

A noble pursuit



Could you introduce your research on the endangered noble crayfish (*Astacus astacus*)?

Our work focuses on important issues surrounding the conservation and management of this critically endangered species. For example, we study to what extent the noble crayfish is divided into genetically unique and locally adapted populations in Sweden. This knowledge is important when designing reintroduction programmes, especially when deciding which natural populations should be used as brood stocks when reintroducing the species into lakes where it has been extirpated.

Another aim is to build up basic knowledge that will facilitate the development of a sustainable noble crayfish aquaculture. There is, for example, a need to develop strains that are suited to the artificial environment in crayfish farms.

What are the main threats to the survival of the noble crayfish?

Acidification, pollution and habitat destruction all threaten the species. The main danger, however, is the lethal crayfish plague (*Aphanomyces astaci*). Today this comes from illegal introductions of the North American signal crayfish, which is much less sensitive to crayfish plague and thereby acts as a chronic carrier.

Although no permits for introducing signal crayfish into new waters have been issued during the last 20 years, people continue to do so because of the widespread myth that signal crayfish grow faster and give higher catches. Consequently, crayfish plague is constantly spreading to new areas.

Is overfishing considered a danger?

The fishing of noble crayfish in Sweden is dominated by private fishing right owners exploiting the species in rivers and lakes all over the country for their own consumption. The size of the catch is not of central importance, it is the tradition of fishing, cooking and having parties that matters. Overfishing is therefore not considered a problem.

Why does farming noble crayfish for consumption have high potential? What is needed to promote the development of an economically sustainable aquaculture industry for the species?

Today, there is high demand for noble crayfish, both for consumption and stocking material. Still, farming of noble crayfish for consumption is rare. To promote and reinforce aquaculture, there is a need to develop strains that are suitable to breed in the captive environment. Our project, 'Combining conservation and sustainable exploitation of an endangered species: the noble crayfish in Sweden', seeks to make a first screening of natural populations in Sweden to search for strains with heritable traits that make them suitable for aquaculture. As a next step, identified strains brought into captivity can be selected further for economically important traits such as growth rate, to become even more suitable.

How do noble crayfish exploitation and conservation go hand-in-hand?

The most important task is to dispel various myths about the superiority of the signal crayfish and convince local fishing right owners to protect their noble crayfish populations. Otherwise, illegal introductions and the spread of plague will prevail.

In their consumer's guide, the World Wide Fund for Nature (WWF) has advised people to 'avoid' noble crayfish in an effort to save the species. Unfortunately, this is counterproductive as it tends to make local people less willing to fish, consume and thereby protect the species. In addition, the few crayfish farmers that already produce noble crayfish for consumption are now having serious problems selling their products, which has led to financial hardship. These same farmers are also producing stocking material and are essential for the restoration actions; thus, there is an obvious risk that, due to WWF's recommendation, the noble crayfish's situation will worsen rather than improve.

Can you summarise the outcomes of the noble crayfish action plan implemented from 2008-13?

The main actions have been to disseminate information via television, radio, newspapers, pamphlets, web pages and through information tours with oral presentations. Funds have also been made available for restoration programmes. Today, people are much more knowledgeable about the disadvantages of signal crayfish, even from a fisheries point of view. People are also now aware it is possible to restore noble crayfish populations after crayfish plague outbreaks and acidification and regain a good noble crayfish fishery.

What do post-2013 conservation plans involve?

The new action plan focuses on central research needs, but will otherwise have the same focus as its predecessor. Knowledge generated within our genetic research project will make it possible to evaluate the success of past reintroduction projects and help improve future restoration actions.



Cultural and natural conservation

Building on work that laid the foundations for protecting the noble crayfish in Sweden, a team at the **Swedish University of Agricultural Sciences** (SLU) is improving understanding of the species' genetics to enhance conservation actions and aquaculture development

THE NOBLE CRAYFISH (*Astacus astacus*) is Sweden's only native freshwater crayfish species. It is a widespread species that has undergone significant declines. Population numbers are estimated to have fallen by as much as 97 per cent over the last 100 years, and an accelerating extinction rate led to the species' classification as critically endangered in 2010. A number of contributing factors have been responsible for this sharp decline, including habitat loss and acidification. The key issue, however, is crayfish plague (*Aphanomyces astaci*); a lethal disease that has spread following the first introduction in 1907.

The alien North American signal crayfish (*Pacifastacus leniusculus*) was introduced in 1960 for recreational and commercial capture as a substitute for noble crayfish in the wake of population losses and a perception that their North American relatives were immune to crayfish plague and would give higher catches. Unfortunately, the alien species is a chronic carrier of the crayfish plague, so the introduction led to a fivefold increase of the spread of the disease. In addition, the signal crayfish is not totally immune and can also die from the plague if stressed.

A VALUABLE SPECIES

The noble crayfish is a keystone species with a distinct role in the ecosystem as both a predator

and a food source to a range of species. It also has significant cultural, social and economic value in Sweden, where it costs more than €90 per kg; double the price of the signal crayfish. A significant amount of crayfish is consumed annually in Sweden, amounting to 0.5 kg per capita; the highest per capita consumption of freshwater crayfish worldwide.

Consumption is particularly high during August when the annual crayfish party, which has long been a part of Swedish tradition, takes place. These parties involve dressing up in special hats, drinking, singing songs and, of course, eating crayfish. During the European football championship in 2004, the main evening newspaper in Sweden distributed a supplement containing 34 pages. The supplement dealing with crayfish included in the same newspaper at the start of the crayfish season contained 68 pages! This anecdote illustrates the importance of crayfish traditions in Sweden.

TAKING ACTION

In spite of the catastrophic implications for the noble crayfish, relocations and stocking of live signal crayfish without permits still occur, both in Sweden and beyond. As many as 117 cases of illegal releases of signal crayfish were discovered in Sweden between 2007 and 2009. Since 1998,

action plans have been in force with a view to conserving the noble crayfish. As a result, national legislation has become stricter, and reintroduction and liming programmes have been introduced. The media and information programmes also play key roles in dispelling various myths and directing attention to the plight of the native noble crayfish. The idea is to inspire people to manage their noble crayfish populations instead of releasing signal crayfish.

Reintroduction and restoration of noble crayfish populations in lakes where it has become extinct is perhaps the most important conservation measure, and success in this area is optimised by research focused on evaluating earlier management measures. Johan Dannewitz, Stefan Palm and Lennart Edsman make up a dedicated team of researchers whose project, 'Combining conservation and sustainable exploitation of an endangered species: the noble crayfish in Sweden', aims at increasing basic knowledge which will help in developing sustainable management of the native crustaceans.

CRAYFISH COLLABORATIONS

The researchers have identified several knowledge gaps in terms of colonisation history, population genetic structure and adaptive differences between crayfish populations from

INTELLIGENCE

COMBINING CONSERVATION AND SUSTAINABLE EXPLOITATION OF AN ENDANGERED SPECIES: THE NOBLE CRAYFISH IN SWEDEN

OBJECTIVES

The project includes controlled breeding studies aimed at identifying heritable differences between noble crayfish populations from different geographic areas in Sweden in important traits such as growth and survival. In parallel, the researchers collect molecular data for in-depth studies of genetic population structure, microevolutionary processes and evaluations of stocking programmes. The results are anticipated to be of importance when selecting suitable brood stocks for effective future aquaculture endeavours of noble crayfish for consumption and stocking. The knowledge obtained will also serve as a necessary basis for effective conservation and sustainable use of populations in the wild.

PARTNERS

Center for Fish and Wildlife research (CFW) • Swedish Aquaculture Association • Swedish County Administrative Boards • Crayfish farmers (Svenssonkräftan, Sunelycke and Rånekräftan crayfish farms) • Swedish Rural Economy and Agricultural Societies • Swedish fishing right owners association

FUNDING

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JOHAN DANNEWITZ works on scientific questions related to the conservation and management of aquatic resources, and is primarily interested in conservation genetics and stock assessment of salmonid fishes and freshwater crayfish.

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different areas. They believe new knowledge will lead to more effective conservation measures and improve the preconditions for the development of an economically sustainable noble crayfish aquaculture.

The project is divided into two key, concurrent sub-projects. The first is focused on the collection of molecular genetic data from a large number of noble crayfish populations in Scandinavia for detailed studies of population genetic structure. The second involves breeding noble crayfish of different origins under common environmental conditions, in order to identify and quantify genetic differences for important traits such as growth and survival.

Although based at the Swedish University of Agricultural Sciences (SLU), the work involves partnerships with a number of universities and institutes spanning several countries. It also requires close collaboration with the authorities responsible for fishery management in Sweden, and stakeholders such as crayfish farmers and fishing right owners.

THE IMPORTANCE OF GENETICS

Little is currently known about genetic differences between local populations of noble crayfish, in terms of both DNA and phenotypic traits. "From a conservation perspective, this lack of knowledge is problematic, because so far the origin is rarely considered when selecting crayfish for release within reintroduction or supplemental programmes," Dannewitz asserts. "From an aquaculture perspective, there is a need to develop strains that are suitable for the captive environment and fulfil certain criteria important for crayfish farmers."

Drawing on a well-established network, Dannewitz, Palm and Edsman are investigating genetic variation in noble crayfish with a view to selecting strains that seem suitable for aquaculture. "We simply try to make use of what nature has to offer instead of developing strains through costly and time-consuming breeding programmes," the researchers explain. "Wild strains that fulfil basic criteria could then be selected further in the captive environment for important traits like growth rate, survival and claw size."

ENHANCING UNDERSTANDING

Due to lack of knowledge about population genetic structure, geographic origin has previously not been considered when selecting material for

reintroductions or supplemental stocking. However, the importance of preserving genetic diversity and locally adapted traits is now understood, and the team hopes that results generated within their project will help refine the selection of stocking material for reintroduction and restoration of noble crayfish populations.

The breeding experiment, aimed at investigating genetically based trait differences between populations, is split into three stages across the project's duration: the first is devoted to mating and hatching; the second involves rearing of offspring at crayfish farms; and the third stage comprises laboratory work.

FISHING FOR DNA

Following sampling of males and females from a number of crayfish populations across Sweden, pairs of sexually mature individuals will be left to spawn in separate aquaria. After hatching, offspring from all experimental families will be counted, divided and pooled into evenly sized, mixed groups that will be stocked in ponds at two to three well established crayfish farms in Sweden. The experiments will draw to a close at the end of the second growth season, when a large sample of offspring will be taken from each of the ponds. Family and population origin of sampled crayfish youngsters will be determined by DNA analyses. This is when analyses and comparisons of length, weight, claw injuries, and various morphometric traits will be carried out.

FUTURE ACTIONS

Dannewitz, Palm and Edsman hope their findings will contribute to the development of future guidelines on how to select suitable crayfish strains for aquaculture. In addition, the research is expected to provide an important knowledge base for the successful implementation of an action plan aimed at the long-term conservation and sustainable use of Sweden's remaining populations of the precious noble crayfish.



The noble crayfish (*Astacus astacus*).