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The Invertebrate Conservation Trust

ARK SITES FOR WHITE-CLAWED CRAYFISH – GUIDANCE FOR THE AGGREGATES INDUSTRY

Through establishing Ark sites for White-clawed crayfish the aggregates industry can make a significant contribution to conserving one of the UK's most threatened invertebrates.

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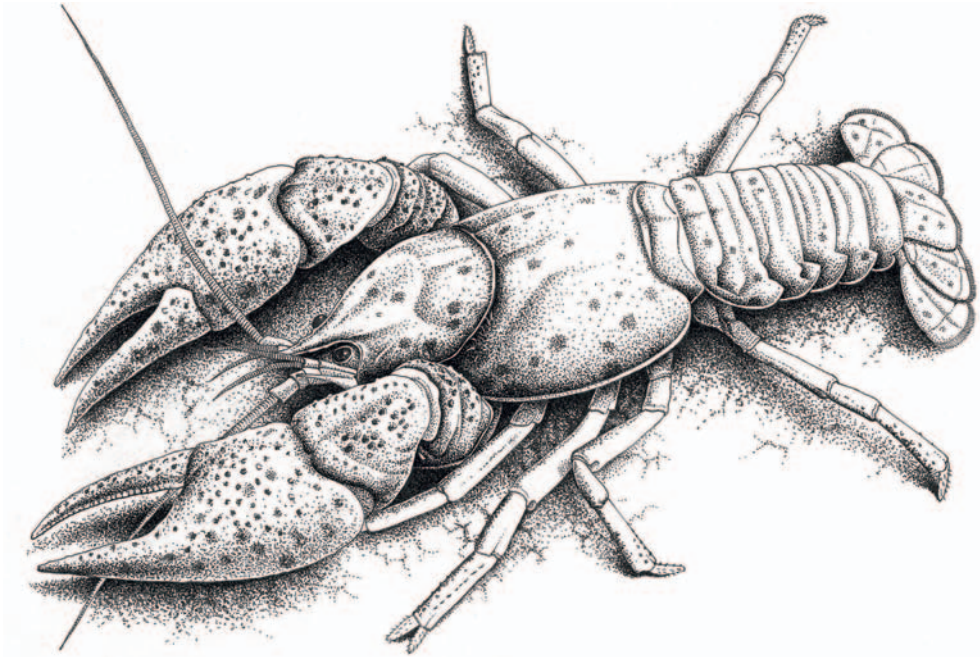
INTRODUCTION

The aggregates extraction industry can, and does, play an important role in nature conservation. Many of the UK's best wildlife sites are on former extraction sites, and as active sites come to the end of their working lives, they present great opportunities for creating habitats of high value for bees, beetles, dragonflies, spiders and other invertebrates. A whole range of other wildlife including birds, plants, amphibians and reptiles can also benefit. There are many circumstances where there can be a biodiversity gain by the activities of the aggregates industry, positives rather than negatives, and perhaps none more so than for invertebrates.

Post-extraction, habitat creation and site restoration projects have the potential to make a considerable contribution to the conservation of rare and threatened species and maintaining sustainable populations of invertebrates in our countryside – many of which provide essential ecosystem services such as pollination. There are plentiful opportunities for delivering UK Biodiversity Action Plan (BAP) targets for the conservation of habitats and species. One species urgently in need of help and which can benefit directly from site restoration schemes is the White-clawed crayfish.

The White-clawed crayfish is the only native crayfish in the UK, and is one of our largest freshwater invertebrates. However, it has declined across most of the UK due to a number of threats – all a result of human actions. Unless measures are taken to help the species immediately it will continue to decrease in range and faces extinction in England and Wales during the next few decades.

One approach to conserving the White-clawed crayfish is to establish isolated new refuge sites - known as "Ark sites" - where new populations can be established, safe from threats. There is an urgent need to establish Ark sites to safeguard the long-term survival of White-clawed crayfish across its UK range.



Flooded quarries, pits and other former aggregates and minerals workings can be potential Ark sites of the future. Setting up Ark sites can be straightforward and inexpensive, and they can easily be incorporated into site restoration schemes. Through establishing Ark sites the aggregates industry can make a considerable contribution to providing a sustainable future for the White-clawed crayfish in the UK.

Left: ***White-clawed crayfish (Austropotamobius pallipes).***

Cover illustration credit: Ian Jackson, The Art Agency. Cover picture credit: Releasing WCCs © BREA. Illustration credit above: Ian Jackson, The Art Agency

THE WHITE-CLAWED CRAYFISH

Left: *White-clawed crayfish.*

WHITE-CLAWED CRAYFISH

Biology and ecology

The White-clawed crayfish (*Austropotamobius pallipes)* is the only native species of freshwater crayfish in the UK. Adults can reach up to 15cm in body length, making the White-clawed crayfish one of the UK's largest freshwater invertebrates.

Historically, White-clawed crayfish occurred mainly in streams and rivers, but they have also been successful in a very wide range of habitats, from headwater streams to lowland rivers, canals, amenity lakes and old mineral workings, wherever the water quality is good.

White-clawed crayfish spend all of their lives in freshwater but can survive out of water for a few hours. They can cross short distances on land to access new sites; for example an individual can walk along a stream bank to avoid a short section of fast-flowing water in order to get to more favourable glides and pools.

White-clawed crayfish are largely nocturnal, which helps them avoid predation by birds and fish. However, they are still vulnerable at night to otters and introduced mink. The crushed remains of crayfish can be found in otter spraint and this is sometimes the first indication that crayfish are present in previously un-surveyed waters. The crayfish hide from predators in refuges on the bed or in the banks and use their prominent claws in defence if attacked. Juvenile crayfish are particularly vulnerable to large predatory fish such as carp and eels; they are also eaten by a range of predatory invertebrates, including other crayfish.

White-clawed crayfish have a varied, omnivorous diet, including leaf litter, submerged aquatic plants, other invertebrates (especially slow-moving ones such as aquatic snails, worms, some insect larvae and eggs), dead fish and occasionally fish eggs or fry. The actual diet depends on the age of the crayfish and the availability of different foods.

White-clawed crayfish mate in autumn, and the females then brood their eggs under their tails through the winter and spring, when crayfish are relatively inactive. Activity increases with warmer temperature in spring. The eggs hatch, the young develop while still attached and are later released. The timing of release depends on temperature - it can be as early as June in southern England, or as late as early August in northern England. White-clawed crayfish are slow-growing and typically take three years to reach sexual maturity (at 24 mm carapace length or more). Those that survive to maturity may live for ten years or more.

Distribution

The White-clawed crayfish is found across Europe, from Ireland, through England, Wales and France to Spain, southern Germany and Austria, Italy and the eastern Adriatic countries as far south as Montenegro. Except for Ireland, it is under threat and declining throughout its range. Across England and Wales it is much diminished although still widely spread where underlying geology is suitable. The most abundant remaining populations are in northern England, especially Cumbria, and parts of the Midlands. White-clawed crayfish are not native to Scotland, although there are two populations that were introduced to sites in the past.

CONSERVING THE WHITE-CLAWED CRAYFISH

Threats

The White-clawed crayfish has suffered severe declines in England and Wales and across Europe as a result of human actions. The main current threats to our native crayfish are:

Invasive non-native crayfish

A number of non-native crayfish have been introduced through both deliberate and accidental means, mainly through aquaculture activities. These include the American Signal crayfish (*Pacifastacus leniusculus*) which is the most widespread non-native crayfish in the UK and a vector for crayfish plague (see below). Other invasive non-native crayfish include the American Red swamp crayfish (*Procambarus clarkii*), Spiny-cheek crayfish (*Orconectes limosus*) and Virile crayfish (*Orconectes virilis*), and the European Noble crayfish (*Astacus astacus*) and Narrow-clawed (or Turkish) crayfish (*Astacus leptodactylus*).

All of these species strongly out-compete White-clawed crayfish for food and other habitat resources. Once non-native crayfish have been introduced to lakes or river catchments containing White-clawed crayfish their loss is inevitable. At present there is no known method for the effective control of non-native crayfish. The large number of non-native introductions, both deliberate and accidental, also makes control a near-impossible task.

Crayfish plague

Crayfish plague (*Aphanomyces astaci*) is a fungal disease frequently carried by the Signal crayfish. The disease is always lethal to White-clawed crayfish; a single infection is enough to start an epidemic that can eliminate all of the White-clawed crayfish in a watercourse or lake within a few weeks. The infective spores can survive in water for up to about two weeks and can be transmitted very easily with fish for stocking, on wet nets or other fishing gear. Spores can be killed quite easily using disinfectants or by completely drying equipment.

Loss of habitat or habitat quality

Historically, populations of White-clawed crayfish were lost from many lowland rivers due to urban pollution. In the late 20th century there were extensive losses due to agricultural pesticides such as sheep dips. Progressive improvements in water quality mean that many watercourses now have adequate water quality, but increasingly it is the rapidly expanding populations of Signal crayfish that are able to take advantage and move into the cleaner rivers and streams.

Other threats include: erosion of over-grazed riverbanks; siltation from soil run-off; modification of watercourses for drainage or flood defence; and abstraction of surface water or groundwater, such that formerly perennial streams dry out periodically.

Above: *White-clawed crayfish (left) and Signal crayfish (right).*

Ark sites for conservation

Action is already being taken to address the causes of White-clawed crayfish decline, including improving habitat quality. Despite this populations are still being lost at an alarming rate. There are currently no practicable methods for eradicating non-native crayfish from catchments.

White-clawed crayfish cannot survive where there are non-native crayfish. Most of their existing range has already been lost, or will be lost in future, as the invasion of introduced non-native crayfish continues unchecked through most river catchments. Special Areas for Conservation (SACs) have been designated for White-clawed crayfish, but these are not enough to conserve the species on their own. Furthermore, some existing SAC sites for White-clawed crayfish are threatened by non-native crayfish.

One approach to conserving the White-clawed crayfish is to establish isolated new refuge sites - known as "Ark sites" - where new populations can be established, safe from non-native crayfish and crayfish plague. Ark sites are now recognised as an essential part of the White-clawed crayfish conservation strategy for England and Wales.

An Ark site for White-clawed crayfish is an isolated, self-contained site with running water, still water, or both, which can support a healthy, self-sustaining population of White-clawed crayfish with little need for ongoing management.

Although there are a few existing Ark sites, there is an urgent need for many more to be established to

AGGREGATES SITES – THEIR POTENTIAL AS CRAYFISH ARK SITES

Above: *Ark site in a former sand pit.*

safeguard the long-term survival of White-clawed crayfish across England and Wales. Setting up Ark sites can be straightforward and inexpensive, and can provide a sustainable future for the White-clawed crayfish in the UK.

Regional conservation strategies for White-clawed crayfish

White-clawed crayfish face similar threats throughout their distribution across England and Wales, but the current situation differs between the various counties and regions. In some counties there are hardly any remaining populations of White-clawed crayfish, whilst in others there are still relatively extensive populations in rivers, even though the future prospects for those populations may not be good. Local strategies will need to vary accordingly.

Local action groups for conservation of White-clawed crayfish have already started in some areas (see "Further information"). Their aims are:

- to identify existing populations of White-clawed crayfish for protection in situ, and/or as donor populations for potential Ark sites.
- to establish the degree of threat to current populations.
- to reduce the risks to existing populations where feasible (e.g. through public education).
- to identify potential Ark sites.
- to establish Ark sites and monitor their success.

In most cases, the Environment Agency and Natural England/Countryside Council for Wales will be involved, often with local councils or National Parks Authorities and the local Wildlife Trust and other stakeholder groups and individuals too. Local action groups are a key source of information in helping to identify potential Ark sites and support initiatives on individual sites.

Up to date local information is essential, e.g. frequency of crayfish plague in the surrounding area, the proximity of non-native crayfish and their rate of expansion, the location of remaining White-clawed crayfish populations and how threatened they are (i.e. whether they can be used as donor stock to start new populations).

The local or regional situation will dictate the approach to Ark site selection and assessment. In some regions there may be plenty of potential Ark sites and therefore scope to select the best ones, or create a large number of them (or ideally, do both). In other regions the opportunities are much more limited and potential Ark sites may have more associated risks, e.g. existing angling. The urgency of need will also influence the approach, i.e. in regions with few remaining populations of White-clawed crayfish which are under threat of imminent extinction there may be a case for adopting a "now or never" approach and accepting suitable but sub-optimal Ark sites if options are limited. This may provide time to seek additional, more favourable, Ark sites in the longer term.

At a regional level computer mapping (GIS) can be used to identify sites suitable for Ark site creation; this scoping approach has been trialed by Buglife in South West England (see "Further information").

AGGREGATES SITES – THEIR POTENTIAL AS CRAYFISH ARK SITES

Aggregates and minerals extraction sites can make a significant contribution to the number of potential Ark sites and therefore to the conservation of the White-clawed crayfish. Through establishing Ark sites in former extraction sites the industry can contribute to national and regional Biodiversity Action Plan (BAP) targets and can add considerable value to site BAPs and restoration plans.

Because White-clawed crayfish are so threatened across their existing range, a large number of Ark sites are needed across many counties to give White-clawed crayfish the best chance of survival.

Aggregates and minerals sites can provide ideal new Ark sites for White-clawed crayfish.
Their advantages include:

- Sites are often isolated from existing streams and rivers that may be colonised by invading

SELECTING ARK SITES

Left: *Gravel pits and other water-filled extraction sites can provide ideal new Ark sites for White-clawed crayfish.*

non-native crayfish, and hence safe for native White-clawed crayfish.

- Extraction operations often produce permanent water-filled sites that are suitable for White-clawed crayfish with no further modification. Additional habitat can be provided, usually cheaply and easily from locally available material during or after restoration.
- As these are often newly created waterbodies they are often of lower nature conservation value than more established sites, and therefore less ecologically sensitive to crayfish introduction or habitat creation/modification.
- The wide range of materials extracted in the UK means that many different types of site are potentially available.
- Historic, current and future needs for aggregates and minerals mean that sites suitable for White-clawed crayfish are available now and a future succession of sites can be planned.

Provision for conservation of White-clawed crayfish can be included in site management plans at various stages:

- planning of new sites and the environmental assessment of proposed extraction sites.
- during site working and phased restoration.
- at any revision of restoration plans.
- as a new or additional use for restored or disused workings, either alone or in association with other proposals.

SELECTING ARK SITES

When identifying and assessing suitable White-clawed crayfish Ark sites, ideally they should be isolated, free from non-native crayfish species, and the threat of colonisation by non-native crayfish, with suitable White-clawed crayfish habitat, and sustainable in the long-term.

Ark site selection - coarse filter

If the answer to any of the questions below is "**No**", the site should not be considered as a potential Ark site for White-clawed crayfish, and do not proceed to further assessment.

1. Does the site have permanent water?

2. Is the site free of non-native crayfish species?

3. Are White-clawed crayfish absent from the site?

4. Is the site physically isolated from the threat of colonisation by non-native crayfish species?

5. Is water quality likely to be suitable for White-clawed crayfish? (i.e. equivalent to GQA[1] chemistry A-C)?

[1] General Quality Analysis – a standard method for measuring water quality. The chemistry GQA is based on levels of dissolved oxygen, ammonia, and biological oxygen demand. The Biological GQA is based on macro-invertebrate survey data. Picture credit: gravel pit © Nick Mott

ESTABLISHING ARK SITES: HABITAT CREATION AND ENHANCEMENT

The **coarse filter** is a useful starting point and should eliminate unsuitable sites at an early stage. Sites which pass this initial assessment should then be assessed in finer detail to determine suitability.

More detailed criteria have been developed so that waterbodies (running water or still water) can be assessed for quality, or likelihood of success as Ark sites (to be published in 2009). In summary, these deal with:

- Degree of enclosure (sites are safest if they have no connection to a watercourse, or to another watercourse if the site is an isolated stream).
- Terrestrial (land) barriers (e.g. the distance to a watercourse, and risk of flooding from watercourses).
- Aquatic barriers (for sites with a connection to a watercourse there has to be a major physical barrier downstream that cannot be climbed by non-native crayfish).
- Habitat suitability – water quality and quantity (biological quality is good, equivalent to Biology GQA[1] A or B; the risk of polluting discharges is very low; if the water level varies there are plenty of refuges for crayfish at all water levels).
- Habitat suitability: site structure and refuges (if this is not particularly favourable initially, it is usually easy to improve by creating new habitat– see next section).
- Habitat suitability: food sources (only applicable for new waterbodies which have had little time to develop ecologically; usually easy to improve by creating new habitat)
- Usage: angling (best with no angling, but can have potential if anglers are careful).
- Usage: other usage (proximity to urban areas may increase risk of illegal introduction of non-native crayfish and some water-based recreation may increase risk of crayfish plague).

ESTABLISHING ARK SITES: HABITAT CREATION AND ENHANCEMENT

The presence of suitable habitat for White-clawed crayfish is an essential requirement of any potential Ark site. However, it is one factor that can be easily resolved through creating new habitat, often using materials present on site, or recognising and enhancing what already exists.

Habitat creation does not have to cover the entire waterbody: if resources or materials are restricted, small bays or sections of suitable habitat may be sufficient to support populations of crayfish.

Recognising and creating suitable habitat

In many aquatic habitats, the number of crayfish that a site can support depends on the availability of shelter (refuges). Crayfish are versatile in their diet, so food supply is not usually the limiting factor. Crayfish can use a wide range of natural and artificial refuges, from natural rock crevices to twig-filled supermarket trolleys or drinks cans!

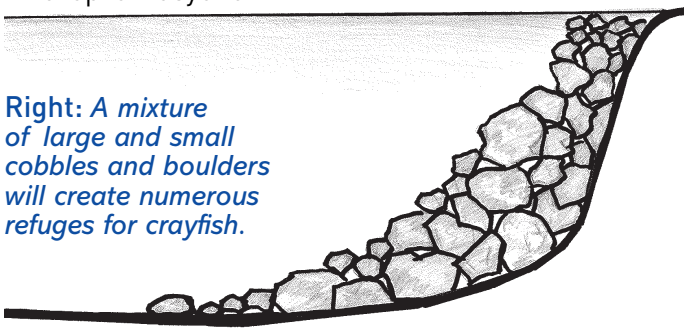
From the perspective of a crayfish criteria for a suitable refuge may be:

- Big enough space to get the whole body inside, including claws, but
- Not so roomy that a predator can reach inside too.
- Stable enough to resist high flow, if there is any, and
- With rough inside surfaces for bracing against increased flow, or attempted eviction by other crayfish.
- Not liable to sudden loss of water.
- Easy to keep clean of excess silt - so horizontal refuges are preferred and slight movement of water may be useful.
- Close to good foraging area.
- Readily accessible, i.e. not so flat or embedded that it lacks room for crayfish beneath.

The table on page 7 shows examples of habitat creation for White-clawed crayfish.

The following features of potential value as crayfish habitat may be found on aggregates and minerals sites, inadvertently created by the extraction process, or naturally establishing following cessation of operations:

- Steep to vertical rock faces with abundant fissures.
- Piles of boulders and other broken rock.
- Cobbles from sand and gravel deposits.
- Steep banks with a high clay content.
- Bankside trees with roots exposed in the water.
- Broken concrete and brick rubble from former buildings.
- Old logs and accumulations of twigs
- Stands of emergent vegetation with a steep drop-off beyond.



Right: *A mixture of large and small cobbles and boulders will create numerous refuges for crayfish.*

Picture credit: cobbles sketch by Vicky Kindemba

Habitat creation and enhancement for crayfish

(adapted from *Guidance on habitat for White-clawed crayfish* – see "Further information")

Form of refuge	Technique	Comments
Stone on the bed	Place large cobbles or boulders (›20cm across) on the bed. Stack to leave gaps for crayfish.	Best in deeper areas not regularly exposed by changing water level. Local stone is best. Material should not be of uniform size, a good range from approximately 20-80cm will create a variety of refuges.
Stone along banks	Place large cobbles or boulders (›20cm across) in the margins. Can stabilise eroding slopes with unmortared stone. Use unfaced stones otherwise gaps between will not be large enough.	Not useful if banks are mainly exposed, or shallow water adjacent. Comments on size of material as above. Natural banks are preferable, especially vertical banks with projecting stones and tree roots below water level. Gabion baskets filled with small stone, ‹15cm, don't have gaps large enough for crayfish, except a few juveniles.
Wood or vegetation along banks	Plant trees along some bank sections for shade.	Trees on vertical, slightly undercut banks are best, with large roots and a pool below. Do not plant too many trees as this will result in the loss of aquatic vegetation.
	If there is a need to stabilise banks, can use stakes with branches interwoven (basket-weave spiling). Can use faggots for facing banks – twiggy coppice stems, hedge cuttings, other woody brashings, etc. tied in a bundle, then pegged or staked in groups across the exposed bank.	If fresh-cut willow stakes are used they will grow. Willow walls need maintenance – coppicing and/or cut and weave. Faggots need to be replaced over time. If faggots are built up to surface level they can provide nesting sites for waterfowl too. They can provide refuge from predation by fish for a range of aquatic invertebrates. As with stone, one should consider whether reinforcement is necessary? If so, this is a better option for crayfish than solid walls or piling.
Artificial refuges	Where the banks are vertical and some form of hard reinforcement is required on built structures refuges can be constructed using bricks or blocks with holes in. Face the bank with a few layers of engineering bricks set on side, with holes facing outward. Similarly, standard concrete blocks (breeze-block) can be used, place on side. Pack space with sections of plastic pipe 20-50mm diameter. Glue in place, or bed into mortar at the back. Set at right angles to flow.	If abundant fissures are present within the rock face, these may provide sufficient refuges without the need for enhancement.
	Take either coarse hessian sacking or plastic netting (e.g. strawberry net). Fill loosely with straw in a 'pillow' or 'sausage'. Peg bag to bed in submerged margins.	Good for juvenile crayfish. Can use in a lake or gravel pit. Using nets with barley straw close to water inlets helps reduce growth of algae, if nets are in place before start of season (February). Needs a top up of straw every year or two. Can make juveniles easier to detect in surveys, if sample the bags.
	Water-filled gravel pits often have a very shallow gradient and a relatively uniform bed of sand and gravel, sometimes with few stones large enough to hide crayfish. If larger stones are not available, good habitat can be created quickly with faggot bundles secured or anchored to the bed.	Faggot bundles should be used in groups so they bulk up to make longer and wider structures. If faggots are built up to surface level they can provide nesting sites for waterfowl too. Faggots need to be replaced over time.

INTEGRATING ARK SITES

Above: *When submerged, stone revetting provides stable refuges for crayfish.*

Above: *Engineering bricks can be used to create artificial refuges for White-clawed crayfish.*

INTEGRATING ARK SITES

Through careful planning wildlife can be provided for alongside other after-uses and site restoration objectives such as public amenity, recreation, agriculture and conserving geodiversity.

Combining White-clawed crayfish conservation with other restoration end uses

Most after-uses of mineral sites can be compatible with conservation of White-clawed crayfish, although some are more favourable than others (see table). Ark sites can be integrated within restoration schemes that have amenity as a priority after-use, and are compatible with most watersports.

In most cases, the land-use of terrestrial areas is not important to White-clawed crayfish, provided that any use of adjacent land does not: change the quality and quantity of the aquatic habitats used by the crayfish; or increase the risk of disease or colonisation by non-native crayfish.

Nature conservation

Compatibility with other nature conservation objectives is high, except possibly in a few cases on existing sites of very high value for nature conservation.

Introducing White-clawed crayfish is likely to lead to slight changes in the detailed ecology of existing waterbodies; however, the benefits for conservation mean this is likely to be acceptable in many recently established waterbodies and in some long-established ones too.

The introduction of White-clawed crayfish will have some effects on the existing invertebrate fauna through changes in predation and competition among species, with some species potentially decreasing and others increasing in abundance. Some slow-moving species, such as some caddisfly larvae and aquatic snails, may be particularly sensitive to predation by crayfish. If a site is already of high importance for the conservation of aquatic invertebrates, and includes rare and threatened species, the impact of introducing White-clawed crayfish would have to be assessed carefully. In such circumstances it may be better to consider other sites if available. If no existing information is available (or no recent survey data) then a survey should be undertaken to assess the ecological impact of introducing crayfish.

Angling

Angling is a very common after-use of water-filled extraction sites but it has risks for White-clawed crayfish. Nevertheless, angling is possible within Ark sites for White-clawed crayfish, but care is required from all participants if the Ark site is to be successful in the long term.

In descending order of preference:

- no angling - best.
- coarse angling by a responsible club – reasonable chance of success.
- coarse angling general public use - possible.
- put-and-take-fishery, e.g. rainbow trout – unlikely to be compatible.

The risks to White-clawed crayfish from angling are:

- transmission of crayfish plague on wet nets and equipment.
- transmission of crayfish plague with water and stocked fish.

- accidental introduction of non-native crayfish with stocked fish.
- accidental or deliberate introduction of non-native crayfish as angling bait or food for fish (also illegal).
- introduction of predatory fish (e.g. catfish).
- unsympathetic fisheries management (e.g. regular use of herbicides, over-stocking with fish, or excessive use of ground-bait contributing to eutrophication).

All of these can be avoided or mitigated. In general, actions taken to protect White-clawed crayfish are also in the best interests of angling.

Above: *Angling brings the risk of introducing crayfish plague unless all anglers are careful with cleaning and drying their equipment.*

Compatibility of White-clawed crayfish Ark sites with other end uses of aggregates and minerals sites

Restoration end use	Compatible	Comments
Nature conservation	yes, very	White-clawed crayfish can co-exist with amphibians, fish, wildfowl and a range of aquatic invertebrates.
Amenity and education	yes	White-clawed crayfish make good subjects for environmental education (although public access may increase the risk of aquarium or pond discards, including non-native crayfish).
Watersports	yes	Banks may need to be protected from excessive erosion associated with some activities. Wetsuits and other equipment need to be clean and dry to avoid risk of crayfish plague contamination.
Angling	yes, possible with care	High risk of crayfish plague unless measures are taken to prevent transmission on contaminated gear or fish. Possible risk of introduction of non-native crayfish with stocked fish.
Agriculture	yes, usually	Waterbodies need protection from fertiliser, pesticides and other agricultural runoff; for example through the use of buffer zones.
Industrial/ commercial/ housing development	yes, usually	Waterbodies need good protection from polluting discharges (planned or accidental). Care is needed in drainage design and a buffer of vegetation around the Ark site. Water levels should not fluctuate excessively - permanent water is necessary as is suitable habitat at all water levels. Any drainage out of the Ark site must have a secure barrier against non-native crayfish.

MONITORING | WHITE-CLAWED CRAYFISH AND THE LAW | CONCLUSIONS

Above: *This Ark site is within a former extraction site that is now a country park.*

MONITORING

Monitoring the success of site management techniques and habitat creation schemes is vital. Monitoring of habitat creation and subsequent management will flag up features or management that need to be improved. With each new scheme our knowledge of the subject develops further. Every habitat creation scheme should be viewed as an opportunity to learn and share best practice.

The success of an Ark site is determined by the presence of a healthy population of white-clawed crayfish at an abundance consistent with the amount of suitable habitat. It takes time for a population to develop and it may be difficult to detect in surveys for the first few years. Crayfish are likely to be evident in about five years, although it may take much longer to reach "capacity".

WHITE-CLAWED CRAYFISH AND THE LAW

White-clawed crayfish are protected under UK wildlife and fisheries legislation, which means that a number of licences are required to catch White-clawed crayfish and/or move them to new sites. Professional advice must be sought when planning Ark sites.

The White-clawed crayfish is protected from "taking and sale" under the Wildlife and Countryside Act 1981 (as amended). It is listed under the EU Habitats and Species Directive and is a UK Biodiversity Action Plan Priority Species.

A protected species licence is required for any surveys for White-clawed crayfish. Licences are issued by Natural England and the Countryside Council for Wales. Surveyors are expected to have had suitable training on the conservation of White-clawed crayfish and sufficient practical experience of crayfish surveys. A crayfish survey licence is not required for general macro-invertebrate surveys, or surveys where it is reasonable to expect White-clawed crayfish to be absent.

Consents for crayfish trapping are required under the Salmon and Freshwater Fisheries Act 1975; these are issued by the Environment Agency. A consent is required for any use of crayfish traps, even if crayfish are thought to be absent from a site.

Any proposal to stock a potential Ark site with White-clawed crayfish requires a protected species conservation licence from Natural England or the Countryside Council for Wales as appropriate, in addition to the survey licence held by the crayfish surveyor. Fisheries consents must also be obtained from the Environment Agency under the Salmon and Freshwater Fisheries Act, to introduce any crayfish to the receptor site and a separate consent to remove stock from the donor site too.

The landowner will need to give permission prior to setting up a potential Ark site for White-clawed crayfish. It is advisable to secure the co-operation of any other stakeholders too including site managers and anglers.

CONCLUSIONS

- White-clawed crayfish need help now – new Ark refuge sites are essential to prevent further extinctions of populations due to the spread of non-native crayfish and disease.
- Former aggregates and minerals workings, and those in operation or planned, can provide excellent Ark sites.
- Most aggregates and minerals sites are suitable, if water conditions are suitable and there are good barriers against colonisation by non-native crayfish.
- Ark sites for White-clawed crayfish can be implemented easily and at low cost.
- Having White-clawed crayfish on restored mineral sites is compatible with most after-uses, if taken into account in design and management.
- Provision for White-clawed crayfish on aggregates and minerals sites can contribute to local Biodiversity Action Plans, to regional crayfish conservation strategies, and to the conservation of White-clawed crayfish nationally.

FURTHER INFORMATION

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Natural England
www.naturalengland.org.uk

Environment Agency
www.environment-agency.gov.uk

Wildlife Trusts
www.wildlifetrusts.org

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