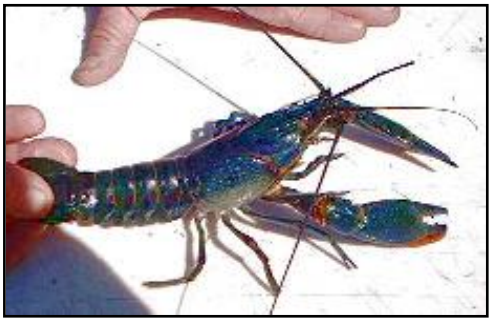
Red Claw Crayfish Risk Analysis for Arizona




Photos by: Stick-Fins Fish Farm

Name
Australian red claw crayfish (*Cherax quadricarinatus*)

Description
Identifying crayfish can be difficult. Positive identification requires looking at a number of characteristics and having enough experience to interpret them. Mature red claw crayfish can generally be identified by their large size (compared to other crayfish species), and their greenish-blue coloration with red patches on the margins of their claws.

Life History
Red claw crayfish possess many of the characteristics of a successful invader described by Kats and Ferrer (2003) for alien crayfish in general. These include being a habitat generalist, having broad dietary requirements, and high reproductive potential (Kats and Ferrer 2003). Red claw crayfish are described as having non-aggressive behavior when in crowded conditions, which makes them ideal for aquaculture purposes (Masser and Rouse 1997). Red claw crayfish were also observed to be most active between 6 pm and midnight (Masser and Rouse 1997).

Reproductive Strategy
Similar to that of other crayfish species, except that red claw crayfish has multiple annual spawning and higher fecundity than other species (Masser and Rouse 1997). It is important to note that it is not necessary to introduce both a male and a female crayfish to begin a new infestation. One female carrying viable sperm could begin a new population if released into a suitable environment. Red claw crayfish readily mate in captivity so it is reasonable to expect that mature females, whether used as aquaculture stock or as science class specimens, could produce offspring.

Environmental Tolerances and Restrictions
Red claw crayfish can survive 46-85°F (8-29°C) water and can tolerate high salinity (up to half that of seawater), pH range of 6.5-9, water hardness and alkalinity of 20-300 ppm and low oxygen concentrations (≥1 ppm). The species is considered prolific with sexual maturity within one year. Female red claw crayfish can produce up to 1000 eggs at temperatures of 59°F (15°C) and above (www.fisheries.nsw.gov.au/aqu/fw/fw_crays.htm), and can produce 3-5 broods during their breeding season (www.dpi.qld.-gov.au/fishweb/2702.html). Many Arizona aquatic systems

have water quality regimes suitable for this species. For example, water data (USGS 1999) indicate suitable water temperatures in San Pedro River ranging from 50-80°F (11-27°C).

One large production supplier of Australian red claw crayfish in Florida, Stick-Fins Fish Farm (http://farmingcrawfish.com/stick-fins-fish-farm/about_company.html), is hybridizing their sixth generation of red claw crayfish to breed at lower water temperatures and to grow faster.

Wildlife in natural settings often survive conditions that induce mortality in a laboratory. A case in point is the blue tilapia (*Oreochromis aureus*), which was thought to have cold-water lethal limits of 48-52°F (9-11°C), and up to 61°F (16°C). In spite of this temperature intolerance, blue tilapia have become established in several water bodies in Arizona. Blue tilapia have been found to survive lower temperatures depending on water salinity and fish life stage (adult vs. juvenile). Even if thermal tolerance of red claw crayfish is similar to that observed in the laboratory, there are many waters in Arizona where temperatures would be suitable for the species. The red claw has been observed to burrow, although less than other Australian crayfish. Burrowing to any extent would provide thermal insulation and likely allow the species to sustain itself in colder water conditions.

Preferred Habitat
Red claw crayfish inhabit lakes, ponds, and streams with annual water temperatures above 50°F (11°C). Like other crayfish species, they prefer areas that offer rocks, logs, or other debris as cover.

Distribution
- **Native Range:** tropical region of northern Australia
- **Expanded Range in United States:** aquaculture production in Florida and Texas, and perhaps elsewhere (this is not well documented)
- **Expanded Range Globally:** aquaculture production in Australia, New Zealand, Southeast Asia, Africa, Central America, and South America; feral populations documented in South Africa, Mexico, Jamaica, Puerto Rico, Singapore, and Venezuala

Current Status in Arizona
Presumed not present, but positive identification among known crayfish populations has not been conducted by Department staff, partner agencies, NGOs, or Scientific Collecting Permit investigators (few of which are proficient in identifying various species of crayfish).

Australian crayfish and all freshwater species within the crayfish families Astacidae, Cambaridae, and Parastacidae are already listed as Restricted Live Wildlife in Arizona, per R12-4-406.

Pathways
Crayfish will actively move into connected waterways, reservoirs, and ponds. Overland movement is possible during wet or high humidity conditions (such as at night, during or following rainy weather).

Crayfish experts identify illegal stockings and bait bucket dumping as likely translocation pathways to isolated or new habitats.

Red claw crayfish are intensively marketed by aquaculture suppliers as a profitable economic enterprise. Recent Google.com web-searches identify dozens of articles and web-links promoting red claw crayfish for sale and aquaculture production. This pathway is the most likely route for this species to enter Arizona. Ahyong and Yeo (2007) documented feral populations of red claw crayfish in water supply catchments of Singapore. In Great Britain, aquaculture of a North American crayfish species led to escape, establishment, and eventual extirpation of many populations of native white-clawed crayfish, *Austropotamobius pallipes* (Lodge et al. 2000b). Feral populations of these crayfish result from escape from aquaculture propagation facilities or intentional release.

Whether housed inside or outside, crayfish are very likely to enter the wild through escape and/or release. Aquaculture was identified as the 4th most important vector in crayfish introductions in North America and is increasing in importance as a vector (Lodge et al. 2000a). An estimated 65% of introductions for aquaculture purposes lead to established populations (Beveridge undated). Red claw crayfish introductions and/or escape from aquaculture settings have been documented in Africa, Puerto Rico, and Venezuala (de Moor 2002; Williams et al 2001). Personal communication from several experts have shown that likelihood of escape is high and red claw will escape almost all attempts to contain it (Ian Ruscoe Aquaculture Policy Expert, Northern Territory Australia); will escape from enclosed systems (James Furse, Freshwater Crustacean Ecologist, Queensland Australia); enclosed or not enclosed, in most cases nonnative species find a way to escape and become established (Dr. Chris Taylor, Research Scientist, Illinois Natural History Survey); are virtually impossible to contain them in any facility (Dr. Irene de Moor, South African Institute of Aquatic Biodiversity, South Africa).

In Australia it is illegal to release red claws outside their natural range in Queensland (Short 2000) and illegal to utilize in Tasmania for aquaculture (Piper 2000). Illinois has prohibited the introduction of Australian crayfish (Lodge et al. 2000b). In Arizona, Rule 12 A.A.C. 4, 406. F, lists "Australian crayfish and all freshwater species within the families Astacidae, Cambaridae, and Parastacidae" as restricted live wildlife.

Known/Potential Impacts

Crayfish are omnivorous, with a wide range of dietary capabilities—see review by Childs (1999). A number of peer review publications exist that demonstrate the significant deleterious impacts crayfish can have on fishes, aquatic species, and aquatic habitats (Lorman and Magnuson 1978; Lodge et al. 1986; Hepworth and Duffield 1987; Lodge and Lorman 1987; Hanson et al. 1990; Olsen et al. 1991; Miller et al. 1992; Lodge et al. 1994; Tayler et al. 1996; Lodge et al. 2000a; Kats and Ferrer 2003). Numerous field observations coupled with a recently completed Heritage-funded research projects, also indicate that crayfish can have a pronounced impact on native amphibians (Fernandez and Rosen 1996, Kats and Ferrer 2003) and native fish (Carpenter and McIvor 1999).

Little research has been done to determine the impacts of red claw crayfish on aquatic species. Culture experiments combining tilapia and red claw crayfish found significantly reduced

survival, food conversion, and final weight of tilapia cultured with red claw crayfish present compared to culture without (de Moor 2002). Red claw crayfish were shown to dominate local Australian crayfish, *Cherax depressus*, and prawn, *Macrobrachium australiense* (Cook et al. undated) and can out compete native shrimp in Puerto Rico (Williams et al. 2001).

Parasites and diseases of Australian crayfish are not fully known nor their impacts fully understood. There are several diseases and/or parasites specific to red claw crayfish. Microsporidiosis is caused by a protozoan that infects the muscle of crayfish. Two microsporidian species have been detected in red claw crayfish. One of these, *Thelohania*, can cause mortality and is difficult to detect at early life stages. Viruses include bacilliform virus (CqBV), parvo-like virus, hepatopancreatic reo-like virus (CqHRV), white spot syndrome virus (WSSV) and Giardiavirus-like virus (CGV). CGV was observed to cause 85% mortality and WSSV has caused massive shrimp losses around the world (viral infections web site www.us.geocites.com/crayfishdisease/pages/info_pa/virus.html ; WA Australia gov. web site – www.fish.wa.gov.au/comm/broc/mp/mp100/mp10007.html). As of 1997, there were no approved therapeutics for treatment of red claw crayfish (Masser and Rouse 1997).

The existence of crayfish plague (*Aphanomyces astaci*), native to North America, has been proposed as insurance against possible escape of Australian crayfishes. However, only a few species (of the 390 species native to North America) are known to harbor crayfish plague (Lodge et al. 2000a). Further, red claw crayfish appear to be susceptible to crayfish plague possibly only at lower water temperatures. Crayfish plague was pathogenic to red claw in experiments at 57 (F) degrees (14 C), but caused no mortality at 68 (F) degrees (20 C) (Roy undated).

Benefits

Red claw crayfish are marketed as "freshwater lobsters" due to their large size, and therefore make them appealing for commercial aquaculture as a food commodity.

Effective Treatments

Based on research and recommendations in the U.S. Forest Service Technical Guidelines for AIS Prevention 11-08 document, the following treatment methods are effective at killing crayfish when cleaning equipment from infected waters:

- Direct exposure to ≥140°F wash water
- Dry in direct sunlight for 3 hours
- Exposed to a 20% cleaning solution of bleach sodium hypochlorite (22 oz bleach/1 gallon water) for a minimum of 30 seconds

Note: quaternary ammonia solutions may be effective, but no data was available.

Recommendation

Through Arizona Game and Fish Department Directors Order {A.R.S. §17-255.01(B)}, list Australian red claw crayfish (*Cherax quadricarinatus*) as an aquatic invasive species in Arizona, with subsequent affected waters listing and mandatory conditions for movement.

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