Use of edible alien crayfish for human consumption

Toshifumi Nonaka

Abstract.—In Japan alien crayfish (the signal crayfish *Pacifastacus leniusculus* and the red swamp crayfish *Procambarus clarkii*) have increased. Alien crayfishes have a major impact on Japanese freshwater ecosystems, and new methods for protection and conservation are needed. I give the Information as a kind of conservation by using on culinary use of edible.

INTRODUCTION

In Japan, there are three species of crayfish. One is a native species, *Cambaroides japonicus*, and two are alien species, *Procambarus clarkii* and *Pacifastacus leniusculus*. *P. clarkii* are widely distributed in Japan, and are damaging aquatic ecosystems in Japan. *P. leniusculus* are rapidly expanding distribution in Hokkaido and this species is damaging ecosystems in Japan. It has been designated as an Invasive Alien Species (Ministry of the Environment Government of Japan: http://www.env.go.jp/en/nature/as.html). To prevent damage to ecosystems by these two alien species, measures must be taken soon. One important measure is to reduce the number of adult crayfish. Australia and New Zealand have implemented eradication and control programs in various ways. See additional notes as (Gherardi & Angiolini, 2004). Although various attempts to remove alien crayfish in Japan have been carried out, there has not been a reduction in the number and distribution of alien crayfish. Also, the disposal of captured alien crayfish is problematic. Therefore, effective measures need to be taken.

*P. leniusculus* has been used as a food item in Europe (e.g. Finland, Sweden, United Kingdom and so on), (National Geographic, 2011; Kawai, 2007). In addition, they were initially introduced as a food item for Japanese people. Therefore, the use as a food is a potential method of reducing the number of alien crayfish.

In this present paper, I will present some examples to show how to prepare the alien crayfish of *P. leniusculus* and *P. clarkii*.

Alien crayfish in Japan

*Pacifastacus leniusculus* (Invasive Alien Species)(Photo. 1)

*Pacifastacus leniusculus* (hereafter: signal crayfish) was originally introduced into Japan in the early period of Showa (1927–1930) as a food item for cultivation.

Although cultivation of this species was attempted in national fisheries experimental stations, the attempt was only successful in Lake Tankaiteike in northern Shiga Prefecture and in Lake Mashu in Hokkaido.

The habitat of signal crayfish has gradually extended so that their increasing population is concerned to have had a marked
negative influence on the native species and the biodiversity, especially in Hokkaido, Fukushima (Lake Onogawa, Lake Hinohara), and Chiba (Tone River).

According to the fishery report of Hokkaido in 2007, the total number of captured signal crayfish in Lake Toya, Lake Shikotan, and Lake Shikaribetsu and others was 19,412. In addition, in 2012, over 100,000 individuals were captured in Lake Toya (Photo. 2).

*Procambarus clarkii* (designated as Invasive Alien Species) (Photo. 3)

*Procambarus clarkii* (hereafter: swamp crayfish) was imported by Kamakura-shi, Kanagawa Prefecture as a food for the American bullfrog (*Rana catesbeiana*) in 1927 and the distribution was restricted to near Kamakura at the beginning. However the area of distribution quickly expanded, and habitation is now throughout much of the country until it reaches Hokkaido, Shikoku, and Kyushu.

**Alien crayfish as food**

Crayfish is a commonly used and expensive food item in Europe. However, in Japan, they are not commonly eaten because of the abundance and availability of seafood in typical grocery stores.

**Signal crayfish**

After the enforcement of the Invasive Alien Species Act on February 1, 2006, there are a very limited number of handling contractors of signal crayfish; only two fishery organizations, the Akan Lake Fishery Collaboration Association (ALCA) and the Toro Lake Fishermen’s Cooperative Association, which are permitted to handle the species. The internet web site (http://
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According to the Law, catching signal crayfish is permitted to ALCA only in the Akan Lake. The sales of signal crayfish started in September, 1993. The average annual capture volume is from 2.5 t to 3 t.

Capture is allowed from May to
November

- The capture method is the so-called “pull-up method” using a basket trap
- The captured signal crayfish are kept in a holding tank for several days before dispatch as a requirement of the Invasive Alien Species Act.

In addition, the sales procedure (Table-1) in accordance with the Law needs to be displayed when selling the signal crayfish.

**Sale**

**Signal crayfish for personal consumption**
- Boiled signal crayfish (complete) (not cultured) 1,785 yen (Photo. 5)
- Boiled signal crayfish (incomplete: various sizes) (not cultured) 1,785 yen
  Size: 20–33/1kg
  Fishing season: mid May to end of November
  Shipment unit: from 1kg Dispatch: Frozen
  No limit on sale
  Signal crayfish for restaurants
- Live signal crayfish (complete) (not cultured) 1,630 yen (Photo. 6)
- Live signal crayfish (incomplete, various sizes) (not cultured) 1,470 yen
  Size: 20–33/1kg
  Fishing season: mid May to end of November
  Shipment unit: from 1kg Dispatch: Not frozen
  *prices stated above for October, 2009
  - Limited sale for restaurants by the Invasive Alien Species Act

**Processed food**
- Soup of lake lobster 500 yen per tin (Photo. 7)
  This is sold in the Akan fishery collaboration association, and it also sells in souvenir shops, such as at the station and at the airport in Hokkaido.
  The soup of the tomato flavoring containing a can, and the present state—even when delicious, when and it is suggested to add whipped cream for serving and it carries out It can be eaten in the style of potage or it uses can be used for the a sauce of pasta, etc., although arranged.
  - Snack of signal crayfish 500 yen per box (Photo. 8)

**The snack with powder of signal crayfish**

**Cooking**

There are several restaurants that serve signal crayfish; however, most restaurants dealing with signal crayfish provide this food only for a limited period or season in the year. Typical menus of signal crayfish provided in restaurants are as follows:

**Appetizer with signal crayfish (Photo. 9)**
- Boiled signal crayfish served with seasonal vegetables with sauce americaine*
  *Sauce americaine: Broth is made from sautéed and well boiled heads and husks of signal crayfish with various vegetables. Whipped cream is put in to complete the sauce

**Fried signal crayfish (tempra) (Photo. 10)**
- Japanese style fried signal crayfish, fried with tempura powder.

**Boiled signal crayfish (Photos. 11 & 12)**
- Signal crayfish parboiled with salt. Lemon may be added depending on preference. Also, Uchiko (ovary), or nursery powder, may be added. Not only the tail meat but also the internal organs are delicious.

**Grilled signal crayfish with herbs (Photo. 13)**
- Grilled signal crayfish, cut in half lengthwise, and sprinkling with various herbs and salt, makes this dish more fragrant.

**Pasta of signal crayfish (Photos. 14 & 15)**
- Pasta dish with signal crayfish, finished using americaine sauce. Various arrangements, i.e., gnocchi, can be enjoyed.

**Japanese soup noodle with signal crayfish (ramen) (Photo. 16)**
- Signal crayfish arranged in a Japanese soup noodle, ramen.

**The swamp crayfish**

The swamp crayfish has been sold in Japanese food markets. However, there is very limited information on the market circulation of the swamp crayfish, when compared with that of the signal crayfish.

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Photo.-15 Pasta of signal crayfish (gnocchi)

Photo.-16 Ramen noodle of signal crayfish

Photo.-17 Swamp crayfish for sale in Tsukiji market

Photo.-18 Swamp crayfish for sale in Ueno Ameyoko

Photo.-19 Temporary holding pen for swamp crayfish

Photo.-20 Boiled signal crayfish (left 3) and swamp crayfish (right 2)

Photo.-21 Chinese hot stir-fried dishes of swamp crayfish

Photo.-22 Chinese stir-fried dishes of swamp crayfish

Photo.-23 Crayfish sold in a supermarket (July in Finland)

Photo.-24 Crayfish served in a restaurant (July)

Photo.-25 Introduce Explanation of the concept of Crayfish parties and associated product
CONSUMPTION OF ALIEN CRAYFISH

Photo.-21 Chinese hot stir-fried dishes of swamp crayfish

Photo.-22 Chinese stir-fried dishes of swamp crayfish

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Photo.-26 Crayfish sold for the party
handle the swamp crayfish (Photo. 18).

–The quantity which is traded of the swamp crayfish in the Tsukiji market during May to October and 1 time is 5 kg to about 10 kg
–Sell by laying in stock for two to three orders in one month
–Lay in stock and sell to orders from French restaurants etc.

The fisherman of Chiba Prefecture as well as Ibaraki Prefecture, where fishing for swamp crayfish occurs in Kasumigaura Lake, and the catch is shipped to the Tsukiji market.

–Several contractors capture the swamp crayfish, and all contractors start crayfish fishing in May, when the crayfish become active.
–All crayfish shipped to Tsukiji market are captured from the wild and are not cultured.
–Capture is by using a basket trap.
–According to the order amount to ship.
–Captured swamp crayfish will be kept between three and four days before shipping (Photo. 19).

Cooking

There are a very few chances for the general public to see dishes of cooked swamp crayfish even though most Japanese people have experience of playing with, or fishing for swamp crayfish in their childhood. In fact, even in Tsukiji market, the purchase orders for swamp crayfish tend to be periodical and orders are typically made by foreign people.

In America, you can view images of boiled swamp crawfish or jambalaya. In China, there is available information such as restaurants which are popular for their crayfish dishes.

In Japan, individuals have HPs introduces how to eat crayfish. However, in restaurants these dishes are most regularly eaten.

Recently, across the country, which is to be done as well as removal of crayfish in native ecosystem conservation activities. Some people have to eat and let eat accordingly. But generally they are not considered as good food. Also, people who have played during their childhood with crayfish, majority of people do not consider swamp crayfish as suitable as a food.

For cooking methods of swamp crayfish, it seems that the cooking recipes for signal crayfish are applicable to swamp crayfish. However, because the size of swamp crayfish is much smaller than signal crayfish there are some limitations (Photo. 20).

Chinese hot stir–fried dishes of the swamp crayfish (Photo. 21)

The swamp crayfish was stir–fried together with prickly ash or red pepper is a popular Chinese dish. Although it has a very hot seasoning, it is an appropriate accompaniment to consume with alcohol, such as beer, is suited well

Chinese stir–fried dishes of the swamp crayfish (Photo. 22)

The swamp crayfish is stir–fried with seasoning in Chinese style. The back of the main body of the swamp crayfish is cut prior to being cooked. The internal organs promotes the taste of the swamp crayfish appropriately.

Crayfish party

In Finland and Sweden, there is a cultural custom to eat crayfish during the summertime. In this time, crayfish are sold in most supermarkets (Photo. 23). People enjoy eating crayfish in restaurants, or in their own houses (Photo. 24).
In Finland, crayfish fishing begins on July 21.

In Sweden, crayfish parties are held in various places in August to celebrate the summer.

In recent years, crayfish parties (Photo. 25) have been introduced to Japan; and as a result, some grocery stores have started to sell imported crayfish (Photo. 26) from China (Photo. 27) for crayfish parties.

Proposal to reduce alien crayfishes

The annual retail volume of alien crayfish in Japan is assumed to be approximately 5t.

For signal crayfish, the annual retail volume is 2.5 to 3t according to the data from Akan Lake in Hokkaido. For swamp crayfish, it is estimated that the annual retail volume may be between 1 and 1.5t when the number of river fish wholesalers and the average volume (1) of the crayfish sold in one wholesaler in Japan are considered.

(1) The average volume of swamp crayfish sold by one wholesaler is assumed to be 200kg.

This volume of sales, the annual retail volume of alien crayfish in Japan, can be regarded as relatively small when compared with the figure of imported freshwater Chinese mitten crab (Eriocheir sinensis), which is also a designated species in the Invasive Alien Species Act. The smallest imported volume in the recent years was 88t in 2009 of Chinese mitten crab, and thus, the annual retail volume of alien crayfish in Japan is only 1/45 of the imported volume of Chinese mitten crab.

Stock estimation using more than 100,000 individuals of signal crayfish was implemented at Lake Toya in 2010. However, there was still no clear sign showing the population reduction of signal crayfish.

Estimations of the population sizes of the swamp crayfish and signal crayfish in Japan are very difficult.

However, the large number of individuals of swamp crayfish and signal crayfish in Hokkaido and Honshu, is of no doubt. Because you they have been continuously active recorded in many parts of Japan as well as programs to removal them in of Hokkaido.

Reduction of population sizes of alien crayfishes is one of the urgent issues for the conservation/preservation of native ecosystems in Japan. Utilization of those alien crayfishes as a food source can be one of the possible measures to control their populations, and at the same time achieving the effective use of the natural resource.

The main problem associated with alien crayfish as foods is its image that they are able to tolerate low water quality, when compared with marine crabs, since they live in the mud of rivers and lakes where the water quality is low. Also, the abundant supply of fresh sea foods in the market leads to a reduction of the attractiveness of alien crayfish.

Therefore, in order to promote the demand for and acceptance of alien crayfishes as a food source, it is necessary to change the image or remove the negative image of alien crayfish and increase the chance to be seen in local supermarkets gradually by improving the volume of market circulation. The following activities may be effective for the above goals:

–Promotions to explain the nutritional benefits of alien crayfish as a food by developing cooking recipes that are inexpensive and delicious, similar to those for Shanghainese mitten crab.

–Deregulation, or simplification, of the legal procedures of the Invasive Alien Species Act and other relevant laws for capturing and market circulation.

–Establishment of incentives for not only capturing alien crayfish but also purchasing them to handling contractors and buyers; i.e., Crayfish Incentive Point).

These institutional structures will improve the attitude toward the use of alien crayfish among the general public and enhance the public consumption of these unwanted species as a food source while their population sizes in natural environments can be controlled and reduced, resulting in less negative effects on aquatic ecosystems.

Use of alien species, the law for Invasive Alien Species. Its original purpose was to remove the alien species. Therefore, careful efforts are required.

We are required to reduce the number of
habitats and habitats of alien crayfish in the country and for their use as a business that holds alien crayfish food items. However, because of the continued use of the Alien crayfish, there could be a need requirement for farming, would likely which may, if improperly regulated, increase the Alien crayfish in the future. Therefore, we are assuming a situation may arise, it is necessary to consider guidelines for the handling of foods and the Law regarding Invasive Alien Species responses to reduced populations of alien crayfish.

Acknowledgements.—I wish to thank the Akan Lake Fishery Collaboration Association (ALCA: Akan–cho) for giving information on sales of signal crayfish, and Wine Bar Jose (Chuo–ku, Sapporo) for their help in the various ways of cooking crayfish. My thanks are also due to Dr. Tadashi Kawai (Wakkanai Fisheries Institute, Wakkanai) for giving me the opportunity to publish and for various support.

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