed using RAPD markers. Heredity, 87, 80–87. <http://www.nature.com/hdy/journal/v87/n1/full/6889090a.html>
- Grandjean, F., Souty-Grosset, C. and Holdich, D.M (1997). Mitochondrial DNA variation in four British populations of the white-clawed crayfish, *Austropotamobius pallipes* : implications for management. Aquat. Living Resour.. Vol. 10, no 2. <http://www.alr-journal.org/articles/alr/pdf/1997/02/alr97207.pdf>
- Holdich, D.M. 2003. Ecology of the white-clawed crayfish, *Austropotamobius pallipes*. Conserving Natura 2000 Rivers, Ecology Series No. 1. English Nature, Peterborough. <http://publications.naturalengland.org.uk/publication/72041>
- Holdich, D.M. & Rogers, W.D. 1997. The white-clawed crayfish, *Austropotamobius pallipes*, in the British Isles, with particular reference to its conservation in Britain. Bulletin Française de la Pêche et de Pisciculture, 347, 597-616.
- Kettunen, M and ten Brink, P. 2006. Value of Biodiversity - Documenting EU examples where biodiversity loss has led to the loss of ecosystem services. Final report for the European Commission. Institute for the European Environmental Policy (IEEP), Brussels, Belgium.
- James, J., Cable, J., Slater, F. & Gilvear, J. (2015) The distribution of crayfish species in the UK. Buglife - The Invertebrate Conservation Trust.
- Moorhouse, T.P, Poole, A.E, Evans, L.C, Bradley, D.C. and Macdonald, D.W (2014). Intensive removal of signal crayfish (*Pacifastacus leniusculus*) from rivers increases numbers and taxon richness of macroinvertebrate species. Ecol Evol. 4(4): 494–504. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3936395/>
- Peay, S. (2001) Eradication of alien crayfish populations. Environment Agency and English Nature, R&D Technical Report W1-037/TR1. www.nonnativespecies.org/downloadDocument.cfm?id=990
- Rees, M., Nightingale, J. & Holdich, D.M. 2011. Proceedings of the Species Survival: Securing white-clawed crayfish in a changing environment conference. Held on 16th and 17th November 2010 at Bristol Zoo Gardens. The South West Crayfish Project. http://iz.carnegiemnh.org/crayfish/iaa/docs/2011_Bristol_Crayfish_Conference_Proceedings_Ir.pdf
- Rogers D & Watson E 2017. Assessment of the condition of the white-clawed crayfish *Austropotamobius pallipes* in the River Wye Special Area of Conservation in 2014-2016. NRW Report No. 187, 163pp. Natural Resources Wales, Bangor

Stebbing, P.D.; Longshaw, M; Taylor, N.; Norman, R.; Lintott, R.; Pearce, F; Scott, A. 2012. Review of methods for the control of invasive crayfish in Great Britain. Cefas Contract - Final Report C5471. <http://www.nonnativespecies.org/index.cfm?pageid=472>

Annex 2: Definition of self-sustaining population

Context

There is almost no systematic crayfish monitoring, therefore self-sustaining populations of WCC cannot meaningfully be based on population assessments.

Assessment can be based on proxy habitat attributes, which are measurable and, in combination, provide a habitat-envelope within which WCC ought to perform well. Given the rates of losses, this model should not be used on sites with anything other than 1 year old WCC presence data, since many historic sites no longer hold this species. However, information should be collated to show a full age-class of juveniles and adults is present to ensure there is a functioning breeding population.

Attribute	Where?	When?	Measure	Note
White-clawed crayfish presence	In river/ standing waterbody of concern	At the latest 18 months before assessment	Full population age class of juveniles (<25mm) and adults	Presence of target.
Signal crayfish	Not present within the sub-catchment unless the white-clawed crayfish population is hydrologically, biologically and physically remote.	At the latest 18 months before assessment	Absence within this zone	A test of absence of principal agent of decline.
Crayfish plague	Not present within the sub-catchment unless the white-clawed crayfish population is hydrologically, biologically and physically remote.	At the latest 18 months before assessment	No presence of crayfish plague	A test of absence of agent of decline

Further information

Natural England evidence can be downloaded from our [Access to Evidence Catalogue](#). For more information about Natural England and our work see [Gov.UK](#). For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail enquiries@naturalengland.org.uk .

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Cover image

White-clawed crayfish *Austropotamobius pallipes*
Jenny Wheeldon, Natural England