

# NOBANIS - Invasive Alien Species Fact Sheet

## *Pacifastacus leniusculus*

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### Bibliographical reference – how to cite this fact sheet:

Taugbøl, T. and Johnsen, S.I. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Pacifastacus leniusculus*. – From: Online Database of the North European and Baltic Network on Invasive Alien Species – NOBANIS [www.nobanis.org](http://www.nobanis.org), Date of access x/x/200x.

### Species description

**Scientific names:** *Pacifastacus leniusculus* (Dana, 1852), Astacidae.

**Synonyms:** no common synonyms used.

**Common names:** signal crayfish (GB), signalkrebs (DK), Signalkrebs (DE), signaalvähk (EE), täplärapu (FI), žymėtasis vėžys (LT), signālvēzis (LV), signalkrebs (NO), rak sygnałowy (PL), сигнальный рак (RU), signalkräfta (SE).



**Fig. 1.** *Pacifastacus leniusculus*, note the white-turquoise patch on the upper side of the claw (chelae), photo by Eilif Byrnak.

### **Species identification**

The signal crayfish is similar to and can easily be confused with the only native freshwater crayfish species of the region, namely the noble crayfish (*Astacus astacus*). The signal crayfish is distinguished from the noble crayfish, both as juvenile and adult, by the smooth nature of the chelae and the lack of a row of spines on the shoulders of carapace behind cervical groove. The white-turquoise patch on the upper side of the chelae is also unique to the adult signal crayfish (Fiskeriverket/Naturvårdsverket 2005, Lewis 2002, Pöckl *et al.* 2006).

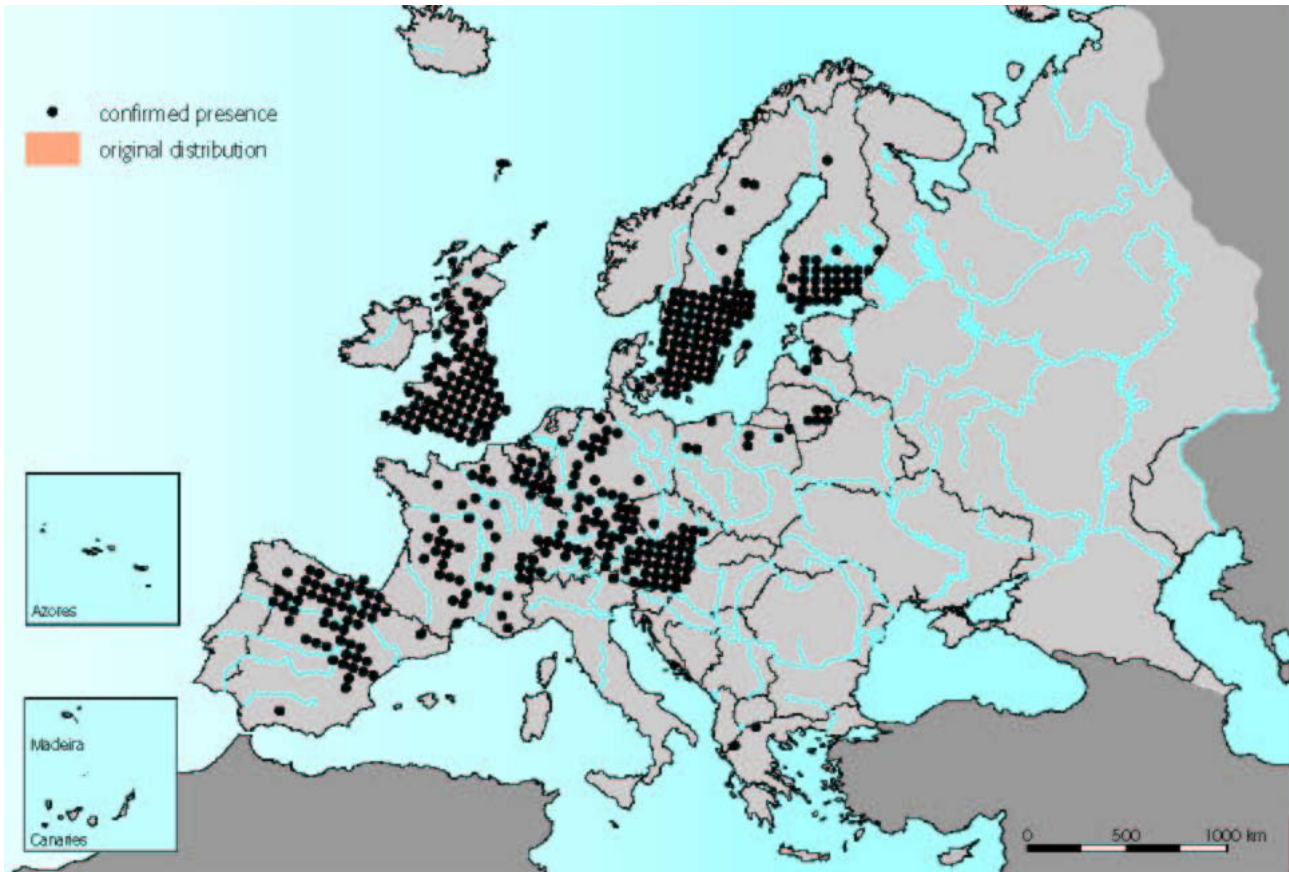
### **Native range**

The native range of the signal crayfish is the northwestern USA and southwestern Canada where it occurs from British Columbia in the north, central California in the south, and Utah in the east (Lewis 2002).

### **Alien distribution**

#### **History of introduction and geographical spread**

A small batch of signal crayfish was introduced from California, USA, to Sweden in 1960 in an attempt to find a species which could replace the populations of the indigenous noble crayfish, *Astacus astacus*, which was severely depleted by the crayfish plague from 1907 onwards (Fiskeriverket/Naturvårdsverket 1998). The signal crayfish was considered to occupy the same ecological niche and presumed to be able to restore the recreational and commercial important crayfish fishery in the plague affected areas. The fact that it was also a carrier of crayfish plague was unknown at the time (Unestam 1972). Trials were successful and in 1967-69 a large number of signal crayfish were imported from USA and introduced into Swedish and Finnish waters (Lowery and Holdich 1988, Westman 1995). These were followed by further secondary introductions, including large numbers of domestic hatchery-reared juveniles. Further introductions, especially of juveniles from Sweden, were made to many European countries (Lowery and Holdich 1988). The signal crayfish is at present most established in Sweden where it occurs in approximately 3000 localities. An increasing number of signal crayfish introductions have taken place during the last 20 years in Denmark and this illegal praxis still goes on (Eilif Byrnak, pers. comm.). Until 2006, the signal crayfish was recorded in 24 European countries (Souty-Grosset *et al.* 2006). However, the signal crayfish was registered for the first time in Norway in late 2006, extending the list to 25 countries (Johnsen *et al.* 2007). This makes the signal crayfish the most widely spread alien freshwater crayfish species in Europe (Souty-Grosset *et al.* 2006). In the Nordic-Baltic region it is found in all countries except Estonia and Russia (nor in Iceland, Greenland and Faroe Islands where no freshwater crayfish species occur).



**Fig. 2.** Present distribution of signal crayfish (*Pacifastacus leniusculus*) in Europe. © Publications Scientifique MNHN, Paris, 2006. (After Souty-Grosset *et al.* 2006). The single pond in Norway with signal crayfish is not represented in the map (but see Johnsen *et al.* 2007).

### Pathways of introduction

The most common pathway of introduction into natural waters is stocking by humans. In the 1970-80s the stocking policy in the region was liberal, and the signal crayfish was introduced legally into a large number of natural waters. From the late 1980s onwards, the introduction of the signal crayfish into new areas was restricted by the environmental authorities due to the threat it posed to the indigenous, red-listed noble crayfish (Troschel and Dehus 1993, Skurdal *et al.* 1999, Edsman 2004). However, the distribution of the signal crayfish still rapidly increases, including more and more watercourses. The crayfish can spread by natural migration only within a watercourse, between migration barriers. Most of the current spread is therefore due to illegal introductions by humans.

### Alien status in region

The signal crayfish has been introduced to all countries in the region, except Estonia, Russia and the North Atlantic Islands (see table 1). It is very common in Sweden and Finland, common in Germany and found in a more limited number of localities in Denmark, Poland, Lithuania and Latvia (Souty-Grosset *et al.* 2006). In Norway, it is only found in one small isolated pond (Johnsen *et al.* 2007). However, within a short time it will also appear in Lake Store Le, a bordering lake between Norway and Sweden, where signal crayfish has been recorded in the Swedish part of the lake (Taugbøl 2004).

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Denmark				X			
Estonia	X						
European part of Russia	X						
Finland						X	
Faroe Islands	X						
Germany					X		
Greenland	X						
Iceland	X						
Latvia			X				
Lithuania				X			
Norway			X				
Poland				X			
Sweden						X	

**Table 1.** The frequency and establishment of *Pacifastacus leniusculus*, please refer also to the information provided for this species at [www.nobanis.org/search.asp](http://www.nobanis.org/search.asp). Legend for this table: **Not found** –The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available.

## Ecology

### Habitat description

The native habitat of the signal crayfish ranges from small streams to large rivers, and lakes from the coastal to the sub-alpine regions. Signal crayfish can also survive in brackish water (Holdich *et al.* 1997). The distribution of the signal crayfish in Europe comprises the same range of habitats (Souty-Grosset *et al.* 2006).

### Reproduction and life cycle

The signal crayfish has a typical life cycle of a member of the crayfish family Astacidae (Lewis 2002). Mating and egg laying occurs during autumn, mainly in October. Egg numbers usually range from 200 to 400. After egg laying the female carry the eggs under the tail until hatching. Hatching time varies greatly depending on temperature, and in natural populations it may occur from late March to the end of July. The eggs hatch into miniature crayfish that stay with the mother for three stages (two moults). In the third stage the juvenile crayfish gradually become more and more independent of the mother, adopting a solitary life. Size at maturity is usually 6-9 cm total-length (from tip of head to edge of tail-fan) at an age of 2-3 years. Estimates of survivorship to age 2 vary from 10-52%, being dependent on both abiotic and biotic factors. Competition and cannibalism can greatly affect survival in dense populations. Maximum age and size are reported to be approx. 20 years and 16-18 cm, but such sizes are very seldom.

### Dispersal and spread

Humans are the overall most important vector for dispersal and spread (see above) of the signal crayfish. Due to fisheries in natural waters in most regions where it occurs, signal crayfish are easily accessible as stocking material. Within the watercourse the signal crayfish can spread by own migration. Upstream migration rates of more than 1 km per year are reported from rivers in Finland

and England. Downstream spread can be faster (Westman and Nylund 1979, Guan and Wiles 1997a, Peay and Rogers 1999). There are also indications that the signal crayfish may pass dams and waterfalls by walking on dry land (Hiley 2003). Probably this behaviour is triggered by high density or other unfavourable conditions. Normally, the crayfish would not leave water and expose itself to great predation risk on land, but at least this shows its potential for self dispersal.

## Impact

### **Affected habitats and indigenous organisms**

The signal crayfish occupies the same ecological niche as the indigenous noble crayfish. It occurs mainly in localities previously inhabited by these species, and maintains in general the same effects on natural habitats. It is considered to be a non-burrowing species in North America, but in Europe it constructs burrows in river and lake banks (Holdich and Reeve 1991), similar to the noble crayfish. As an opportunistic polytrophic feeder it also consumes detritus and thereby plays an important role in the degradation and mineralization of dead organic matter. It may exert a significant grazing pressure on macrophytes, aquatic insects, snails, benthic fishes and amphibian larvae. Several studies indicate that signal crayfish have a stronger impact on the food web structure than the indigenous noble crayfish (Guan and Wiles 1997b, Nyström 1999, 2002 and references herein).

The most severe effect of the signal crayfish is the extermination of the noble crayfish, caused by the transmission of the crayfish plague disease (another invasive species) (Alderman 1997). Indigenous European crayfish species have no resistance against this disease and experience total mortality. American crayfish species on the other hand have co-evolved with the crayfish plague and developed defence systems making them to a natural host for and carrier of this parasitic disease (Unestam 1972, Evans and Edgerton 2002). Most, if not all, signal crayfish are infected by the crayfish plague. Thus, if a signal crayfish population is established in a watercourse, the crayfish plague is also established, and there is no possibility for the noble crayfish to co-exist. For this reason, the spread of signal crayfish is the most serious threat to the indigenous noble crayfish.

### **Genetic effects**

No hybrids with other crayfish species have been reported. Signal crayfish can mate with noble crayfish, but the eggs are not fertile.

### **Human health effects**

No human health effects have been reported, although allergies towards shellfish may occur.

### **Economic and societal effects (positive/negative)**

In many countries in the region, especially Sweden and Finland, the signal crayfish populations support a large, commercially and recreationally important, fishery (Ackefors 1999). In Europe as a whole in 1994, a total of 355 tonnes of signal crayfish was estimated from capture fisheries (Ackefors 1998). This level has increased considerably, and in Sweden in 2001 estimated catch was 1200 tonnes. In recent years, however, levels have fallen for unknown reasons. Viruses in combination with a chronic plague infection have been suspected as a possible reason (Söderhäll 2004). Cultured amount of signal crayfish in Sweden was estimated to 42 tonnes in 1996 (Ackefors 1998).

The most serious negative effect of the signal crayfish is the extermination of the indigenous noble crayfish, due to the uncontrolled spread of the signal crayfish to more and more watercourses. The

noble crayfish has great sociocultural/-economic traditions in the region (Swahn 2004) and is more valuable than the signal crayfish, also from the pure economic point of view. First and foremost because of the uncontrolled spread of signal crayfish, the noble crayfish is recognized as a threatened species included in the international Red List, the Bern Convention and EU's Habitat Directive.

## Management approaches

### **Prevention methods**

Preventing the further introduction of signal crayfish to new water bodies by humans is the greatest management challenge (for efforts, see below). In most countries in the region the introduction of live non-indigenous crayfish species, like the signal crayfish, is not permitted (Skurdal *et al.* 1999). In Latvia the import of live crayfish is allowed, only a veterinary certificate is needed (Arens and Taugbøl 2005). In all countries stocking of live crayfish in natural waters requires permission from the authorities. The lack of effective control and enforcement is, however, a problem.

### **Eradication, control and monitoring efforts**

When the signal crayfish is established in a water body there is no practical way of eradication, except perhaps in very small, enclosed waterbodies where insecticides or other chemicals might be applied. Extensive trapping may reduce population density and slow down the speed at which it spreads naturally, but it is not an effective control method. Monitoring of the distribution and identifying new populations by test-fishing provide important information necessary in a management strategy. Monitoring of crayfish distribution and occurrence takes place in several countries in the region and reveals that illegal signal crayfish introductions occur to a large extent and is the major reason for further spread.

### **Information and awareness**

The key factor in order to prevent further spread of the signal crayfish is information about the negative effects. It is imperative to convince landowners/fishermen that the indigenous noble crayfish is the best alternative for crayfish harvest. With live signal crayfish easily accessible from natural waters not far away, it is impossible to prevent (illegal) stocking if local people want to do so. Information campaigns, including folders/brochures, media contact and education in schools are important. Likewise concrete projects aimed at conservation and sustainable use of noble crayfish and the prevention of further spread of signal crayfish, through information and involvement of relevant interest groups. The so-called "Astacus"-project, an inter-regional collaboration project between Norway and Sweden, is an example of such a project ([www.astacus.org](http://www.astacus.org)).

### **Knowledge and research**

Several research topics have been carried out on the signal crayfish in the region, especially in Sweden and Finland. Prevalent topics are on its ecology, immunology, behaviour, population biology and environmental impact (see Nyström 1999, 2002, Söderhäll and Söderhäll 2002 and references herein). There has also been some research into improving methods for its culture.

### **Recommendations or comments from experts and local communities**

Signal crayfish should be managed as a valuable resource for recreational and commercial fishery in areas where it is established (Ackefors 1999, Taugbøl and Skurdal 1999). In other areas where the noble crayfish still has a chance to survive, the great values of this species should be emphasized, and it should be made clear to all stakeholders that the spread of signal crayfish to these areas is a

tragedy to nature and to the socioeconomic/-cultural values the noble crayfish represents. In addition it is an environmental crime.

Furthermore, in the light of decreasing catches and numerous collapses of signal crayfish populations in recent years, there is no guarantee that stocking of signal crayfish will give a harvestable population in the long run.

## References and other resources

### Contact persons

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### Links

[The Astacus-project](#) (Interreg collaboration Norway-Sweden)

[CRAYNET](#) (EU Thematic Network)

[The International Association of Astacology](#) (IAA)

Global Invasive Species Data Base - [Pacifastacus leniusculus](#) (ISSG - Invasive Species Specialist Group)

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**Date of creation/modification of this species fact sheet: 15-03-2007**