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Cooper, J. E. (2000). A new species of crayfish of the genus *Cambarus*, subgenus *Cambarus* (Decapoda: Cambaridae), from the Broad River basin of North Carolina. *Journal of the Elisha Mitchell Scientific Society,* **116**: 1-12.

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Cooper, J. E. & Skelton, C. E. (2003). A new burrowing crayfish of the genus *Cambarus* Erichson, 1846 (Decapoda: Cambaridae) from the lower Flint River in the Dougherty Plain of Georgia, with notes on *C. (D.) harti* Hobbs, 1981. *Proceedings of the Biological Society of Washington,* **116**: 827-838.

In addition, the following *unpublished reports* are available electronically in response to *e-mail requests:*

1. A report on adventive crayfishes in North Carolina
2. Crayfishes occurring in North Carolina (annotated list).

(Continued on page 13)

LITERATURE OF INTEREST TO ASTACOLOGISTS

Bubb, D. H., Thom, T. J. & Lucas, M. C. (2004). Movement and dispersal of the invasive signal crayfish *Pacifastacus leniusculus* in upland rivers. *Freshwater Biology*, **49**: 357-368.

Parkyn, S. M.& Collier, K. J. (2004). Interaction of press and pulse disturbance on crayfish populations: flood impacts in pasture and forest streams, *Hydrobiologia,* **527**: 113-124.

Kawai, T., Mitamura, T. & Ohtaka, A. (2004). The taxonomic status of the introduced North American signal crayfish, *Pacifastacus leniusculus* (Dana, 1852) in Japan, and the source of specimens in the newly reported population in Fukushima prefecture. *Crustaceana*, **77**: 861-870.

Trontel, J. P., Machino, Y. & Sket, B. (2004). Phylogenetic and phylogeographic relationships in the crayfish genus *Austropotamobius* inferred from mitochondrial COI gene sequences. *Molecular Phylogenetics and Evolution,* **34**: 212-226.

RECOMMENDED PAPER:

Edgerton, B. F., Henttonen, P., Jussila, J., Mannonen, A., Paasonen, P., Taugbol, T., Edsman, L. & Souty-Grosset, C. (2004). Understanding the causes of disease in European freshwater crayfish. *Conservation Biology*, **18**: 1466–1474.

Abstract:
Native European freshwater crayfish (Astacida, Decapoda) are under severe pressure from habitat alteration, the introduction of nonindigenous species, and epizootic disease. Crayfish plague, an acute disease of freshwater crayfish caused by the fungus-like agent *Aphanomyces astaci*, was introduced into Europe in the mid-nineteenth century and is responsible for ongoing widespread epizootic mortality in native European populations. We reviewed

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Crayfish NEWS

Vol.26 No.4 December 2004

The official newsletter of the International Association of Astacology

Tasmanian Giant Freshwater Lobster (*Astacopsis gouldi*) Recovery Effort Update

IAA Member **Todd Walsh** holding a very nice *Astacopsis gouldi*.

Hi Crayfish people:

There has been some movement to widen buffer zones for *Astacopsis gouldi*; we are hoping to have 30m buffer zones on all stream classes (at present the smallest streams have 10 and 20m buffers where *A. gouldi* is found). There is still a push to have large tracts of subcatchments protected from land clearing, this hopefully will happen under a new scheme called Protected Environmental Values; areas with a high biodiversity significance will be given higher protection under this scheme. It is hoped that many areas which were recommended for higher protection for *A. gouldi* by the Giant Freshwater Lobster Recovery Team will be duplicated under this scheme.

(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.

Secretariat

The International Association of Astacology has a permanent secretariat managed by Bill Daniels. Address: IAA Secretariat, Room 123, Swingle Hall, Department of Fisheries and Allied Aquacultures, Auburn University, AL 36849-5419, USA.

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Officers:

(This issue edited by James W. Fetzner Jr. and Francesca Gherardi)

President's Corner

Dear IAA members:

This is the time of the year in which we are more willing to become introspective. Introspection inevitably leads to the desire of self-improvement and to the ritual of making resolutions: What kinds of resolutions are we making this New Year?

Certainly we will help our Association grow and be healthy and wealthy. That should be our priority for 2005, and we will work hard and do our best. But we need the collaboration of all the members to keep this promise. We expect them to be more proactive in participating in the Association matters and more readily available in providing their responses and precious feedbacks to our requests.

Besides, we all need to communicate our findings and ideas to the other members of the Association and strive to develop fruitful collaborations. Crayfish News is an ideal vector of information transfer. Conferences and workshops are fundamental venues for the exchange of ideas and are instrumental to the discovery of new research directions. Don't forget that next year we will have several opportunities to confront our positions with other communities.

Finally, as our last resolution, we will disseminate the passion for crayfish to a wider public and transmit our enthusiasm for their study to the younger generation. We all agree that education is the first step towards our main goal: to work harder and harder in the effort to conserve crayfish biodiversity.

My warmest holiday greetings,

Francesca Gherardi
IAA President

OTHER LITERATURE

Information received from IAA Member **Robin Cooper**

Middle school science project with crayfish: **Ann-Simone Cooper** (8th grade) and her dad (**Robin L. Cooper**) just published a note on growth of cave crayfish. "Growth of Stygobitic (*Orconectes australis packardi*) and Epigean (*Orconectes cristavarius*) Crayfishes Maintained in Laboratory Conditions" is to appear in the next issue of the Kentucky Academy of Sciences.

Abstract:
This study reports on maintenance and growth of the cave crayfish, *Orconectes australis packardi*, and the epigean crayfish, *Orconectes cristavarius,* within laboratory conditions for 1 and 2 years. The *O. a. packardi* survived well compared to the *O. cristavarius* within captivity. The poor survival of the epigean species was probably due to unsuitable conditions. The epigean as well as the cave crayfish molted and grew in captivity, but without any significant difference in molt frequency between species. In the first year of the study, total body length was obtained to assay growth whereas in the second year the more accurate measure of post-orbital carapace length was used. The ability of *O. a. packardi* to be maintained well in captivity is likely due to their lower metabolic rate and ability to handle hypoxic stress better than epigean species.

Crayfish on Ecstasy:

Sparks, G.M., Dasari, S. & Cooper, R.L. (2004). Actions of MDMA at glutamatergic neuromuscular junctions *Neuroscience Research,* **48**:431-438.

Stress in crayfish. Altered behavior to neuromodulators:

Pagé, M.-P. & Cooper, R.L. (2004). Novelty stress and reproductive state alters responsiveness to sensory stimuli and 5-HT neuromodulation. (In Press - *Comp. Biochem. Physiol. A*).

Abstract:
Sensory stimuli can produce varied responses depending on the physiological state of an animal. Stressors and reproductive stage can result in altered biochemical status that changes the responsiveness of an animal to hormones and neuromodulators which affects whole animal behavior in relation to sensory stimuli. Crayfish serve as a model for examining the effects of neuromodulators at the neuromuscular junctions (NMJs) and for alterations in stereotypic behaviors for particular stimuli. Thus, we used crayfish to examine the effect of novelty stressors in males and the effect of being gravid in female crayfish to exogenous application of serotonin (5-HT). The responsiveness of neuromuscular junctions to 5-HT revealed that stressed as well as gravid crayfish have a reduced response to 5-HT at NMJs. The stressed crayfish were not fatigued since the basal synaptic responses are large and still showed a pronounced response to 5-HT. Using intact animals to examine a tail flip behavior we showed that the rate of habituation in tail flipping to a strong repetitive stimulus on the telson is reduced in stressed males. Gravid females show no tail flipping behavior upon telson stimulation.

Sparks, G. & Cooper, R.L. (2004). 5-HT offsets homeostasis of synaptic transmission during short-term facilitation. *Journal of Applied Physiology,* **96**:1681-1690.

Cooper, J. E. (2002). North Carolina crayfishes (Decapoda: Cambaridae): notes on distribution, taxonomy, life history, and habitat. *Journal of the North Carolina Academy of Science,* **118**:167-180.

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NEW BOOKS

Illinois Natural History Survey
Special Publication 28

The Crayfishes of Kentucky

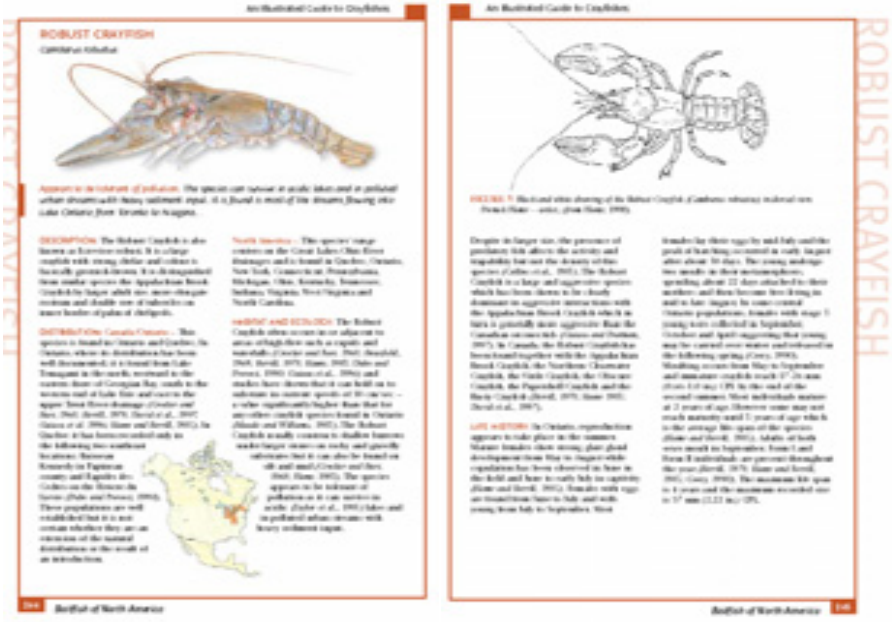
by **Christopher A. Taylor** & **Guenter A. Schuster**

220 pp., hardback with dust jacket $20 per copy (includes shipping and handling)

Replete with color photos of each species, detailed drawings of crayfish anatomy, and distribution maps, *The Crayfishes of Kentucky* provides a unique and detailed guide to the state's diverse populations of crayfishes and their habitats. Students, naturalists (both professional and amateur), and educators will find this publication an indispensable tool.

Ordering information:
Contact: **Ruth Johnson**-(217) 333-6880;
rjohnson@inhs.uiuc.edu
Illinois Natural History Survey
Distribution Office
607 E. Peabody Drive
Champaign, IL 61820 USA

Premek Hamr (Upper Canada College, PHamr@ucc.on.ca) is working on a section in a book on the bait fishes of Ontario (Canada) to be published soon with **Ronald Taylor** (Sir Sanford Fleming College) and **Aleta Karstad** (the illustrator). The Crayfish chapters are comprehensive and include information on many aspects of crayfish life history, ecology and aquaculture (see below). There are species descriptions and information for each of the Ontario species. Here attached is a sample page. IAA members will be kept posted on the date of publication and on how to order the book.



Sample pages from the book on bait fishes of Ontario by member Premek Hamr.

A collection of *Astacopsis gouldi* from Mawbanna, NW Tasmania in 1942.

(Continued from page 1)

There has been a lot of criticism of Tasmanian forest practices and it was actually a major federal election issue. More land has been earmarked for protection, and you can rest assured that the politicians are not able to forget about *A. gouldi*. We will continue to highlight the animal while there is such strong debate about the future of our old growth forests. An unfortunate fact is that while 40% of Tasmania's bush is reserved, very few significant areas containing subcatchments for *A. gouldi* are protected. Unfortunately our largest crayfish tends to live in areas which are prized by forestry companies, however with the widened buffer zones on headwater streams and the push for more formal reserves, I'm confident that we will finally have large enough areas to support major populations.

I managed to capture a 3.8kg specimen last week and duly had extensive media coverage to highlight the animal and its lack of serious protection. We are hoping to run a story in the next 2 issues of the major Sunday Tasmanian newspaper. Here's a photo for all to see. I'm also sending you an old black and white photo from 1942 in the NW of Tasmania. It was a one day fishing trip, the results speak for themselves.

I'm very optimistic that in the next 3 years we will have areas of significant habitat protected which will ensure the long term future of our most famous crustacean.

See Ya,

Todd Walsh
Western Waterwatch
PO Box 715
ULVERSTONE 7315
0439 69 3377

NEWS FROM AROUND THE WORLD

CRAYFISH TRIALS IN LEBANON, MIDDLE EAST

There are 987 freshwater species in Lebanon (Middle East), of which 25 have been introduced. Now there are plans to introduce one more. El Zein & Hawi report that trials are underway to test the suitability of waters in Lebanon for the introduction of the noble crayfish, *Astacus astacus*. The crayfish (1500 plus) were supplied by Max Keller of Bavaria. Based on measurements of the weight, size and mortality the crayfish appear to be doing well at the experimental site at Anjar.

MEETINGS AND RESEARCH IN RUSSIA

From 8-11 June 2004 an exhibition took place in Saint Petersburg entitled "The Week of the Hi-Technology". Among many exhibits (more 1000) in the exhibition were live crayfish and a device for non-invasive measurement of cardiograms using a laser cardiograph. This work is being carried out at the Laboratory of Experimental Ecology of the water systems of the Saint Petersburg Scientific Research Center for Ecological Safety.

Visitors of the exhibition could see a free moving crayfish in an aquarium and its cardiogram on a display computer. Crayfish were exposed to different mechanical and chemical influences and its reactions were reflected by alterations of the cardiogram. The temporal parameters of the cardiograms can be presented as indexes of the variation pulsometry method, which allows us to present on line the functional state of the crayfish by quantitative means. The method was awarded a Diploma and medal of the Exhibition for the display "Biomonitoring of the natural and purified waters quality on basic cardiogram of the aboriginal benthic invertebrates".

Some results of the method have been published in the Abstracts of the recent 15th IAA Symposium IAA in London. Before this, the results of the investigation of crayfish and mussels were published as an abstract in the Baltic Sea Congress in Helsinki (Finland, August 24-28, 2003): Kholodkevich S.V., V.P. Fedotov, A.G. Strochilo, E.L. Kornienko, Y.U. Kucherjavykh, A.S. Kurakin, D.V. Safronova: "On line assessment of the anthropogenic effects on benthic invertebrates by monitoring the cardiac activity with non-invasive fiber optic methods" (p. 156).

On 28th May 2004 members of the Society of Astacology from Estonia visited SPb SRCES RAS. In the delegation were representatives of the EU, Pre-Accession Adviser **Adolfo Merino** and the well-known Estonish astacologist **Tiit Paaver**. **Dr. V.P. Fedotov** gave two lectures on the theme: "Works of the Russian astacologists to development crayfish breeding" and "Ecology of crayfish". A representative of the State Committee of the Fishing of the Russia (**A.A. Chubakov** and **U.A. Ponomarjev**) told delegates about Rules for Fishing and Fish breeding in Russia and in North-West Region of Russia. On 29th

Many participants visited Petergof to see the fountains. During the day, the group visited Lake Berezno (Pskov region) where **Dr. V. P. Fedotov** told them about some plans for creating a crayfish farm at the back of the lake. Head of the Estonian Society of Astacologists, Valery Tootsman, also told about the successes of Estonian crayfish farmers. The majority of the participants could speak Russian and it was a convenient exchange of ideas about crayfish and crayfish breeding.

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biology and various aspects of applied freshwater science. We would like to bring together all European scientists working on freshwater organisms, freshwater habitats, and freshwater systems. The Meeting should serve to assure people that healthy freshwater ecosystems are very important, both in their own lives and that of the whole Planet.

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of Nature Conservation,
PAS 31-120 Krakow
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Invited lectures:

1. Alan P. Covich (University of Georgia, Athens): *'Dispersal-limited communities: functional diversity in tropical insular food webs'*
2. Francesca Gherardi (Universita di Firenze): *'Bioinvasions and the Nero dilemma'*
3. Jonathan Grey (University of London): *'Stable isotopes in aquatic ecology: current awareness'*
4. Jan Kozlowski (Jagiellonian University, Krakow): *'The reasons why life histories are diverse'*
5. Winfried Lampert (Max-Planck Institute of Limnology, Plön): *'Daphnia as a herbivore, predator and prey'*
6. Lennart Persson (Umea University): *'Size-structured interactions and the dynamics of aquatic communities'*
7. Thomas Weisse (Institute for Limnology, Austrian Academy of Sciences, Mondsee): *'Biodiversity of freshwater microorganisms'*

For information, visit the website http://www.sefs4.pan.krakow.pl/

The Sixth International Crustacean Congress will take place at the University of Glasgow, Scotland UK, from July 18th – 22nd 2005. The conference is organised on behalf of the International Crustacean Council by The Institute of Biomedical and Life Sciences, University of Glasgow. The Meeting will also host the 5th European Crustacean Conference, the 4th Crustacean Larval Conference, and the 2005 Summer Meeting of the Crustacean Society.

The Congress will include eight special symposia:

1. Symposium on the Phylogeny of Crustacea Organiser: Rony Huys
2. Symposium on The Biogeography of Anchialine Cave and Marine Interstitial Faunas. Co-Organisers: Geoff Boxshall & Damia Jaume
3. The Fourth Crustacean Larval Conference Organiser: Paul Clark
4. Symposium on the Ecophysiology of crustaceans. Co-organisers: Dave Morritt, John Spicer and Geraint Tarling
5. Symposium on Effects of human exploitation on decapod mating systems. Co-organisers: Mark Butler IV and Alison MacDiarmid
6. Symposium on Diseases of commercial significance. Co-organisers: Grant Stentiford and Jeff Shields
7. Symposium on Invasive Crustacea Co-organisers: Paul Clark and Liz Cook
8. Symposium on The Biology of the Anomura II. Co-organisers: Dr Rafael Lemaitre and Dr Chris Tudge (tudgec@si.edu or ctudge@american.edu)

For information, visit the website http://www.gla.ac.uk/icc6/

UPCOMING MEETINGS AND CONFERENCES

Freshwater biotas are changing worldwide. Human-mediated invasions of organisms are associated with these changes, which commonly include the extirpation of native species. Spectacular cases are the extinction of more than 200 species of cichlids following the introduction of the Nile perch into Lake Victoria in Africa, the alteration of the North American Great Lakes ecosystems by the mass invasion of Ponto-Caspian species, and the complete domination of lowland rivers in the Western United States by non-indigenous fish and invertebrates.

Our ability to predict the effects of biotic invasions is generally still limited, especially when the invaded systems are aquatic. The need to increase our ability to prevent, understand, and manage invasions has been emphasized by the enormous economic and social costs of some recent invasions, as well as by the growing interest in preserving biodiversity.

Through the analysis of empirical cases from freshwater ecosystems, the Workshop will aim at laying the basis for:

- constructing a conceptual model of biological invasions;
- evaluating the role of invasions in the biodiversity loss;
- quantifying economic and social costs of biological invasions;
- developing risk assessment models for indigenous species;
- improving controls of harmful non-indigenous species;
- proposing a series of actions to halt the invasion processes.

Scientific Committee

GUIDO CHELAZZI (University of Florence, Italy) FRANCESCO DESSÌ-FULGHERI (University of Florence, Italy) PIERO GENOVESI (INFS, Italy and ISSG, IUCN) FRANCESCA GHERARDI (University of Florence, Italy) DAVID HOLDICH (University of Nottingham, UK) SANDRO LOVARI (University of Siena, Italy)

Organizing Committee

FRANCESCA GHERARDI and: PATRIZIA ACQUISTAPACE, CLAUDIA ANGIOLINI, LAURA AQUILONI, SILVIA BERTOCCHI, SARA BRUSCONI, ANDREA CACCHIANI, ASTRA CIONI, BARBARA RENAI, RICCARDO RUSSO, ELENA TRICARICO (University of Florence, Italy).

For information, visit the website http://www.dbag.unifi.it/inwat

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The 4th Symposium for European Freshwater Sciences (SEFS4) will be hosted by the Polish Academy of Sciences and Jagiellonian University in the historical city of Krakow, Poland, from 22 to 26 August 2005. The Symposia for European Freshwater Sciences are coordinated by the **F**reshwater **B**iological **A**ssociation, in collaboration with other European freshwater and limnological Associations. The FBA is an independent charitable organization based at Ambleside, UK, which, since 1929 has conducted and sponsored high-quality research into the functioning of freshwater ecosystems. A keen advocate of closer working links among European freshwater scientists, the Association's initiatives resulted in the first SEFS symposium in Antwerp. It has continued to provide support and administrative assistance to all subsequent SEFS meetings. Like the previous Symposia, SEFS4 will be devoted to basic questions in freshwater

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THE WHITE SPOT SYNDROME VIRUS

The picture shows a crayfish, *Pacifastacus leniusculus,* experimentally infected with the white spot syndrome virus (WSSV), a severe parasite on shrimp. Also in this case, the WSSV triggers spots on the cuticle of the crayfish.

Read more about the infection of white spot virus in crayfish in:

Jiravanichpaisal, P., Söderhäll, K. and Söderhäll, I. 2004. Effect of water temperature on the immune response and infectivity pattern of WSSV in freshwater crayfish . Fish and Shellfish Immunology 17, 265-275.

Kenneth Söderhäll
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MISSOURI LAW ENFORCEMENT AGENTS ENGAGED IN CRAYFISH CONSERVATION

During late 2003 and 2004, Missouri biologists and law enforcement officers worked together on several issues to improve conservation of native crayfishes. In late 2003 we discovered that the infamous rusty crayfish (*Orconectes rusticus*) was being imported to our state from Wisconsin by the fishing bait industry. Biologists and law enforcement agents from the Missouri Department of Conservation (MDC) immediately began working with bait suppliers and stores to halt the potential introduction of this crayfish to our waters. Our local bait industry was cooperative, and we helped them transition to using two native species (*O. virilis* and *O. immunis*) for their bait sales.

This past summer, MDC law enforcement agents discovered that some individuals were capturing wild native crayfish at a state conservation area and then illegally selling them for bait in Missouri and across our state border in Oklahoma. The agents designed a covert operation and arrested the individuals in the act of making several illegal sales.

Most recently, the biologists and law enforcement agents have jointly proposed new state regulations that, if enacted, will make it illegal to transport any wild-caught, native crayfishes across our state borders. We believe that such regulations will help conserve several of our rarer native crayfishes that are being sold commercially and possibly introduced to waters far outside of our state.

Bob DiStefano
Missouri Department of Conservation
Bob.DiStefano@mdc.mo.gov

CRAYFISH FROM DEEP INSIDE A EUROPEAN CAVE

The stone crayfish, *Austropotamobius torrentium*, is widespread in central and south-eastern Europe, but it has not been recorded from caves before. It occurs in the River Aggitis that flows out of the

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Aggitis Cave after passing through the Falakro Mountain in northern Greece.

Recently it was found within the cave itself at distances of 2100 and 7100 m from the entrance. The crayfish found were pigmented, although those from the deeper parts had characteristically bluish pereopods. The origin of the deep-dwelling crayfish is unknown, although they occur above and below the cave system, it is unlikely that they could have entered the system from above in recent times.

At present little is known about the crayfish population(s) inside the cave, but it is hoped to find out if they carry out the whole of their life history there and what they might be feeding on.

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NEW APPROACH TO CRAYFISH RESEARCH IN FINLAND

Finnish Game and Fisheries Research Institute is setting up a research program on crayfish. The program will form a platform for the Institute's crayfish projects, and a network for the crayfish research in the country. It will focus on the most important questions in the crayfish management in Finland, in a situation where the introduced signal crayfish (*Pacifastacus leniusculus*) population is rapidly increasing in many former noble crayfish (*Astacus astacus*) lakes devastated by the crayfish plague 100 years ago. As well known, the noble crayfish populations very seldom recover in large lakes and water systems after the plague.

The program is planned to last seven years, until 2012. Therefore it will be very concentrated on the main questions, and will try to avoid complicated and time consuming projects. Short term experiments and compiling data from many available sources will provide answers to most open questions, although some follow up studies will be needed.

The first of the two main targets is to measure the factors that regulate the distribution of the noble crayfish, as well as the distribution of the signals, remembering that Finland is at the northern limit of the both species. The other target is to measure the rapidly growing signal crayfish production and its socio-economical and ecological influences.

Markku Pursiainen
Program manager (Crayfish Research)
Finnish Game and Fisheries Research Institute, Jyväskylä Game and Fisheries Research, Survontie 9, 40500 Jyväskylä, Finland
markku.pursiainen@rktl.fi; www.rktl.fi

SIGNAL CRAYFISH IN HUNGARY – A VECTOR OF *APHANOMYCES* – DOOMED FUTURE FOR *ASTACUS* IN THE DANUBE CATCHMENT AREA

Three years ago a young biology teacher, namely Peter Illés discovered that signal crayfish were very abundant in Gyöngyös river, West-Hungary. I visited the place for the first time two years ago in October, and I collected more than 70 specimens in three hours. I brought some crays home and I kept them in a tank. One of them was put in another tank along with 10 noble crayfish. After two weeks none of them was alive except the lonely *Pacifastacus lenuisculus*. I presumed that he was a host of the killer fungus (*Aphanomyces astaci*), but I could not find the evidence due to the lack of skill and technical background.

Last year, I made a reciprocal

(Continued on page 7)

PHOTO ALBUM

Pavel Kozak and **Premek Hamr** during their Czech outing.

(Continued from page 17)
are maintained in the restored Everglades ecosystem.

Selected References

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VanArman, P.G. 2003. Biology and ecology of epigean crayfish that inhabit Everglades environments *Procambarus alleni* (Faxon) and *Procambarus fallax* (Hagen). Doctoral dissertation. Nova Southeastern University Oceanography Center, Davie, FL. 173 pp.

IAA Member **Peggy VanArman**, Ph. D.,
Associate Professor of Biology
Palm Beach Atlantic University submits this synopsis of her doctoral dissertation (earned Ph.D. in June 2003)

(Continued from page 24)
recent developments and current practices in the field of crayfish pathology. The severity of crayfish plague has resulted in an overemphasis on it. Diagnostic methods for detecting fungi and fungal-like agents, and sometimes culturing them, are frequently the sole techniques used to investigate disease outbreaks in European freshwater crayfish. Consequently, the causes of a significant proportion of outbreaks are undetermined. Pathogen groups well known for causing disease in other crustaceans, such as viruses and rickettsia-like organisms, are poorly understood or unknown in European freshwater crayfish. Moreover, the pathogenic significance of some long-known pathogens of European freshwater crayfish remains obscure.

For effective management of this culturally significant and threatened resource, there is an urgent need for researchers, diagnosticians, and resource managers to address the issue of disease in European freshwater crayfish from a broader perspective than has been applied previously.

(Continued from page 6)
experiment. **Peter Illés** and I put ten noble crayfish in a cage in the Gyöngyös river, where signals are so abundant. After ten days all nobles were dead. My susppicions rose high and I decided to co-operate with **Birgit Oidtmann** whom I know from the 12th Symposion, Augsburg. She was ready to make the necessary tests in her laboratory in Munich at the Veterinarian University, Faculty of Zoology.

This year I was successful to send her 25 signal crays and some of them arrived alive at the laboratory. After the research work made by PCR method, four specimens proved to be the vector of *Aphanomyces astaci*.

There is a confusing experience - I have been keeping one signal crayfish along with four noblecrays in the same tank since the middle of September of this year and all are seemingly healthy. Maybe it means, that not all specimens are vectors as the had not been infected or in some cases the fungus is inactively stored somewhere in the animal waiting to be triggered off by a yet unkown factor.

Apart from this phenomenon the consequences foretell a doomed future to all members of the genus *Astacus* in the Carpathian basin and further in the Balkan as the Gyöngyös river flows into the Raba River, which is a tributary of the Danube.

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ACTIVITY REPORT – UL LAFAYETTE CRAWFISH RESEARCH CENTER – SUMMER/ FALL 2004

Presented to: The Louisiana Crawfish Promotion and Research Board

Date: December 2004

The UL Lafayette Crawfish Research Center began to harvest crawfish during the first week of December 2004 with catch of 0.25-0.75 lbs per trap. All ponds, regardless of size, are managed as permanent crawfish ponds and rice, where planted, serves as a forage crop and is not harvested. Main production ponds 15 and 18 acres in size were drained at the end of June 2004 for completion of an effluent project funded by the Louisiana Department of Environmental Quality – report attached. The ponds were refilled with enough water to permit water planting of rice seed in mid-July. The ponds were drained following the planting of rice but loss of our well prevented us from flushing the seedlings or growing them in water. We were only able to flush and add water in the ponds in late August.

Our replicate pond levees were renovated in July and rice was drill planted at the end of August. A permanent flood was established in mid-September. Rice was planted in water in our secondary production pond, 4.65 acres in size, in late August and a permanent flood was established in late September.

Mild weather and regular rainfall has permitted the establishment of good crawfish crops in all three production ponds. The replicate ponds seem to have good crawfish crops despite the fact that all levees were renovated extensively. There was significant variation in crawfish production in those ponds during the preceding three seasons when forage crops were volunteer vegetation, sorghum-sudan grass, and rice but all ponds have been managed in the same manner during the past summer to ascertain what will happen with regard to production and species composition.

A survey of the bird fauna of a

(Continued on page 8)

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crawfish-rice complex in the Perry, LA area was completed in September of this year. Funded by both the Louisiana Crawfish Promotion and Research Board and the Coypu Foundation, a seasonal checklist of the birds recorded during the two year study period was completed and a copy is attached.

The Louisiana Department of Environmental Quality Crawfish Effluent Project was completed in June 2004 and a project summary is attached. Note that the project showed rice to be the best forage crop for crawfish production and high percentage of red swamp crawfish when compared to volunteer vegetation and sorghum-sudan grass. Furthermore, approximately 1,000 pounds of crawfish were produced per acre in two large R&D ponds in each of three consecutive crawfish seasons. Both ponds were planted with rice as crawfish forage. One was periodically flushed while the other one was not flushed. The study showed no benefits to flushing water in permanent crawfish ponds planted with rice in late June or early July. Furthermore, flushing favored lower percentages of red swamp crawfish than in the un-flushed pond.

In recognition of the value of crawfish-rice production systems for waterbird habitat, a proposal to revise and update a management bulletin for managing such systems for waterbird habitat was submitted to the Louisiana Rice Research Board. A copy, slightly modified for submission to other funding sources, is attached. While the LRRB received the proposal favorably, it was unable to fund the proposal and assistance from the Louisiana Crawfish Promotion and Research Board to fund the proposal will be requested.

I will present a report entitled "Greater Ecological Considerations in Crawfish Aquaculture" at the Aquaculture America 2005 meeting in January in New Orleans. A copy is attached for your information. This follows the Crawfish Research Center's long term initiative to demonstrate the significance of crawfish systems as waterbird habitat and address, as best possible, the issue of bird-crawfish interactions.

The Crawfish Research Center will have a major presence at the Louisiana Crawfish Farmer's Association "Crawfish Expo" in Crowley, LA on December 9, 2004. An informational booth will be manned by center personnel and I will present a joint report on "Early Season Crawfish Harvesting Tips" developed in collaboration with colleagues in the LSU Agricultural Center – **R. Romaire**, **G. Lutz**, **M. Shirley**, and **R. McClain**.

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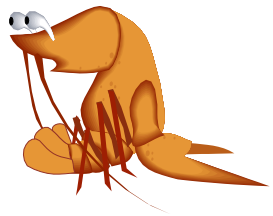
CRAWFISH AS FUEL!

An intrepid motorist has driven 16,000 miles around America without a drop of petrol (gas)! He used green machines that thrive on organic waste. In Louisiana he drove across the swampy state in a modified Hummer that was fuelled by crawfish, jambalaya and the occasional Pop Tart! **Arnold Schwarzenegger** only manages to get 6 mpg from his Hummer whereas 12 mpg was obtained using Cajun food!



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crayfish occurred in low food availability, low water levels and high density. Slough crayfish had higher survival and matured earlier than Everglades crayfish.

Growth of Everglades crayfish was most impacted by low food availability, drying conditions, high density, and intraspecific competition. The best conditions for growth of Everglades crayfish included high food availability, low water levels, low density, and interspecific competition with Slough crayfish. Growth of young Slough crayfish was most impacted by low food availability, high density, and high-density interspecific competition. Slough crayfish grew largest under conditions of high food availability, low density, and low-density interspecific competition, but reached the same size in all three water levels tested. Under all conditions tested, young Everglades crayfish grew larger,

Experiment 3. Behavior patterns (feeding, resting, moving, digging, retreating, avoiding, or approaching) and substrate choices (plants commonly found in Everglades environments: *Utricularia foliosa, Panicum hemitomon, Typha domingensis,* and sand) of 2-month old young were observed during a 48 hour time period following designs by Bovbjerg (1960) and Capelli (1975). Observations were made during day and night periods, in the presence of an arthropod predator. Data were analyzed using chi-square techniques. In the absence of the predator, feeding was the primary activity of both species during the day, but at night Everglades crayfish foraged while Slough crayfish rested. In the presence of an arthropod predator, both species fed more during the day, but spent more time resting at night. Slough crayfish sheltered more in vegetation than Everglades crayfish. Both species exhibited diurnal behavior, whether the predator was present or not.

Both species spent the greatest amount of time in *U. foliosa* and *P. hemitomon,* and the least amount of time in *T. domingensis* and on sand, whether a predator was present or not. At night, in the presence of the predator, Slough crayfish spent more time secluded in *U. foliosa* than Everglades crayfish, but Everglades crayfish were more exposed on sand.

Conclusions indicate that water levels, amount of food, density and competition significantly and differently affected growth and survival of both Everglades and Slough crayfish. Young of both species exhibited diurnal behavior, but behavior and substrate choices were affected by the presence of a predator. It is crucial that differences in biology and ecology between young Everglades and Slough crayfish be considered by water managers when determining future hydrological conditions, to ensure that appropriate distribution and abundance of each species

(Continued on page 18)

BIOLOGY AND ECOLOGY OF EPIGEAN CRAYFISH THAT INHABIT EVERGLADES ENVIRONMENTS, *PROCAMBARUS ALLENI* (FAXON) AND *PROCAMBARUS FALLAX* (HAGEN) (FLORIDA, USA)

Crayfish are important freshwater ecosystem managers in North America, and may dominate energy and nutrient flow and serve as keystone species (Holdich 2002). However, they are usually overlooked in conservation efforts (Davis and Ogden 1994). In ongoing restoration efforts in Everglades (Florida, USA) wetlands, crayfish have been identified as intermediates in food webs (prey for over 40 vertebrate species, predators of snails, newts and fish eggs) and as bio-indicators to assess effects of hydrology, fire, nutrient enrichment and pollution (VanArman 2003). Two native epigean crayfish inhabiting Everglades wetlands, *Procambarus alleni* (Everglades crayfish) and *P. fallax* (Slough crayfish), are similar in appearance, but differences between these species in biology and ecology may critically affect food webs in the Everglades ecosystem.

Although both species occur in sympatric and syntopic distribution, hydrology can affect the presence of either species by influencing development, survival, shelter and food availability. Adult Everglades crayfish inhabit areas that provide short hydroperiod and low water levels with suitable substrate in which they can burrow, whereas adult Slough crayfish rarely burrow and prefer deeper, more permanent waters (Hobbs 1942; Hendrix 2000; Huffman 2001). Shifts in relative abundance of these two species through water management decisions may have considerable effects on wetland communities and the overall availability of crayfish as food for other organisms.

There is sparse information on the biology and ecology of juvenile Everglades and Slough crayfish (Rhoades 1970, 1976; Hendrix 2000). To determine if there were differences in biology and ecology of juvenile crayfish, this research focuses on three laboratory experiments, conducted from 1997 to 2002, on newly hatched young of both species, up to three months of age. Young crayfish were hatched from berried females captured in the field or bred in the laboratory.

Experiment 1. Weight and total length (growth), sexual development (presence and size of male reproductive gonopods), and survival of hatchlings were monitored to three months of age, under stable conditions (water depth and food availability). Data were recorded at approximately four-week intervals. Linear regression showed that juvenile Slough crayfish were heavier at a given length, and combined with gonopod development, was used to predict that Slough crayfish become mature at an earlier age than Everglades crayfish. Everglades crayfish grew significantly larger than Slough crayfish, at a faster rate, but Slough crayfish had significantly higher survival rates than Everglades crayfish.

Experiment 2. In this multifactorial experiment, data analyzed through ANOVA techniques indicated that abiotic (food availability and water levels) and biotic (density and competition) factors had significant effects on the survival and growth of hatchlings to three months of age. In conditions simulating three different water levels, survival of Everglades crayfish was significantly impacted by low food availability, high density and intraspecific competition, while highest survival took place in conditions of high food availability and low density. The lowest survival of Slough

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SHORT ARTICLE

The Crayfishes of Northeastern NSW, Australia

Although I would rather be writing this *after* the successful completion of my PhD thesis, I feel that now would be a suitable time to mention my research to the IAA community. (It would have been nice to get to London in March, but one of my sons was in the middle of being born at the time.)

For the past four years, I have been studying the freshwater crayfishes of north-eastern New South Wales, Australia. There are a number of beautiful species in this neck of the woods, but unfortunately they are generally under-studied and rarely mentioned. I wanted to study a regional assemblage of crayfishes so that I could try to understand differences between them.

The focus species of my research have been four species of *Euastacus* that inhabit my study area: *E. gumar*, *E. mirangudjin*, *E. sulcatus* and *E. valentulus*. These range from small, highland animals (*E. gumar* and *E. mirangudjin*) to the large, lowland *E. valentulus* (can exceed 2kg). To a lesser extent, I have also been studying *E. suttoni* and our only endemic *Cherax*, *C. cuspidatus*. At two sites I have also recorded a few *Tenuibranchiurus* spp., which have been sent to **Pierre Horwitz** (Edith Cowan University), who is currently revising the genus.

IAA readers will be familiar with *E. sulcatus* through the recent and exciting research undertaken by **James Furse** (Griffith University), but if a lot of those other names don't ring any bells, it's because these crayfishes have been largely overlooked by biological research. For most species, the best available information is embodied in the extraordinary taxonomic works on *Euastacus* by Morgan (1988, 1989, 1991, 1997). Now, I think crayfish are about the coolest animals on the planet, so just how such a regional suite of crayfishes could have been left largely unstudied for this long greatly intrigued me. Such was the setting for my decision to embark on this study.

The ensuing research was a tremendous privilege. It brought great joy to be able to work with these animals, in some of the most beautiful places imaginable. In all, I sampled around 240 sites, in order to get a good overall picture of the distributions and habitat of these crayfishes. Around 55% of the sites yielded specimens, and the known locations for all species was considerably increased. As one of the best examples of this, *Euastacus sulcatus* had previously been recorded from two sites in NSW, and I was able to record it from 26 sites, vastly extending its range to the south, southeast, west and southwest. Several unusual colour forms were also recorded for this species, including red base colour with cream patches, red base with turquoise patches (as in the image), and black base colour with tan patches. Note that the *E. suttoni* image is also from a population with unusual colouration for that species.

Investigations into the biology of these species was also very exciting. Through a 24 month mark-recapture program, for each of the four focus species, I looked at comparative reproduction (egg size and number; embryonic and postembryonic development; size at maturity; spawning frequency and timing), moulting and growth (or lack thereof!), injuries and wounds, ectosymbiotic fauna, and general behaviour.

From this biological investigation, important insights were gained which will no doubt be of great use in the future management of each of these species. I must admit that I was somewhat surprised that the

(Continued on page 11)







Clockwise from Upper Right:
Cherax cuspidatus; *Euastacus sulcatus* (Mt Warning); *E. mirangudjin*; *E. valentulus*; *Tenuibranchiurus* sp.; *E. suttoni* (Ewingar); *E. gumar*.

IAA Member **David Rogers**.

PROFESSORSHIP OFFICIAL FOR FORMER IAA PRESIDENT

Former IAA President, **David Rogers** has been officially conferred the title of Professor of Freshwater Biology on 16 December 2004. The Professorship was awarded on the basis of expert witness work for Court Cases involving fish and freshwater biology and for voluntary fish expert work in China and Malawi over the past couple of years as well as crayfish research.

At present, research work undertaken by his company, David Rogers Associates (DRA) involving both David and **Liz Watson**, the present IAA Secretary, in conjunction with the University of Derby and Associates in the University of Oxford and Imperial College, London, centre on population dynamics of crayfish and the UK Biodiversity Action Plan for white-clawed crayfish (http://www.crayweb.info/ and http://www.ukbap.org.uk/).

DRA's current contracts in this field include:

1. Examination of the feasibility of transfer of Sterile Insect Technologies to signal crayfish population control/ eradication.

2. The effect of a new law in the UK law to permit trapping of crayfish on the crayfish population and the general river ecology.

Two native crayfish breeding and reintroduction projects.

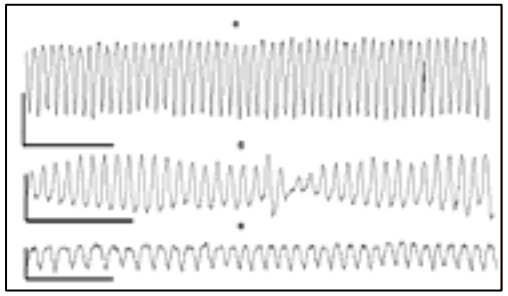
The University of Derby has recognised the importance of creating a centre of expertise for crayfish within its research team by conferring the Professorship.

HEART ACTIVITY OF CRAYFISH DURING FREE BEHAVIOR

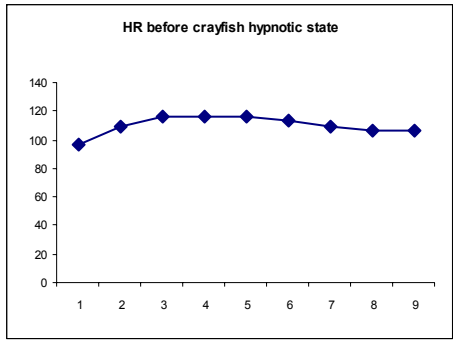
Investigation of the reactions of the crayfish (*Astacus astacus*; *Pontastacus leptodactylus*; *Procambarus clarki*) has been made with the help of a laser cardiograph and the non-invasive fiber optic method and the method of variation pulsometry (VP), coupled with parallel video recordings of the movements of crayfish. This shows that the heart rate and VP indices have particular definite values according to crayfish's active state or prolonged rest. We (**V.P. Fedotov**, **G.P. Udalova** and **S.V. Kholodkevich**) found that the prolonged rest shows behavioral features and cardiac activity similar to operative rest or sleep. A typical reaction of animal hypnosis was observed in crayfish. In addition to the frozen immobilized posture, increased heart rate and alteration of several VP indices were discovered during the hypnotic process. It is assumed that analogues of sympathetic and parasympathetic nervous influences regulate the level of heart activity in crayfish during different physiological states: active locomotory behavior, prolonged rest or animal hypnosis. Crayfish as highly organized invertebrates provide an efficient animal model for studying the function and the mechanisms of sleep-like states and animal hypnosis.

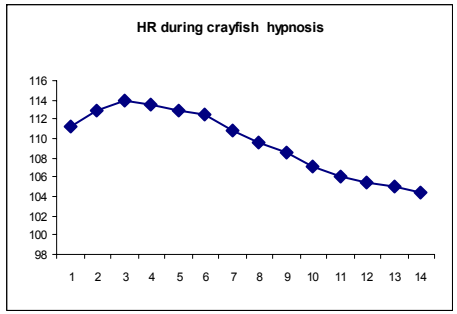
The crayfish *Astacus astacus* in a hypnotic state.

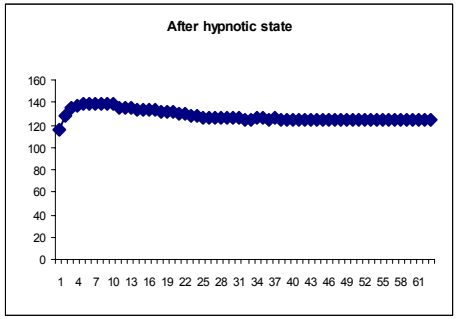
Valery Fedotov
Saint Petersburg, Russia



Cardiac activity of the crayfish *Astacus astacus* in different functional states: а – active state (0.5V; 1S); б- resting state (0.3V; 1S); в – sleep-like state (hypnotic) (0.2V; 1S).







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biological findings differed between these *Euastacus* to the extent that I recorded. There is insufficient room to discuss these varied findings here, suffice to say that these *Euastacus* are biologically very distinct.

From the comparative perspective, one aspect of particular intrigue was that *Euastacus mirangudjin*, which is morphologically rather unlike the 'typically' spiny species, is also very unlike them biologically. In particular, they have a different reproductive strategy, bearing much larger and fewer eggs. The hatched juveniles also lack some very distinctive markings that hatchlings of the other *Euastacus* bear. In light of the morphological and biological differences, I find it most curious that *E. mirangudjin* co-habits many sites with one of these typically spiny species. Given that at no site were any two of the typically spiny species found in sympatry, it interests me that *E. mirangudjin* occurs in close association with the much larger, and very different, *E. sulcatus*. *Euastacus sulcatus* is the only typically spiny species that co-occurs with other *Euastacus*. In fact, by sampling 'peripheral' habitat (e.g. small, moist soaks and gullies in the forest adjacent to the main stream) at many sites inhabited by *E. sulcatus*, several new taxa were recorded during the field research. Descriptions for these have been prepared (Coughran in press), but the important point is that they, like *E. mirangudjin*, are morphologically quite distinct from the 'typical' spinose species. Further, although a number of these new, poorly spinose taxa have now been recorded, they are never found in sympatry with each other either. Thus, in all cases of recorded sympatry between *Euastacus*, the two species involved have been the large, typically spinose *E. sulcatus*, and one of the small, poorly spinose group.

One of the most interesting aspects was that all of the *Euastacus* species were recorded from habitats generally considered unsuitable for the genus. All species were found in habitats lacking any surface water (i.e. the stream had dried up). In such cases, the crayfishes had simply burrowed down to the water table. I was continually amazed at the places I was finding *Euastacus*, by sampling at sites that did not at all appear likely to hold any crayfish. A colleague, **Shawn Leckie** (also studying *Euastacus* at SCU), has similarly found *E. simplex* and *E. neohirsutus* to inhabit areas lacking surface water.

I'm quite fascinated by crayfish, and have thoroughly enjoyed this research. Regrettably, however, I must write of one aspect that in recent months has added a somewhat sobering element to my work. Recently, I received reports of the presence of an exotic crayfish species, *Cherax quadricarinatus*, from one local stream system. With the assistance of recreational fishers, who kindly provided to me the shells from one of their catches, I have now been able to verify that they do indeed belong to this species. Following this, on 27 September 2004, Shawn and I made a field trip to a site just upstream of where the anecdotal reports were claimed. On this trip, we captured eight specimens of two endemic crays (*Cherax cuspidatus* and *Euastacus valentulus*) and four specimens of the invading

One of the new taxa recorded during the study.

(Continued on page 12)

The exotic pest, *Cherax quadricarinatus*. *Three of the animals retrieved from the September 27 field trip.*

(Continued from page 11)

pest species *C. quadricarinatus*.

Thus, for all the information I have been able to gather about our poorly known endemic species, my enthusiasm is somewhat tainted by the knowledge that this exotic pest will, by necessity, become the focus of much of the future research and interest on our endemic species. The findings I have made, new and exciting as they may be, will become merely a snapshot of how these animals occurred prior to the invasion of this exotic pest. Thus, to some extent, *C. quadricarinatus* will defeat the purpose I had when I embarked on my research: to bring to light information on our endemic crayfishes so that we could better appreciate and manage them.

The threats to Australian crayfishes, particularly valid for *Euastacus*, are well documented (e.g. Horwitz 1990, 1995; Merrick 1995). It bothers me that this aquaculture species is increasingly becoming an ecological pest around the world. In the Australian situation, it is particularly saddening in that most of our >100 species are very poorly known (Merrick 1991, 1993). Thus, despite having received the lion's share of our research efforts, two well-studied aquaculture candidates (*C. quadricarinatus*, *C. destructor*) will still dominate the future study of Australian crayfishes, even studies on the biology, conservation and management of our poorly-known endemic crayfishes.

Presently, the exotic species is only known to occur in one stream in the region, and verified reports all occur upstream of a water supply dam, which is upstream of a small, natural waterfall. I hold a vague hope that the species has not yet spread downstream of one of these obstacles, and am trying to muster community and scientific interest in the investigation of this and other questions. Any attempt to study and manage this problem will require funding that is both readily accessible and available for long term research efforts, a rather unfortunate combination under current funding opportunities that I am aware of. However, the response from all agencies, researchers and members of the community has been very positive, and I believe that, despite the serious threat the pest species represents, there will be much to gain in terms of an increased sense of community education and appreciation for the region's endemic fauna and flora. Hopefully, the research will benefit managers around the world where this species has become an established pest.

I'm currently seeking funds and developing proposals to establish a community-based education and monitoring program, and to establish some biological research projects on this exotic pest. However, I've

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spent the past four years studying our endemic species for their intrinsic value, and would greatly appreciate *any* information or advice from astacologists involved in managing this species, *C. quadricarinatus*, or other crayfish, as ecological pests.

I regret that most of this article had to discuss this issue. I look forward with much anticipation to the next IAA symposium, where hopefully I can communicate more on my findings on our endemic animals.

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(Continued from page 24)

3. Hydrological unit distributions of crayfishes in North Carolina.
4. References: North Carolina crayfishes (draft).
5. Crayfishes in Maryland.
6. Provisional list of Virginia crayfishes (annotated list).
7. Provisional list of South Carolina crayfishes (annotated list).

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