**Aphanomyces astaci**

**System:** Freshwater

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<th>Kingdom</th>
<th>Phylum</th>
<th>Class</th>
<th>Order</th>
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<td>Fungi</td>
<td>Myxomycota</td>
<td>Phycomycota</td>
<td>Saprolegniales</td>
<td>Saprolegniaceae</td>
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**Common name**
Wasserschimmel (German), crayfish plague (English)

**Synonym**
Aphanomyces invadans, Aphanomyces meridionalis, Aphanomyces piscicida, Aphanomyces stellatus

**Similar species**

**Summary**
Aphanomyces astaci commonly referred to as crayfish plague is an oomycete or water mould that infects only crayfish species. It is endemic of North America and is carried by North American crayfish species; signal crayfish *Pacifastacus leniusculus*, *Procambarus clarkii* and *Orconectes limosus*. *A. astaci* was introduced into Europe through imports of North American species of crayfish. Native European crayfish populations are not resistant to this oomycete. It has since devastated native crayfish stocks throughout the continent.

**Species Description**

Black melanized spots may be indicative of the presence of the crayfish plague (Persson and Söderhäll, 1983; Vey et al. 1983; Diéguez-Uribondo and Söderhäll, 1993; Nylund and Westman, 2000). Identification of *A. astaci* requires microscopic examination of the affected tissues (Cerenius et al. 1987). Behavioural abnormalities, such as the phenomenon of 'walking on stilts', in which infected crayfish stand on the tips of their walking legs, is not necessarily indicative of an infected specimen.

Research shows that chitinase is expressed at a high level during vegetative growth of the crayfish pathogen (Andersson and Cerenius, 2002). Andersson and Cerenius (2002) state that "The pattern of chitinase expression is one of very few qualitative physiological characteristics known which can distinguish *A. astaci* from other parasitic and saprophytic species and may thus be of practical use for identification."

Oidtmann et al. (2002) developed a method which allows identification of *A. astaci* by means of PCR and restriction enzyme analysis from pure fungal cultures. Recently, Oidtmann et al. (2004) developed a molecular method for diagnosis of *A. astaci* in clinical samples based on internal transcribed sequences of the ribosomal DNA.
Notes
Ways of transmission only involves movements of chronic carriers, i.e. North American crayfish, or infected crayfish (Söderhäll and Cerenius, 1999). The chances of transmission by other means such as items that have been in contact with contaminated water, fish or birds are very low and can only occur during the short period of survival of the Aphanomyces spores, i.e. a few days.

Habitat Description
Aphanomyces astaci is an oomycete or water mould, which only parasitises freshwater crayfish (Unestam, 1969). Co-evolution might have led to different (ecological) genetic variants (Diéguez-Uribeondo et al. 1995). At least three different species of North American crayfish have been shown to carry this water mould in their cuticle: Pacifastacus leniusculus (Söderhäll et al. 1981; Smith and Söderhäll, 1986), Orconectes limosus (Vey et al. 1987), and Procambarus clarkii (Diéguez-Uribeondo and Söderhäll, 1993, Diéguez-Uribeondo et al. 1995). These crayfish are known to be responsible for the transmission of crayfish plague, A. astaci, to the European species of crayfish: noble crayfish (see Astacus astacus in IUCN Red List of Threatened Species), white-clawed crayfish (see Austropotamobius pallipes in IUCN Red List of Threatened Species), and A. leptodactylus (Huang et al. 1994, Lilley et al. 1997; Vennestrom et al. 1998; Oidtmann et al. 1999; Diéguez-Uribeondo and Söderhäll, 1999).

Reproduction
Aphanomyces astaci belongs to the order Saprolegniales. Reproduction among the Saprolegniales can be asexual and sexual. The order Saprolegniales is characterised by the production of biflagellate zoospores during asexual reproduction. Genera of saprolegnian fungi are distinguished by their asexual reproductive apparatus, features of zoosporangium production and the mode of zoospore release (Jong et al. 1991). Aphanomyces species are characterised by zoosporangia of the same diameter-like vegetative hyphae. The spores encyst at the sporangium tip after leaving the zoosporangium and form primary spore aggregates (the spore balls). From these, the secondary free-swimming zoospores emerge, which are the infective stage of the oomycete."

Oldtmann et al. (2002) states that, "A. astaci is an exception in the genus Aphanomyces in that it does not reproduce sexually. But as sexual reproduction can be induced only inconsistently in other Aphanomyces sp. in culture, the absence of sexual structures is not a reliable indication of A. astaci."

General Impacts
The infection process usually starts on the soft unsclerotised cuticle under the abdomen (Unestam, 1973). Hyphae grow in the soft, non-calciified parts of the cuticle. The mycelia grow rapidly through the cuticle and reach the internal body cavity, which, in European crayfish species, results in crayfish death within 6-10 days (Unestam and Weiss, 1970; Unestam, 1972; Alderman et al. 1987). However, in North American species the oomycete elicits a strong defence reaction immediately upon penetration of the cuticle (Unestam and Weiss, 1970). Hyphae extend into the water and produce motile zoospores which infect other crayfish. The first sign of crayfish plague mortality may be the presence of crayfish at large during daylight hours (crayfish are normally nocturnal), some of which may show evident loss of coordination in their movements and easily fall over on their backs and are unable to right themselves. Often, however, unless waters are carefully observed, the first recognition that there is a problem will be the presence of large numbers of dead crayfish in a river or lake (Alderman et al. 1987)."

*A. astaci* has devastated European crayfish populations causing substantial economic losses to previously valuable fisheries (Diéguez-Uribeondo et al. 1997; Alonso et al. 2000; Westman and Savolainen, 2001). Resistant North American crayfish species have been introduced in an attempt to revive crayfish fisheries but research now shows that these species are having detrimental impacts on the remaining native crayfish species (Holdich, 1996; Diéguez-Uribeondo et al. 1997; Josefsson, 1999, et al. 2000). Because of the increased distribution of *A. astaci*, it poses a significant risk to plague free countries and continents (CEFAS, UNDATED).

Management Info
For details on preventative measures, chemical, physical, cultural and biological control options, please see management information.


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ALIEN RANGE

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GLOBAL INVASIVE SPECIES DATABASE
FULL ACCOUNT FOR: Aphanomyces astaci

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Red List assessed species 7: EN = 3; DD = 3; LC = 1;

Aphanomyces astaci

BIBLIOGRAPHY
32 references found for Aphanomyces astaci

Management information


General information

Bower, S.M. 2002. *Synopsis of Infectious Diseases and Parasites of Commercially Exploited Shellfish: Crayfish Plague (Fungus Disease).* Fisheries and Oceans Canada - Pacific Region.

**Summary:** Available from: http://www.pac.dfo-mpo.gc.ca/sci/shelldis/pages/cpfdcy_e.htm [Accessed 19 December 2004]


ITIS (Integrated Taxonomic Information System). 2004. *Online Database Aphanomyces astaci*

**Summary:** An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals. Available from: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=13861 [Accessed December 31 2004]


