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# Crayfish NEWS

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The official newsletter of the International Association of Astacology

## Indoor breeding of redclaw crayfish

**Most redclaw farms are able to produce their own juveniles from dedicated juvenile production ponds. However ponds used for juvenile production can also be used for growout.**

Income generated from these additional growout ponds would likely far exceed the expense of buying juveniles produced elsewhere. Recently some farms have begun to specialise in juvenile production, supplying dedicated growout farms or farms where juvenile production has fallen short of requirements.

According to 'best practice' farming techniques (Jones and Ruscoe 1996), juveniles being stocked for growout should be as uniform in size as possible. Controlling the mating and spawning processes can influence that uniformity by synchronising the hatch and release times of groups of berried females' offspring. A project involving selective breeding of redclaw is proceeding at the Queensland Department of Primary Industry's Freshwater Fisheries and Aquaculture Centre (FFAC) at Walkamin, Queensland, Australia. The trial involves controlled indoor spawning and pond based growout of a line selected for increased growth rate and a control line. The selected line, with improved growth rates, will eventually be released to industry.

The breeding program provides useful insights for crayfish farmers wanting to establish their own controlled breeding programs. Following is a brief description of methodologies and results of the selective breeding and recommendations for hatchery breeding of redclaw.

At the beginning of the trial, ten breeding families of each of two river strains (Gilbert and Flinders) were arranged. After breeding and subsequent growout, the first generation was subjected to a selection. The heaviest 20 females and 5 males from each family were selected to mate with corresponding animals from a different family but from within the same river strain, to avoid inbreeding. At the same time, 20 females and 5 males from around the average were mated with corresponding animals from other families. These two groups became the selected and the control lines, respectively.

After 2 generations of selection a 9.5% increase in size at 7 months of age had been achieved. Full details of the experiment so far and how to set up your own breeding program can be found in Jones *et al.* (1998) "Breeding Redclaw: Management and selection of redclaw broodstock".

This year, selectively bred animals from the redclaw farming industry have also been included in the breeding program. As the aim of the project is to generate a line of faster growing animals for the redclaw industry more replicates of the selected line than the control line are included in the trial.

*(Continued on page 3)*

*The International Association of Astacology (IAA), founded in Hintertal, Austria in 1972, is dedicated to the study, conservation, and wise utilisation of freshwater crayfish. Any individual or firm interested in furthering the study of astacology is eligible for membership. Service to members include a quarterly newsletter, membership directory, bi-annual international symposia and publication of the journal Freshwater Crayfish.*

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## President's Corner

**The IAA President comments on two regional IAA meetings, progress on IAA 12, the IAA directory and notes on eradication and captive breeding.**

We have two regional IAA meetings planned for this year. The first, in Astrakhan on 2-6 August 1999 which I am attending to promote our organisation and the second in Cuernavaca, Mexico on 19-21 October 1999 where Board Member, David Rouse, will promote the IAA. The promotion of IAA regional meetings between the biennial international symposia has certainly kick-started interest in astacology in these areas where attendance at the meetings are anticipated at 30 delegates in Astrakhan and 40 in Mexico. I hope that further details of the Mexican meeting can be found elsewhere in this newsletter and they should be available on the IAA website soon.

The Herculean task of organising any meeting in the former Soviet-Union, which has fallen to Andre-Serge Mikouiza, should not be underestimated. Whereas we normally keep bureaucracy to a minimum in the IAA, this is not possible during the organisation of the Astrakhan meeting due to the administrative detail required by the Russians. For example, my application for a visa has been rejected 3 times already. The first time it was rejected because there was not an official Russian company stamp on my letter of invitation, this was despite the fact that it was on headed paper and signed by the director of the Caspian Fisheries Institute. The second time it was rejected because the signature of the writer did not run across the stamp, and the third time because the stamp was not clear enough. Each time I have had been involved in further e-mails and faxes with Andre-Serge to get the necessary documentation. I am sure that you can imagine the frustration involved, despite my agent making 3 trips to the Russian Embassy in London this week, I still have no visa, so I am not absolutely sure whether I can go. However if the meeting organisers have only a fraction of the problems for other administrative procedures in organising this conference, I think that we should thank them greatly for ever attempting the exercise.

Gunter Vogt informs me that 75 manuscripts have been revised for IAA 12 and only a few are still missing. The review process went off to the IAA 12 organisers' complete satisfaction and they are now entering the final step of formatting and composing the book. If you attended the IAA 12 symposium in Augsberg in August 1998 you can expect to receive a copy of this book free of charge in December 1999. If you did not attend and would like to have a copy of this book, which will contain the latest advances in astacology, and interests of astacologists around the world, then books will be available from Max Keller (contact address in the IAA Directory) at a cost of 40DM plus shipping cost. I hope that in the next newsletter we can give details of simple methods of buying the book with a credit card.

The IAA directory has now been updated and distributed by Jay Huner and if you have not yet received a copy please contact Jay (contact address on page 2 of newsletter). If your entry is incorrect or has omissions also please contact Jay so that they can be corrected for the next directory.

## Editorial

Six months ago I shifted my e-mail facility from home to my office at University. I wish I hadn't! Last week the entire hard disk that serves our Department crashed and took all of my current and archived e-mails with it! This included about 300 pieces of IAA correspondence. Much to my annoyance their was no auto back up in operation at the time. As a result I can only include some of the items sent to me for this issue of the newsletter. If you have e-mailed me a contribution that does not appear in this issue, could you please re-send it and I will endeavour to have another issue out within 2 months. Apologies for any inconvenience.

With regard to IAA 13, to be held in Perth, Western Australia next August (6 - 12th, 2000), I have been advised by the airlines that delegates must book their tickets immediately. This is due to the huge demand generated by the 2000 Olympics which begins in Sydney about a month after our symposium.

Included in this issue is the first call for papers for IAA 13. Please note that the preferred submission method for Abstracts is by e-mail (my University has promised to install an auto-backup!).

*Glen Whisson*, editor
E-mail: twhisson@alpha2.curtin.edu.au

A recent project for rare mussel rehabilitation, which I have been involved with in north Bavaria, has brought my attention to an indirect effect of a very strong crayfish population on mussels. The very rare freshwater mussel species (*Unio crassus*) depends on distinct freshwater fish, e.g. bullheads (*Cottus gobio*), which serve as hosts for the glochidia (they live in the gills of the fish). A negative relationship between the signal crayfish and bullheads has been reported in the conservation literature. In the area in question a spreading population of signal crayfish is very dense in places. Where this reduces the fish population the mussel population is also compromised by the reduction in fish hosts. This much is clear to us. However we do not know how much mussels are a favoured diet of crayfish. If anyone could direct us to information on the subject of mussel predation by crayfish, it would be gratefully received. At the present time signal crayfish are

compromising both mussel and fish rehabilition programmes. As the river is to be re-channelled shortly, there is a chance of a signal crayfish eradication attempt. As this project would be of interest to astacologists in a number of countries, I will report any further developments in this column.

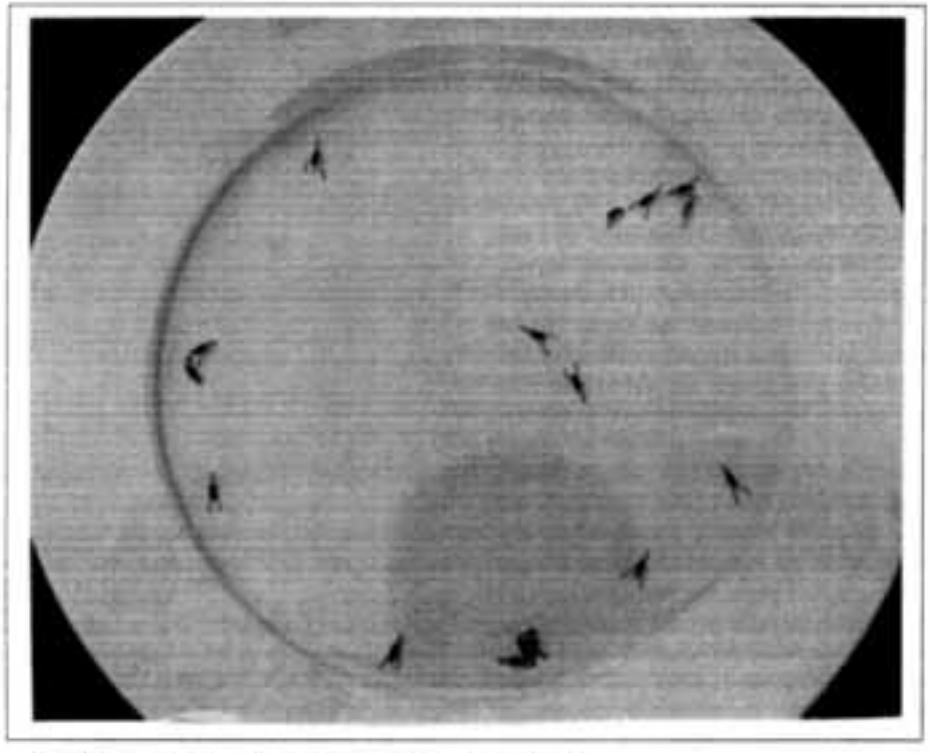
In England we have bred native crayfish (*Austropotamobius pallipes*) this year. This was not a deliberate attempt to increase stocks but was part of Severn-Trent Water's crayfish conservation measures during construction works on a river. Approximately 100 crayfish were removed from the river in July 1998, and bred in captivity in tap water.

In April 1999, the berried females were separated from the other crayfish and individually housed in cages. When the young left the mother, they could avoid predation by her by escaping through the mesh of the cage. The offspring of one such female (Stage 2 juveniles) appear in the photograph below. The adults were released to the river following completion of construction works in June 1999, the young will be reared in captivity a little longer to increase their chances of survival before being released.

One of the objectives of the Board of the IAA is to encourage cartoons that might interest readers, please send them to the editor, Glen.

I look forward to renewing acquaintances and finding new members at our regional meetings.

**David Rogers**
IAA President



Stage 2 juvenile *A. pallipes* bred in captivity in England



## Breeding redclaw crayfish . . .

*(Continued from page 1)*

Experimentally, it is extremely important for the hatch times to be synchronised so that the age of the animals can be accurately recorded. In order to achieve this synchrony in mating and spawning, a heated indoor hatchery was built. The roof has a combination of clear and opaque panels to take advantage of natural light. It is well known that water temperature is the main stimulant in mating and spawning in redclaw crayfish (Jones 1990; Jones 1995; Yeh and Rouse 1995; Jones and Ruscoe 1996; Jones *et al.* 1998). Jones (1990) found that spawning occurs all year when animals are maintained at 26-27°C and at 14 hours daylight. The fibreglass tanks of the current trial were set up with habitat and were continuously recirculated through a 'baffle box' biofilter. Immersion heaters with thermostat were installed in the sump of the system to heat the water to 27°C before being pumped back to the tanks.

Ammonia and nitrite levels along with DO, pH and temperature range were checked routinely. Ammonia nitrogen rose to a peak of 0.02 mg/L shortly after stocking and nitrite nitrogen rose to 0.075 mg/L, both well below toxic levels (Meade and Watts 1995). The pH ranged from 7.4-8.6, DO ranged from 4.2-6.1 mg/L and temperature ranged from 25.5-27.5°C. These water quality conditions are within optimal ranges for mating and spawning of redclaw crayfish.

Mature crayfish were removed from the ponds and breeding groups arranged. Males and females were kept separate for 4 weeks and fed to excess a combination of raw chopped squid, beef liver, ribbon weed (*Vallisneria* sp.) and crayfish pellets (Athmaise™). Left over food was vacuumed out of the tanks the morning after feeding, and the volume replaced. Twenty-six 1500 L tanks and two 750 L tanks were used. The 1500 L tanks were divided in two with an aluminium frame supporting 4mm HDPE mesh, in order to keep males and females separate. The 2 smaller tanks were to house spare animals in case of mortalities, with males and females separated.

Regular checks while cleaning revealed that some crayfish had moved from their designated side and were in with members of the opposite sex. These animals were moved back to their designated side or if already berried were discarded and replaced. After 4 weeks the mesh barriers were removed from the larger tanks. At the same time, animals in the smaller tank, the reserves, were discarded.

*(Continued on page 6)*

***Table 1.*** *Numbers of berried females at different stages and total number for the three treatments after 6 weeks*

| | Stage 1 green | Stage 2 brown | Stage 3 yellow | Stage 4 red | Stage 5 red, eyes | Stage 6 red, eyes, legs | Stage 7 hatched, attached | Total |
|---|---|---|---|---|---|---|---|---|
| **Control** | 1 | 7 | 5 | 0 | 0 | 28 | 3 | 44 |
| **Farm** | 2 | 17 | 4 | 1 | 0 | 36 | 0 | 60 |
| **Selected** | 3 | 27 | 16 | 1 | 1 | 109 | 1 | 158 |

## Breeding redclaw crayfish . . .

*(Continued from page 5)*

Two stage 1 berried females were discovered in the smaller tank where contact with a male had not been possible for more than 4 weeks. These two berried females were maintained in separate tanks for several days until they lost their egg clutches. It appeared each of them had spawned without mating. Other crayfish species, including *Austropotamobius palipes* have also been observed spawning clutches of unfertilised eggs without mating (Woodlock and Reynolds 1988).

fter a 4 week conditioning phase at approximately 27°C and 14 hours of daylight per 24h (14L:10D), the animals were allowed to mix and mate freely. Six weeks later all females were checked for berries. The overall berry rate was approximately 45% in the six week period, which is comparable with the redclaw spawning trials of Yeh and Rouse (1995), who obtained rates of 39.2 - 45.6% per month, although significantly less than the 75% (in 6 weeks) achieved by Jones (1995) when using females staged for ovary development. Table 1 shows the numbers of berried females and stage of berry (Jones 1990) in each of the three treatments.

Figure 1 depicts the frequency of different stages of egg development, as a percentage of the total number of berried females in each of the three treatments. It is clear that the proportion of berried females at stages 2 and 6 makes up the great majority of berried females. In fact the berried females at stages 2 and 6 make up 79.6, 88.3 and 86.1 % of the total numbers for the control, selected and industry stock, respectively

Jones (1990) showed that at 27°C the stages of egg development occur in approximately weekly succession. From Fig.1 we can see that there was a pulse of mating and spawning, coinciding with egg development stage 6, approximately 1 week after mixing. This was followed by a lapse in spawning of approximately 3 weeks, followed by a second pulse of spawning and mating 1 week later. The two pulses of mating and spawning shown by the large proportion of berried females with eggs at developmental stages 2 and 6, occurred approximately 4 weeks apart. Both these pulses coincided with new moons. There is no direct evidence to suggest that the crayfish used this stimuli (ie. very dark nights) as a synchronising cue for reproduction, however it is a common cue for reproductive events in many species.

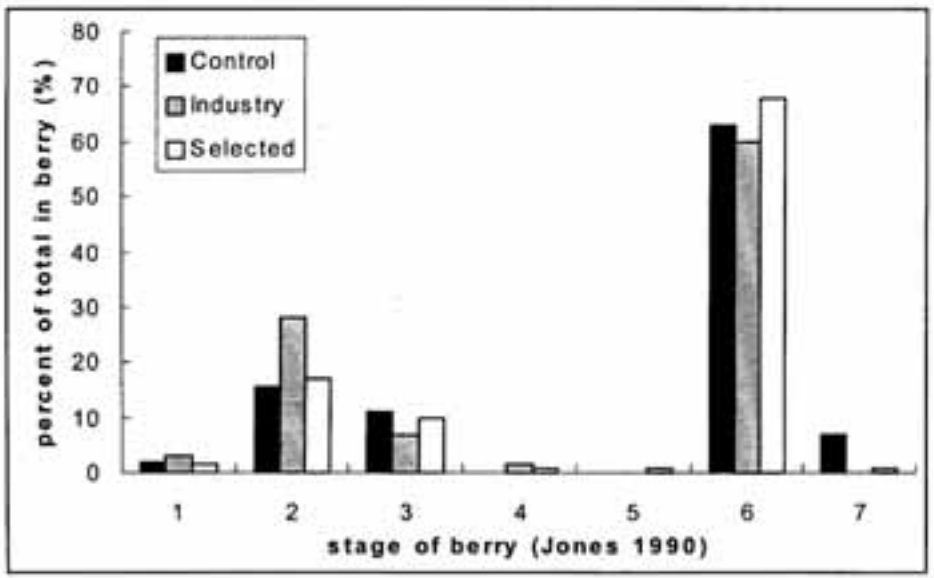



*Figure 1. Percent of berried females in each stage of egg development for the three breeding lines*

The following are recommendations for synchronised indoor breeding of redclaw crayfish.

1) A large number of tanks should be used so that a large number of breeding groups can be maintained, thereby ensuring high levels of genetic diversity.

2) A male to female ratio of 1:1-1:3 should be used, also to maintain genetic diversity.

3) Water temperature should be maintained around 27-28°C with as little daily variation as possible. This is best achieved with a recirculating water system.

4) 14 L: 10D should be present to simulate summer conditions.

5) Abundant shelter should be used to reduce stress on the animals.

6) Light should be greatly reduced in the tanks to simulate the natural (pond) environment. This can be achieved with layers of 90% shade cloth.

7) Stocking density should not exceed 20 per square metre in the tanks.

8) Males and females should be kept separate for at least 2 weeks of conditioning before mixing and breeding.

9) A varied diet including some high quality protein rich foods and some fresh plant matter should be used during the conditioning phase.

10) Animals should be checked for berries no more than once per week (or longer) as dislodgement of early stage eggs is common when handling.

11) Berried females should be transported in well aerated water and released in the late afternoon or evening. Normal acclimation procedures should be followed.

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## NEW CRAYFISH PUBLICATION

As a result of the successful Florence workshop that addressed the introduction of alien crayfish species in Europe, a publication titled "Crayfish in Europe as alien species. How to make the best of a bad situation?" has been released. Edited by **Francesca Gherardi** and **David Holdich**, the publication includes the following contributions:

• ***Introduction***

Native and alien crayfish in Europe: An introduction
*David M. Holdich & Francesca Gherardi*

• ***Aspects of the biology of alien crayfish***

The introduction of alien species of crayfish in Europe: A historical introduction
*Paula Henttonen & Jay V. Huner*

Life history characteristics of crayfish: What makes some of them good colonizers?
*Ossi V. Lindqvist & Jay V. Huner*

The negative effects of established crayfish introductions
*David M. Holdich*

The positive effects of established crayfish introductions in Europe
*Hans Ackefors*

Ecological impact of introduced and native crayfish on freshwater communities: European perspectives
*Per Nystrom*

Diseases of European freshwater crayfish, with particular emphasis on interspecific transmission of pathogens
*Gunter Vogt*

• ***Case studies of alien crayfish in Europe***

The situation in Italy
*Francesca Gherardi, Gilberto N. Baldaccini, Silvia Barbaresi, Paolo Ercolini, Giorgio De Luise, David Mazzoni & Maurizio Mori*

The situation in Belgium, France and Luxembourg
*Jacques C.V. Arrignon, Pierre Gérard, Ady Krier & Pierre J. Laurent*

Distribution of crayfish species and legislation concerning crayfish in Switzerland
*Thomas P. Stucki & Erich Staub*

German conservation strategies for native crayfish species with regard to alien species
*Peter Dehus, Erik Bohl, Birgit Oidtmann, Max Keller, Sandra Lechleiter & Simon Phillipson*

The status of crayfish populations in Spain and Portugal
*Pedro J. Gutiérrez-Yurrita, J.M. Martinez, Maria Ilhéu, M.A. Bravo-Utrera, J.M. Bernardo & C. Montes*

Crayfish introductions in the Nordic and Baltic countries
*Jostein Skurdal, Trond Taugbol, Aloyzas Burba, Lennart Edsman, Bjorn Soderback, Bjarne Styrrishave, Jaanus Tuusti & Kai Westman*

Native and alien crayfish in the British Isles
*David M. Holdich, W. David Rogers & Julian D. Reynolds*

The American spiny-cheek crayfish, *Orconectes limosus* (Rafnesque), in the fauna of Belarus
*Anatoly V. Alekhnovich, Sergei E. Ablov, Victor F. Kulesh & Oleg A. Pareiko*

• ***Conclusions***

A review of possible methods for controlling alien crayfish populations
*David M. Holdich, Rolf Gydemo & W. David Rogers*

The future of native crayfish in Europe: How to make the best of a bad situation?
*Trond Taugbol & Jostein Skurdal*

Native and alien crayfish in Europe: Some conclusions
*David M. Holdich, Hans Ackefors, Francesca Gherardi, W. David Rogers & Jostein Skurdal*



This book is a 1999 publication, 204pp, costs US $110, and is available from:

A.A. Balkema Publ., PO Box 1675, 3000 BR Rotterdam, Netherland [fax: + (31.10) 413.5947], or

A.A. Balkema, Old Post Road, Brookfield, VT

## MANAGING CONSTRUCTED WETLANDS FOR CRAWFISH TO ENHANCE WATERBIRD CONSERVATION

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Crawfish, *Procambarus* spp., are cultivated in the South by establishing perpetuating populations in shallow impoundments that are flooded in the cool months. Rice is regularly cultivated in the warm months; however, mature crawfish broodstock remain sequestered in burrows during this time. Therefore, shallow water habitat is available for at least 9-10 months.

Over 48,000 ha of crawfish impoundments provides critical waterbird habitat from south-central Louisiana into south-eastern Texas. There are high densities of invertebrate prey including crawfish, aquatic insects, zooplankton, mollusks, small crustaceans, and worms and small vertebrates such as amphibians and fishes. Predaceous waterbirds including wading birds, shorebirds, gulls, terns, grebes, cormorants, and pelicans benefit more from such units than reflooded soybean, grain, and rice fields.

Problems associated with waterbird depredation on crawfish crops remain to be quantified and addressed. However, waterbird conservation benefits can no longer be discounted. Non predaceous species like ducks, geese, and coots benefit from these shallow water, artificial wetlands and adapt readily to the 2-3 hour disturbance caused when crawfish traps are tended 2-5 days per week. Because crawfish crops of 500-700 kg/ha have real commercial value, there is incentive to manage constructed wetlands in the South for crawfish production.

## REGIONAL CRAYFISH MEETING FOR MEXICO

A three day regional meeting is being held in Mexico on 3, 4 & 5 November 1999.

The preliminary program is as follows:

*Wednesday 3 November:*
Opening Ceremony
Plenary Sessions
1. Biogeography & Conservation
2. Ecology
Welcome reception

*Thursday 4 November:*
Plenary sessions
3. Behaviour
4. Systematics, evolution & paleontology

*Friday 5 November:*
Plenary sessions
5. Aquaculture
6. Physiology & reproduction
Closing ceremony

Further information and abstract registration forms are available from:

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## IAA SESSION AT THE CRUSTACEAN SOCIETY SUMMER MEETING

IAA sponsored a paper session at the summer meeting of The Crustacean Society in Lafayette, Louisiana (USA), 26-30 May 1999. Titles and authors follow. Inquiries about copies of the meeting abstract book should be directed to Dr. Darryl Felder, Department of Biology, University of Southwestern Louisiana (the host), Lafayette, Louisiana 70504 USA [e-mail: dlf4517@usl.edu].

- The effects of photoperiod and water temperature on spawning success of the eastern white river crayfish *Procambarus acutus acutus* (Girard). Grant Blank, William Daniels, and Brad McAbee.
- Activation of hemocytes from *Procambarus zonangulus* by microbial molecules assessed by flow cytometry. Washingon Cardenas, Jill A. Jenkins, and John R. Dankert.
- Crayfish relative abundance as a function of hydrology in Everglades National Park. A. Noble Hendrix.
- Cultivating crawfish, *Procambarus* spp., in a small, spiral-shaped earthen pond. Jay V. Huner.
- Effects of substrate on aggressive interactions among juvenile red swamp and white river crayfish (Cambaridae). Jay V. Huner, David M. Guilmet, and Mark Konikoff.
- Resource utilization during starvation in tissues of the crayfish, *Procambarus clarkii*. Mickie L. Powell.

Three related crayfish papers were presented during the Molecular Methods Symposium and "Blue Crab" Symposium(!!). They were:

- On the origin(s) of freshwater crayfishes. Keith Crandall.
- Molecular population genetics of selected North American crayfishes (Decapoda: Cambaridae). James W. Fetzner, Jr., Keith A. Crandall, and Monte L. Bean.
- Immunohistochemistry of ovary and hepatopancreas using polyclonal antibody against vitellin of the red swamp crawfish, *Procambarus clarkii*.

## CRAYFISH NEWS FROM RUSSIA

**Dr VP Fedotov** and Dr SV Kholodkevich report that they study *Astacus astacus* and *Astacus leptodactylus* (or more correctly *Pontasacus leptodactylus)* in the Saint Petersburg Center for Ecology and Safety in the north-west of Russia. They have created a device for invasive control of the physiological state of crayfish in laboratory and field conditions based on controling cardiac rhythms and other parameters. The device is very small (25x25x15cm$^3$) and light (about 1kg). Crayfish are used as bioindicators of water quality in inner waterbodies.

They also wish to inform IAA members that they produce a crayfish newsletter in Russian. Each issue is 20-25 pages and costs about US$5 per issue + $2 for postage. Any information on new forms of crayfish marketing or recent reports on ecological investigations into crayfish as bioindicators of water systems would be greatly appreciated.

Dr Valery Fedotov can be reached by e-mail: fedotov@mailcity.com.

## ASSISTANCE NEEDED FOR *ATACOPSIS GOULDI* RESEARCH

The following letter was sent to the IAA Secretariat by Bert Candusio, the Museum Director of the Victorian Institute of Invertebrate Sciences. If anyone can help Bert's cause, or would like further information, please contact him directly by e-mail: iov@netcon.net.au.



"The Insectarium of Victoria / Victorian Institute of Invertebrate Sciences, began a study of the Giant Tasmanian Freshwater Crayfish, *Astacopsis gouldi* in 1995 with the support of the Tasmanian Inland Fisheries Commission after we offered to do the study in light of the lack of biological knowledge pertaining to this species.

When the species was listed by the Australian Federal Government as 'Vulnerable' in 1998, the species went under the control of the Tasmanian Parks and Wildlife Service (Threatened Species Unit).

We requested to the Unit that any offspring produced by our mature male and female specimens would be made available for re-release back into the wild, however, we were informed that this was not required and we continued on with the research.

After our pair produced 190 young in captivity in January this year, the Minister for Conservation and Environment was contacted by our organization for his direct intervention with TPWS after they refused to supply a further 2 mature specimens in order to continue our studies.

It is then we were informed that the minister had not funded or implemented the recovery plan for the species as it would have had a major impact on current forestry practises in Tasmania if the key recommendations of increasing stream buffer zones were to have been implemented.

The minister is also the Minister for Primary Industry and the recovery plan has been sat on by his department for over 2 years. Our organization now faces the prospect of rearing 190 young for at least 7 years until they are mature enough to be sent to selected zoos and other institutions around the world.

We now hold the only captive bred stock to be used for further study and public exhibition worldwide.

Can your organization assist us with this project by providing funding assistance in order to allow the purchase of aquatic cooling units so that we may be able to separate these offspring for further rearing until they are able to be sent to zoos in the future? If not, is there any other way that you may assist the project?"

## DISTRIBUTION OF CRAYFISH *(PACIFASTACUS LENIUSCULUS* AND *CAMBAROIDES JAPONICUS)* IN LAKE SHIKARIBETSU AND SHIHORO, HOKKAIDO, JAPAN

**Tadashi Kawai** and Masakatsu Hirata

In 1998, the comparative distributions *of Pacifastacus leniusculus,* a non-native species, and *Cambaroides japonicus,* a native species, in Shihoro and the Lake Shikaribetsu (banks and shallow margin (to approx. 1m depth) of the lake, inflow rivers, branches of the river, the Lake Shinonome which is located in upper stream of the Lake Shikaribetsu), Hokkaido, Japan, were observed by field collection. Information on the distribution in Lake Shikaribetsu in the past was also collected by hearing from people who live in vicinity of the Lake. The following information was obtained from the field research. The number of habitats of *C. japonicus* in Shihoro has been reduced. In the water systems of Lake Shikaribetsu, the habitat of *C. japonicus* occurs only in a branch of an inflow river (Yanbetsu River), and *P. leniusculus* was collected from the banks of Lake Shikaribetsu. From the research from local people it was learnt that *C. japonicus* had lived along the bank of Lake Shikaribetsu, inflow rivers, and their branches. Both research methods lead to the conclusion that the distribution of *C. japonicus* in Lake Shikaribetsu has been reduced and become restricted, and the introduced species has replaced the habitat along the banks of the Lake.