

adopting a law that will make it illegal to transport them live.

Fishermen who use them for bait often leave behind live crawdads, which eat the vegetation that keeps the stream banks and bottoms stable. The result is a boggy, muddy waterway that's not good for trout. Crayfish also prey on the same invertebrates as the fish.

Some crayfish in Arizona grow to six inches long. They go for vegetation first, but also eat insects, snails, small fish, turtles, tadpoles, frogs and about anything else they find. Experts say their mouths work like wood chippers. To get rid of some of them, state wildlife officials have been pleading with campers, anglers and outdoors enthusiasts to catch as many crawfish as they can. Mr. Aikens even included some recipes in a weekly newsletter.

Many people here are catching and cooking crawdads for the first time, he said. High-country lakes like Woods Canyon and Willow Springs are especially good breeding grounds for crawfish. Educating people on how to cook them has been easy, Mr. Aikens said, because they are prepared the same way as crab and other shellfish.

"Take some hot water, boil 'em and you've got a meal," he said, adding that you can cut off the tails before or after cooking. On larger crawdads, it's possible to eat the meat in the claws.

The lack of a limit has been surprising to some people, including one Cajun. "He said, 'You mean I can go out there and get a pickup truckful?'" Mr. Aikens said. "I told him, 'We'd like you to.' And he said, 'Well, what kind of civilization is this?'"

Joe Puglise, owner of the Pier De Orleans restaurant in Mesa, says crawfish dishes aren't nearly as popular as in his hometown of New Orleans.

"From what I understand the crawfish over here are kind of sandy," he said. "I've never bought any Arizona crawfish."

Still, Mr. Puglise said he is hopeful someone will begin raising them here, even though he fears that Arizona's water isn't muddy enough. Right now he gets his crawdads from China because Louisiana crawfish won't be in season until the end of November.

PAPERS OF INTEREST TO ASTACOLOGISTS

1. Arzuffi, R; Salinas-Laera, C; Racotta, IS, 2000. Food aversion learning induced by lithium chloride in the crayfish *Procambarus clarkii*. *Physiology & Behavior* 68(5):651-654.
2. Harris, DJ; Crandall, KA. 2000. Intra-genomic Variation Within ITS1 and ITS2 of Freshwater Crayfishes (Decapoda: Cambaridae): Implications for Phylogenetic and Microsatellite Studies. *Molecular Biology and Evolution* 17(2):284-291.
3. Hendrix, AN; Loftus, WF, 2000. Distribution and relative abundance of the crayfishes *Procambarus alleni* (Faxon) and *P. fallax* (Hagen) in southern Florida. *Wetlands* 20(1): 194-199.
4. Jones, CM; Ruseco, IM. 2000. Assessment of stocking size and density in the production of redclaw crayfish, *Cherax quadricarinatus* (von Martens) (Decapoda: Parastacidae), cultured under earthen pond conditions. *Aquaculture* 189(1-2):63-71.
5. Keller, TA; Moore, PA. 2000. Context-specific behavior: crayfish size influences crayfish-fish interactions. *Journal of the North American Benthological Society* 19(2):344-351.
6. Rodriguez-Serna, M; Carmona-Osalde, C; Olivera-Novoa, MA; Arredondo-Figuero, JL. 2000. Fecundity, egg development and growth of juvenile crayfish *Procambarus (Austrocambarus) ilamasi* (Villalobos 1955) under laboratory conditions. *Aquaculture Research* 31(2):173-179.
7. Schneider, RAZ; Moore, PA. 2000. Urine as a source of conspecific disturbance signals in the crayfish *Procambarus clarkii*. *Journal of Experimental Biology* 203(4):765-771.
8. Turner, HM. 2000. Seasonality of *Alloglossoides caridicola* (Trematoda: Macroderoididae) infection in the crayfish *Procambarus acutus*. *Southwestern Naturalist* 45(1):69-71.
9. Watson, AHD; Bevenat, M; Pearlstein, E; Cattaert, D. 2000. GABA and Glutamate-Like Immunoreactivity at Synapses on Depressor Motoneurons of the Leg of the Crayfish, *Procambarus clarkii*. *Journal of Comparative Neurology* 422 (4):510-520.

Crayfish NEWS

Vol.23 No.1

December 2000

The official newsletter of the International Association of Astacology



Picture Courtesy: *The Times London*

"It's the Millennium Bug!"

RED SWAMP CRAYFISH BREEDING IN BRITAIN

"British bathers on red alert as Turks feel the pinch"

by *Kenneth Richter and Roy Wiles*
University of North London.

London is a cosmopolitan, exotic, multiethnic city; a magnet for peoples from all over the world. Not slow to exploit the opportunities of a new life, the crayfish from Europe and America have forged a place in the heart of the metropolis. London is a place of tradition and for years hardy swimmers have taken to the "men's bathing pond" on Hampstead Heath in North London. However, in 1991 the American Red Swamp Crayfish (*Procambarus clarkii*)

seemingly ejected from their Cajun Restaurant home (Holdich pers. com.) took up residence (National Rivers Authority 1991). We can now report that Britain's first Red Swamp population is thriving and has spread to other ponds on the Heath. They are also in the canal at Regents Park.

In spring this year we trapped 50 specimens ranging in wet weight from 12g to 75g from 4 ponds. None of the females were berried but low spring temperatures might be responsible for this. Some specimens brought into the laboratory spawned at room temperature after

(Continued on page 3)





The International Association of Astacology (IAA), founded in Hintertal, Austria in 1972, is dedicated to the study, conservation, and wise utilization 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 Jay Huner. The address is: IAA Secretariat, PO Box 44650, University of Southwestern Louisiana, Lafayette, Louisiana 70504, USA.

Tel: (+1 318) 4825239

Fax: (+1 318) 4825395

E-mail: jhuner@usl.edu

Web page:

<http://www.uka.fi/english/organizations/IAA/>

Officers:

• Glen Whisson, President, Aquatic Science Research Unit, Curtin University of Technology, GPO Box U1987 Perth 6845, Western Australia
E-mail: twhisson@alpha2.curtin.edu.au

• Keith Crandall, President-elect, Department of Zoology, Brigham Young University, Provo, UT 84602-5255 USA
E-mail: kac@email.byu.edu

• Francesca Gherardi, Secretary, Department of Animal Biology and Genetics, University of Florence, via Romana 17, 50125 Firenze, Italy
E-mail: gherardi@dbag.unifi.it

• David Rogers, Past President, 9 The Moat, Castle Donington, Derby DE74 2PD, UK.
E-mail: d-rogers@lineone.net

Statements and opinions expressed in *Crayfish News* are not necessarily those of the International Association of Astacology

President's Corner

Ari Mannonen has set up an IAA crayfish chat group that can be accessed via the IAA web site. This is in response to requests for such a forum at the Perth meeting. I encourage everyone to visit the page and make a contribution where possible. Thanks to Ari for his efforts in constructing the service.

This issue contains a call for a new newsletter editor. I am busy with *Freshwater Crayfish 13* and other Board-related matters. If you are interested please contact one of the officers.

My decision to stop editing the newsletter will not hinder my commitment to make *Crayfish News* available "on line" to those who wish to receive it electronically. I would appreciate any suggestions/feedback regarding this idea.

Included with this issue is the next instalment of the IAA History booklet. David Holdich has put a lot of effort into producing this series and we intend to combine all parts and print a more permanent publication. So please, if you notice any mistakes, let David or myself know so we can correct them prior to the final printing.

I welcome Daniel Kamau Mbogo, Graduate Research Officer with the Kenyan Marine Fisheries Research Institute (KMFRI), as IAA Correspondent for Kenya. We look forward to your reports Daniel.

A reminder to members of the two IAA resolutions that we passed at IAA 13 in Australia last year:

Resolution 1: IAA will promote crayfish as a Keystone Species - *unanimously carried*

Resolution 2: IAA supports causes which are concurrent with maintenance of Biodiversity - *one abstention, unanimously carried*

Glen Whisson
IAA President

(Continued from page 1)

1-3 months. The spread of sizes and age of the population suggest that Red Swamps can survive in Southern England and indeed might spread.

In the 1990s the Americans were not alone. They formed an alliance with the more widespread Turkish Crayfish (*Astacus leptodactylus*) on Hampstead Heath. In the winter of 1999 the two species were collected in the same trap from the Men's Bathing Pool but no Turks have been trapped this year. Recent experiments by Alan Brunsdon and Kenneth Richter showed that the Red swamps out-compete Turks for shelters under a range of temperatures (student projects for the University of North London).

However, the loss of Turks also coincided with reports from lifeguards that many Turkish crayfish were seen at the water surface and were eaten by birds. Turks in other ponds are still thriving. In the laboratory 21 of 23 Turks from the affected pond died over a period of 3 months from unidentified causes. Jay Huner suggested that disease, chronic vibriosis, might be involved but this has yet to be confirmed.

Why have the Red Swamps not yet taken over Hampstead Heath and moved out of London?

They apparently have the competitive edge and a resistance to disease. We believe that temperature is important. In experiments on thermal tolerance Red Swamps survive higher temperatures than Turkish or Signal crayfish. At lower temperatures all species were similarly active. Our hypothesis is that red swamp populations are limited by temperature. Although several authors have shown that *Procambarus clarkii* can survive and reproduce (Gutierrez-Yurrita, Delius, Gherardi, Lindqvist & Huner (all 1999)) in colder climates, they do so slower. They also suffer from fish predation, which is higher in ponds and streams than in their preferred

EDITOR WANTED

Glen Whisson has decided it is time to give somebody else an opportunity to produce the IAA newsletter - *Crayfish News*. This is a voluntary position which is sure to give the successful applicant international exposure. Criteria for the position include: good command of the English language, knowledge of suitable computing software, and ability to produce the newsletter in electronic (i.e. pdf) format.

Please contact Glen Whisson or one of the IAA officers for further information - see page 2 for contact details.

habitat - the seasonal wetlands. And last but not least, they have not been so readily distributed over the British Isles by humans as, for example, the Signals.

Warm summers should see increases in red swamp numbers; cool summers should see their decline. Given that Britain had its hottest decade ever recorded in the 1990s, the scene seems to be set for their spread. Red Alert!

Watch this space!

POSTSCRIPT: As it was not mentioned in the article yet (but in my later finished dissertation), I have found juveniles of *Procambarus clarkii* in Hampstead Heath and have therefore proved for the first time *P. clarkii* to be breeding in Britain. This is the second most northern population of *P. clarkii* ever found to be breeding (the first being in northern Germany).

INTERNATIONAL CRUSTACEAN CONGRESS FOR MELBOURNE

IAA member **Kenneth Söderhäll** sends the following information about the Fifth International Crustacean Congress and 'Summer' 2001 meeting of The Crustacean Society, 9-13 July 2001, The University of Melbourne, Melbourne Victoria, Australia. Website <http://www.lam.mus.ca.us/~tc>

Professor Söderhäll will be Keynote Speaker in the Symposium on Diseases of Crustaceans.

Preliminary program

Papers will be accepted for the Congress on any subject dealing with Crustacea but several special symposia have been proposed as part of the meeting. Contact the conveners if you wish to be part of a symposium. The complete up-to-date program will be available at the time of registration.

The Third Crustacean Larval Conference

The scientific committee for the Third Crustacean Larval Conference comprises Klaus Anger (Germany), Danilo Calazans (Brazil), Peter Ng (Singapore), José Paula (Portugal), Henrique Queiroga (Portugal) and Paul Clark (UK). Five subthemes are proposed for the oral presentations: behaviour, ecology, physiology, taxonomy, and evolution and systematics. A poster session is also planned and will incorporate all descriptive larval morphology studies. All oral and poster contributions will be eligible for publication in the larval proceedings. (convener Paul Clark, The Natural History Museum, London, pfc@nhm.ac.uk)

Symposium on the systematics and biology of the Anomura

The symposium aims to: 1) gather researchers to present contributed papers on any aspect of the Anomura; and 2) publish a volume covering key topics summarising knowledge of the Anomura. The volume would include contributed papers presented in Melbourne, as well as review articles and papers from those who will not be able to attend ICC5. (conveners Rafael Lemaitre, lemaitre.rafael@nmnh.si.edu, and Christopher Tudge,

tudge.christopher@nmnh.si.edu, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0163, fax: 1-202-3573043).

Copepods as colonizers and invaders

The invasion of inland waters of Gondwana, the conquest of the open pelagic biome, colonization and coevolution in parasitic copepods, patterns of invasion and colonization of anchialine caves, colonization of the interstitial and its impact on morphology. (convener Geoff Boxshall, The Natural History Museum, London, g.boxshall@nhm.ac.uk)

Ecotoxicology of crustaceans

An opportunity to assess critically what we have learned from over 30 years of study of the responses of crustaceans to chemical pollutants and ask some important questions. Can we gain any understanding of the ecological relevance of pollutant effects in the environment by measuring responses in individuals in the laboratory? Have we the information to synthesise results to obtain an integrated view of the holistic response of individuals? What general principles are emerging across different environments? Are we measuring the appropriate responses to link individuals with populations and the community? (convener Malcolm Jones, University of Plymouth, M.Jones@plymouth.ac.uk)

Burrowing crustaceans

All aspects of the burrowing habit of crustaceans: functional burrow morphology; feeding and burrowing behaviour; subsurface mating; and the impact of burrowing and feeding on the sedimentary environment (convener Fiona Bird, Zoology, La Trobe University, Bundoora, Victoria, Australia, f.bird@zoo.latrobe.edu.au)

Biology of crustacean symbioses

Ecological, behavioral, physiological and morphological adaptations among crustaceans living in close associations with other organisms. These heterospecific associations are being grouped as examples of symbiosis, a broad category that includes, among others,

(Continued from page 4)

commensalism, mutualism and parasitism. (convener Peter Castro, Biological Sciences Department, California State Polytechnic University, Pomona, CA 91768, USA, peastro@csupomona.edu)

The unity of the Peracarida

Although many crustaceologists believe that the Peracarida is a monophyletic taxon, its composition and internal phylogenetic structure is still undecided. Although strictly phylogenetic approaches might answer these questions, our knowledge of the Peracarida comes from the underlying comparative research. Therefore, attendees are invited to submit presentation titles on cross-peracarid comparative studies (including all aspects of biology) as well as phylogenetic research. (convener Buz Wilson, Australian Museum, College Street, Sydney, NSW 2001, Australia, buzw@amsg.austmus.gov.au)

Molecular systematics and evolution

The idea of this symposium is to bring together practitioners of the oldest biological discipline - taxonomy and those of one of the newest - molecular genetics, united by a common interest in crustacean systematics. While presentations are invited on any aspect of crustaceans systematics, those that address broader or more fundamental questions relating to the strengths and weakness of molecular and morphological approaches to crustacean taxonomy and evolutionary history or the use of molecular data for species delineation and construction of stable classification schemes will be especially welcome. (convener Chris Austin, School of Ecology and Environment, Deakin University, cherax@deakin.edu.au)

The biology and management of exploited crustaceans

Australia has a number of industries exploiting a range of crustaceans species including rock lobsters, crabs, prawns and freshwater crayfish using a variety of approaches. These industries are at various developmental stages ranging from the long

established and carefully managed western rock lobster fishery to an incipient freshwater crayfish aquaculture. This symposium provides an opportunity to bring international and Australian experts together to present and discuss common interests and problems concerning the biology and management of exploited crustaceans. (conveners Brad Mitchell and Andrew Levings, School of Ecology and Environment, Deakin University, bradm@deakin.edu.au & ahl@deakin.edu.au).

Estimation of age and growth in crustaceans, with particular reference to Brachyura

Knowledge of the growth rate of an exploited species is an important ingredient to its effective management. However unlike most fish, crustaceans lack the hard structures that can contain a record of their growth history. This symposium aims to provide a forum for discussing and exchanging ideas about techniques for measuring age and growth in crustaceans, particularly crabs. Topics are likely to include tag-recapture, lipofuscin determination, and length-frequency methods, with scope to include techniques for the study of moulting and the statistical representation of growth processes. Contributors will be encouraged to talk about methods and applications that have failed, in addition to those that have worked. (Convener: Ian Brown, Qld Dept Primary Industries, Southern Fisheries Centre, Deception Bay, Qld, e-mail: browni@dpi.qld.gov.au).

Disease Defenses in Crustacea

Diseases in crayfish, shrimp, crabs, and lobsters have gained notoriety for their resulting damage to fisheries and aquaculture industries. With recurring epizootics and the potential for spread of disease, there has been an increased effort to understand the host defense systems, especially in crayfish, shrimp, and lobsters. This symposium will examine key components of the host's defenses ranging from cellular and non-cellular mechanisms, to cuticular barriers and host specificity, and patterns in defensive responses with challenged hosts.



(Continued from page 5)

Different approaches and techniques indicate significant variation in the defensive responses of many decapods. Thus, the symposium will attempt to bring together the disparate components of the crustacean defenses into a generalized synthesis. (Convener: Jeffrey Shields, Associate Research Professor, Virginia Institute of Marine Science, Gloucester Point, VA 23062, USA, jeff@vims.edu)

The impact of fishing on crustacean communities (convener Les Watling, Darling Marine Center, University of Maine, watling@maine.maine.edu)

EUROPEAN CRAYFISH MEETING

Information about the European meeting "Knowledge-based management of European native crayfishes" being organised by **Catherine Souty-Grosset** is now available at the following web site:
<http://labo.univ-poitiers.fr/umr6556>

The meeting will be held from 13 to 15 September 2001 in Poitiers, France. Registration fees will be indicated in the second circular available in mid-March.

Catherine can be contacted on:
E-mail: catherine.souty@univ-poitiers.fr
Tel: +33 (0)5 49 45 36 07
Fax: +33 (0)5 49 45 40 15

CRAWFISH EXTINCTION

IAA member **Joe Fitzpatrick, Jr.** sent the following item.

Dr. Salvador Contreras-Balderas of the University of Nuevo Leon has reported to me (29 October 2000) that *Cambarellus alvarezi* Villalobos, reported in 1996 (Contreras-Balderas, & M. de L. Lozano-Vilano. Ichthyol Explor. Freshwaters 7(1):33-40.) to be severely imperiled, is now extinct. Apparently this has happened because of destruction of its habitat. Agricultural practices of the region have significantly

lowered the water table of the aquifer supplying the springs that provided the water for the aquatic community and they are now dry.

Joining the crawfish in extinction are several snails and pupfishes, all only very recently discovered by science. This is now the second record of extinction of a North American crawfish (previously, *Pacifastacus nigriceps* from California). Both seem to be the result of avoidable human encroachment and destruction of habitat.

Dr. Contreras also tells me that members of *Procambarus clarkii*, apparently introduced, have recently appeared in the states of Chihuahua and Nuevo Leon and are wreaking havoc with local species.

These developments emphasize the importance of conservation measures, especially with such a high percentage of North American crayfishes recognized as endemic and also in some sort of "threatened situation."

Contact details:
J.F. Fitzpatrick, Jr.
Curator of Invertebrates, Tulane University
Museum of Natural History)
E-mail: jfitz@museum.tulane.edu

CHARACTERISATION OF CRUSTACEAN VIRUSES

IAA member **Brett Edgerton** sends the following information about his planned research into the characterisation of crustacean viruses.

I have been awarded a Fellowship from the Centre National de la Recherche Scientifique of France to work with Dr JR Bonami at University of Montpellier 2. The Fellowship is for 12 months, beginning in February 2001, and the research will involve characterisation of crustacean viruses.

I have a particular interest in an enigmatic group of viruses which infect the

hepatopancreas of crustaceans. Preliminary work indicates that these viruses are common in freshwater crayfish - viruses belonging to this group have been described in *Cherax quadricarinatus*, *Cherax destructor*, *Astacus astacus* and *Pacifastacus leniusculus* in Australia, Europe and USA.

I would like to hear from colleagues who would be willing to collaborate in research aimed at determining how common these viruses are in freshwater crayfish species. Collaborators would collect 10-15 freshwater crayfish, of species not mentioned above, fix hepatopancreatic tissue in formalin, and send the material to me for examination. It would be best if the crayfish were from natural populations which have not mixed with introduced species. Alternatively, I would appreciate it if anyone with archived histological sections or blocks of hepatopancreas from other freshwater crayfish species could send these for examination.

Please contact me by email on:
<brettedgerton@hotmail.com>

CRAYFISH IN RUSSIA UPDATE

IAA member **Valery Fedotov** sends the following crayfish news from Russia:

I continue to study, with my student, the physiological reaction of the crayfish *Astacus astacus* to environmental changes. In one project we will evaluate the ecological role of *Astacus astacus* in state waterbodies including eutrophic conditions. In another project we will study the assimilation volume of the waterbodies with help from biomarkers including crayfish and molluscs.

IAA members may be interested to know that we have now published the following paper:

V. P. Fedotov, S. V. Kholodkevich, and A. G. Stochilo: Study of contractile activity of the crayfish heart with the aid of a new non-

invasive technique. Journal of Evolutionary Biochemistry and Physiology, Vol. 36, No. 3, 2000, pp. 288-293. Translated from Zhurnal Evolyutsionnoi Biokhimi i Fiziologii, Vol. 36, No. 3, 2000, pp. 219-222. Original Russian text Copyright 2000 by Fedotov, Kholodkevich, Stochilo.

IAA 14 TO BE STAGED IN MEXICO

IAA member **Pedro Joaquín Gutiérrez-Yurrita** and his team are organising the fourteenth IAA symposium for August 2002.

IAA 14 will be held at the University of Querétaro in the historic city of Santiago de Querétaro, Central México. The Lecture Hall is located very close to the Historic Centre and downtown of Querétaro. All facilities and services for communication are available: computer, internet, email, printer, photocopies, fax, etc. There will be simultaneous translation from English into Spanish or vice versa for the most important lectures.

Accommodation will be available in different hotels for delegates at a reduced room rate. A range of alternative accommodation will be available within walking distance of the Lecture Hall with prices starting from US\$5/night for back-packer style accommodation to US\$80/night for resort style accommodation and up to US\$150/night in luxury hotels.

For more information contact Pedro on:
E-mail: yurrita@sunserver.uaq.mx
Tel/fax: +52 42 15 47 77

UPDATE ON YABBY HYBRID EXPERIMENT

An interim report has been produced on the yabby hybrid growout experiment being conducted by a group of researchers from Fisheries Western Australia, led by IAA member **Craig Lawrence**.



The results have been highly promising and, assuming disease clearances can be obtained, the commercialization process will commence as soon as possible.

The objectives of the research covered by the interim report were:

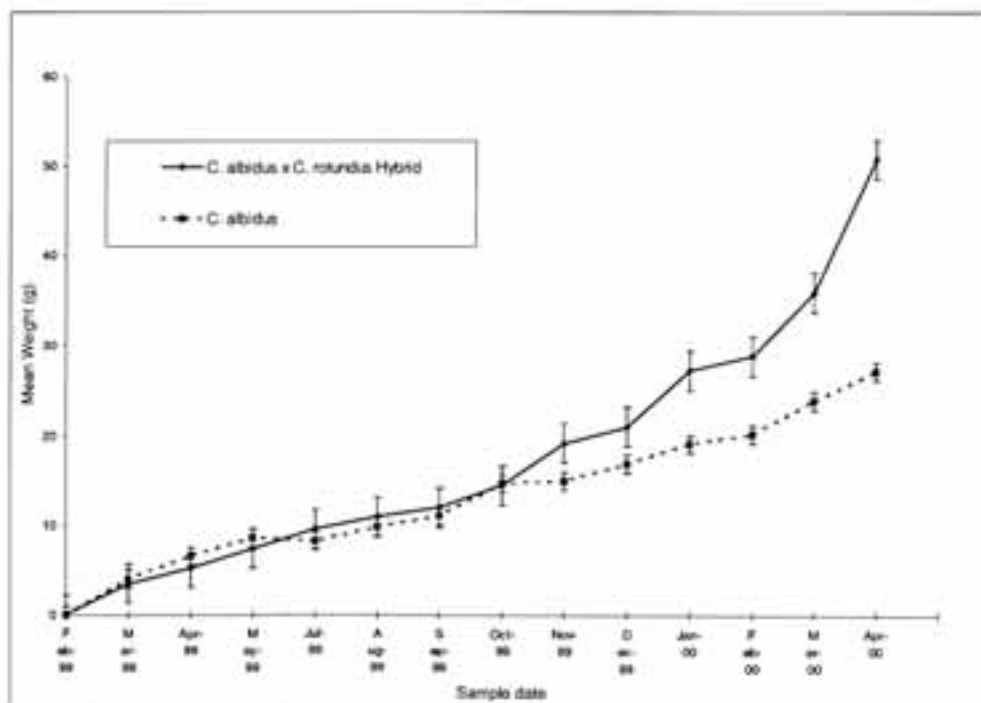
1. Confirm the feasibility of large scale production of all male hybrid progeny.
2. Record the growth rate of hybrids.
3. Compare the growth rate of hybrids with WA yabbies.
4. Develop a *Thelohania* free broodstock population.
5. Develop a commercial options paper for transferring the technology to industry, including an economic costing of various

production scenarios for producing male progeny (this is subject to the project showing that the all male progeny have commercial potential).

Non-technical summary

It has been shown in an earlier FRDC project (94/075) that hybridising two species of freshwater crayfish, female *Cherax rotundus* from New South Wales crossed by male *Cherax albidus* from Western Australia produces only male progeny.

This hybrid offers considerable potential for controlling reproduction by yabbies in aquaculture ponds. In this current project, the production of only male progeny from this hybrid has been confirmed in multiple crosses. These all male hybrids have been shown to grow faster than mixed sex groups of *C. albidus* in aquaria. Now this comparison



Growth of *Cherax albidus* vs *C. albidus* x *C. rotundus* hybrids over 424 days (bars indicate SE; n = 4)

has been repeated, under model pond conditions, where growth can be assessed more realistically. The hybrids grew almost twice as fast as *C. albidus* yabbies. This gave increased numbers of yabbies in the larger and therefore more valuable size categories. The final harvest value of *C. albidus* x *C. rotundus* hybrids was 4.6 times greater than that of the *C. albidus* yabbies.

Sensory evaluation showed that the taste of the hybrids is comparable with currently farmed *C. albidus* yabbies.

While the survival of hybrids in a simulated transport trial was lower than *C. albidus* yabbies, it was greater than that reported previously for transport survival of *C. albidus*. Further research is needed on this important aspect.

While stocks of both *C. rotundus* and *C. albidus* are available in New South Wales, elsewhere in Australia commercialisation of this hybrid is limited by availability of *C. rotundus*.

Space and environmental limitations have restricted the quantity of *C. rotundus* that could be produced in this study. To overcome this challenge the project will be extended at Avondale to produce potential broodstock for farmers in larger ponds.

An economic evaluation of three potential methods for producing hybrids 1) stocking breeding ponds, 2) cage reproduction and 3) hatchery production, shows that a small farm producing \$5000 worth of *C. albidus* yabbies/year could expect to increase returns to \$23,000/year. Thus capital costs, incurred from establishing facilities for hybrid production using any of the three methods proposed, would be paid back in less than one year.

Source: ACWA News 31:12

THE LOUISIANAN RED SWAMP CRAYFISH *PROCAMBARUS CLARKII* IN LAKE NAIVASHA, KENYA

By IAA Great Britain Correspondent **Dr John Foster**, IAA Kenyan Correspondent **Daniel Kamau Mbogo** and Earthwatch Lake Naivasha Project Manager, Dr David Harper.

In East Africa, *Procambarus clarkii* was first introduced to Uganda, probably in the 1960s. It was then introduced into various water bodies in Kenya including Lake Naivasha in the Rift Valley in 1970 but it has only ever been commercially exploited in Lake Naivasha.

Lake Naivasha is one of only two freshwater lakes in the Kenyan Rift Valley. It is situated at an altitude of 1890m above sea level about 100 km² north of Nairobi and has an area of about 160 km². The lake is shallow, having for the most part, a depth of about 8m, and is subject to wide fluctuations in water level.

By 1974 *P. clarkii* was well established in the eastern basin of Lake Naivasha where commercial exploitation began in 1975. By 1977 *P. clarkii* was abundant in the Eastern Basin, moderate on the southern shores and scarce on the western shores but stocks were spread by riparian owners along the western shores as a local food resource and these introductions were highly successful.

The freshwater crayfish fishery has had mixed fortunes in its shorter life span compared to commercial fin fish fisheries for introduced American bigmouth bass *Micropterus salmoides*, and two tilapia species *Oreochromis leucostictus* and *Tilapia zillii*.

Initially opened in 1975, catches of several hundred tonnes per annum of *P. clarkii* were exported live, mainly to Europe (predominantly Sweden and Germany) until 1981 when catches peaked at 500 tonnes or about 19 million adult freshwater crayfish. Then, the European Union imposed a ban on the import of live freshwater crayfish from

Kenya due to fears concerning an outbreak of 'cholera' in East Africa.

This led to a collapse of the Lake Naivasha commercial freshwater crayfishery and bankruptcy of some of the businesses involved, as the internal Kenyan market for freshwater crayfish is small and mainly limited to tourist outlets in the Naivasha and Nairobi areas and some local consumption in the Naivasha area.

Since 1981 catches have been at well below maximum sustainable yields, averaging about 20-40 tonnes per annum or about 0.75-2.25 million adult freshwater crayfish per annum.

Many Kenyan tribal peoples have taboos against eating fin fish let alone freshwater crayfish, regarded by many as a particularly ugly looking 'insect'. That being said, the poor local Naivasha fishermen (daily wage perhaps \$1-\$3) eat the crayfish and there is some fish poaching for them on Lake Naivasha but this is kept under control by the Kenyan Fisheries Service (a branch of the Kenyan Wildlife Service).

In December 2000 whole shelled *P. clarkii* retailed in Naivasha town fishmongers at 75 schillings per kilogramme while frozen peeled *P. clarkii* tails retailed for 300 schillings per kilogramme (then, there were about 75 schillings to the US dollar and about 100 schillings to the British pound/sterling).

An Earthwatch Expedition in December 1999 (lead by Dr Foster) recorded *P. clarkii* in abundance throughout the lake (CPUE for 10 trap hours up to 146 adult freshwater crayfish). There was moderate abundance of adult freshwater crayfish in the littoral zone, very high abundance of adults in the profundal zone and moderate abundance but the largest crayfish recorded in the deepest water in the lake (the volcanic crater Crescent Island Lagoon). Freshwater crayfish abundance was related to habitat type.

By contrast, despite considerable sampling effort, an Earthwatch Expedition in December 2000 (lead by Dr Foster) scarcely recorded adult freshwater crayfish in the littoral or profundal zones. The adult freshwater crayfish stock was <1.0% of the abundance of the previous year.

The population change from 1999 to 2000 can be summarised as **the natural collapse of an artificial fishery**. The cause is almost certainly due to a drought which has decimated key freshwater crayfish habitat and exposed freshwater crayfish to heavy predation by bigmouth bass and avian predators. The lake level has fallen by about one metre from late 1999 to late 2000 but the shore line has reduced by 100 metres or more in places, completely drying out littoral zones. The limited commercial fishing pressure is not enough to account for the change from 1999 to 2000.

P. clarkii has had both positive and negative effects on the ecology of the lake. Aquatic vegetation change began with the disappearance of native water lilies *Nymphaea caerulea* Savigny, and then native submerged macrophytes, between 1974 and 1980. It is probably not co-incidental that water lilies, and then submerged macrophytes in general, began to disappear in the lake at about the same time as *P. clarkii* was expanding in the littoral zone. *P. clarkii* are also present at densities of up to 70m⁻² (juveniles and adults) in floating alien water hyacinth *Eichhornia crassipes* mats. It is also highly likely that *P. clarkii* impacts the aquatic macroinvertebrate communities in Lake Naivasha.

December 1999 and December 2000 Earthwatch Expeditions recorded *P. clarkii* from the lower reaches of the Rivers Malewa, Gilgil and Karati which flow into Lake Naivasha from the Aberdare Mountains. These *P. clarkii* populations may threaten the **very existence** of species of native African freshwater crabs which are often endemic to specific rivers as well as impacting other aquatic macroinvertebrates.

On the positive side, *P. clarkii* are important prey for the commercially important American big mouth bass. The freshwater crayfish at this RAMSAR site are also essential in the maintenance of dozens of species of piscivorous birds including the world's largest population of African fish eagles and many species of herons, egrets, storks, cormorants, grebes, ibis, kingfishers and marsh harriers together with several species of amphibian and mammals including marsh mongoose and the African clawless otter.

Contact Addresses:

Dr John Foster, The Environment Agency, Saxon House, Little High Street, Worthing, BN11 1DH, UK, Tel. UK 01903 703875, Fax: 01903 215884, E-mail: john.foster@environment-agency.gov.uk

Daniel Kamau Mbogo, Fisheries Officer, Kenyan Marine Fisheries Research Institute, Post Box 837, Naivasha, Kenya.

Dr David Harper, Department of Biology, University of Leicester, Leicester, LE1 7RH, UK, Tel. UK 0116 2523346, Fax: UK 01162 2523330, E-mail: dmb@le.ac.uk

BENTHOLOGICAL SOCIETY MEETING

This year's annual meeting of the North American Benthological Society (June 3-8, 2001, in LaCrosse, Wisconsin, U.S.A.) will feature a special session entitled "Ecology and Conservation of Crayfish". This full-day session takes place on June 7. It is being organized by Bob DiStefano, Charlie Rabeni and Dan Magoulick, and will include a mix of 29 invited and contributed papers as well as accompanying posters. The goals of the session are to:

- 1) highlight the ecological importance of crayfish by reviewing recent research advances;
 - 2) present problems, recent advances and strategies for native crayfish conservation; and,
 - 3) provide a forum for professionals working on crayfish ecology and conservation to meet and interact.
- Bob also hopes to use the session to recruit

new IAA members. Invited speakers will include such notables as Alan Covich, David Lodge, Walter Momot, Alastair Richardson, Keith Somers, and Chris Taylor. There will be an accompanying Crayfish Identification Workshop on Sunday June 3, taught by Dr. Guenter Schuster and Chris Taylor.

For more information about the session or workshop, please contact **Bob DiStefano** (dister@mail.conservacion.state.mo.us). For general information (registration, accommodations, etc.) about the N.A.B.S. meeting, please visit the website at: www.BENTHOS.ORG and click on the "Annual Meeting" button.

RAMPANT CRAWDADS IN ARIZONA

The following article, by John Yantis/Tribune, appeared in *The Dallas Morning News*, 24 September 2000:43.

Non-native Arizona crawdads have overstayed their welcome in the state's lakes and streams. So the Arizona Game and Fish Department wants people to eat them, even offering instructions for how to catch, boil and pinch the mud bugs.

"They've had an easy time for a lot of years," said Rory Aikens, Arizona Game and Fish spokesman. "We've had a quite a push trying to let the public know about the uh, how do you put it, the culinary potential of crayfish and the art of catching them. They're easy to get at about any lake."

Arizona is the only mainland state with no native species of crawdad, a type of crustacean that looks like a mini-lobster and also is called crayfish or crawfish. Decades ago, state officials intentionally put crayfish in Arizona waters as food for sport fish in lakes. Since then, their numbers have exploded.

The state wants to curb that population to lessen the effect on native fish and trout streams, so there are no limits to catching them. To keep them from expanding to other territories, the department is in the process of