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RENEWAL ***

MEMBERSHIP APPLICATION INTERNATIONAL ASSOCIATION OF ASTACOLOGY

APRIL 1994 - APRIL 1996

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If you have not yet paid your dues, please do so as soon as possible. If you do not intend to pay your dues, please be kind enough to tell us to take your name from our mailing list. REMEMBER THIS IS THE THIRD NOTICE and you have already received 3 newsletters, a list of members with addresses and a copy of the IAA X Abstracts Booklet!

FIELD OF INTEREST & SPECIES: _____



Crayfish NEWS

IAA Newsletter

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IAA

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 have a permanent secretariat. The Secretariat is managed by Jay Huner and the address is IAA Secretariat, P.O. Box 44 650, Univ. of Southwestern Louisiana, Lafayette, Louisiana 70504, USA; phone (318) 231-5239 / fax (318) 231-5395.

Officers:

• Jostein Skurdal, President, Eastern Norway Research Inst., P.O. Box 1066 Skurva, N-2601 Lillehammer, Norway.

• Paula Henttonen, Presidents-Elect, Dept. Appl. Zoology, Univ. Kuopio, P.O. Box 1627, SF-70211 Kuopio, Finland.

• Michele Wheatly, Sec. Treas., Dept. of Zool., University of Florida, Gainesville, Florida 32611, USA.

• Jay Huner, Past-President, Crayfish Center, Univ. Southwestern Louisiana, Lafayette, Louisiana 70504, USA.

Crayfish News, the Newsletter of the International Association of Astacology

Please note that our newsletter now are registered at NSDP (Library of Congress, National Serials Data Program with the following code - ISSN 1023-8174.

Have you ever wondered why your most recent publications have not been referenced in the newsletter? What about information about a meeting that you are planning, held, or attended? There are two realistic answers. The first is that your editors, being human, misplaced the information that you sent for the newsletter. However, the second answer is much more likely to explain the situation. That is, you never sent the information in the first place! Do not say that you should have sent something. Send it! It really is never too late to use something that a member thinks is important!

Jostein Skurdal and Jay V. Huner, Editors

IAA NEWS**1. Membership Status**

If the notation 94-96 follows your name on your mailing label, your membership renewal was received prior to the mailing of this newsletter. IAA asks that you take action to pay your dues as soon as possible. If you choose not to renew your membership, please be considerate enough to advise the Secretariat so that we can remove your name from our mailing list.

2. Membership Directory

You will have received two Membership Directory/Renewal forms by the time you receive this newsletter. It is important for you to return the Directory Form to ensure that you are properly acknowledged in the Membership Directory. The Membership Directory will be published in February 1995.

The membership directory is not the membership list mailed earlier this year. The Membership List is sent to members to let everyone know who we all are and to remind you to pay your dues and return the directory form.

3. Status of Freshwater Crayfish Volumes

Freshwater Crayfish 10: Dr. Mike Geddes (Dept. of

Zoology, Univ. of Adelaide, Adelaide, South Australia 5005, Australia) is senior editor of FC 10. He informs the Secretariat that over half of the manuscripts have been refereed and returned to the authors for corrections. The book should be published before the end of summer 1995, if not sooner.

Freshwater Crayfish 8: Dr. Robert Romaine (School of Forestry, Wildlife & Fisheries, Louisiana State Univ., Baton Rouge, Louisiana 70803 USA) is editor of the long delayed FC 8. He informs the Secretariat that the book is ready to go to the printer with the exception of some introductory materials. He is optimistic that the book will be published in 1994.

4. ASZ Meeting

IAA has been a named participant in the American Society of Zoologists annual meeting for some years now. IAA has not been especially active in most years. However, Drs. Milton Fingerman and Brian McMahon organized a most successful crayfish physiology symposium for the 1993 Los Angeles meeting. The Crustacean Society was a major co-sponsor of that symposium and provided a very generous and much appreciated financial contribution. Past-President James Payne was instrumental in developing IAA's initial relationship with ASZ.

A decision on the association's continued relationship with ASZ will be made in the near future by the IAA Board. At this point, there will be only a minor IAA presence at the January 4-8, 1995 ASZ meeting at the St. Louis, Missouri (USA) Adam's Mark Hotel. Those interested in further information should contact ASZ at 401 N. Michigan Avenue, Chicago, Illinois 60611-4267, tel. 312-527-6697 & fax 312-527-6640.

5. Future IAA Meetings

IAA XI

Coordinator Walter Momot (Dept. of Biology, Lakehead Univ., Thunder Bay, Ontario, Canada P7B 5E1) informs the Secretariat that he has received a good response to the initial announcement for the early August 1996 meeting. A second mailing will be made in the next few months.

IAA XII

The IAA Site Selection Committee has reviewed an invitation from Dr. Max Keller to hold IAA IX in Ausburg, Germany in August 1998. It has recommended acceptance of the invitation. More information will be forthcoming on this matter.

6. Group Photo - IAA IX Adelaide

Anyone interested in securing copies of the IAA IX group photo (color or black & white) should contact coordinator Dr. Mike Geddes. He can provide these at a very nominal charge - Dept. of Zoology, Univ. of Adelaide, Adelaide, South Australia 5005, Australia.

Dictionary for common names for crayfish

Member C. W. Hart, Jr. (National Museum of Natural History, Smithsonian Institution, Washington, DC 20560 USA) has recently published the following bulletin:

A Dictionary of Non-Scientific Names of Freshwater Crayfishes (Astacoidea and Parastacoidea), Including Other Words and Phrases Incorporating Crayfish Names. [Smithsonian Contributions to Anthropology, Number 38:1-127, 1994]

There are 83 pages of words and phrases including one page of sign language "signs." Many languages are involved including those of the former Soviet Union and eastern Asia. Dr. Hart advises that there are "a few copies for distribution."

Color crayfish database

IAA "southern" USA Correspondent Keith A. Crandall (Dept. of Zoology, Univ. of Texas at Austin, Austin, Texas 78712-1064 USA) proposes the following novel idea about developing a color crayfish database:

"I would like the help of IAA members concerning an image database for crayfishes. I'm currently scanning colored photographs of various crayfish species to be archived on CD-ROM and made available for educational purposes relating to taxonomy, systematics, and biodiversity. I hope to include related information on species distributions, ecologies, systematic relationships, etc. I am requesting IAA members with colored slides of crayfish to send me a copy for scanning. I can return the slides after scanning if you desire. I think an image database will be a valuable resource for astacologists and others. Thanks for all your help!!"

Yabbie production enhancement program

This is the title of a new yabbie (*Cherax destructor-albidus?*) aquaculture research project that commenced in July 1994 and being led by long time IAA member and former board member Noel Morrissy (Western Australian Marine Research Laboratories, Box 20, North Beach, Western Australia 6020



The drawing is made by Scott Fairman from the Missouri Department of Conservation for the report Bob DiStefanos report cover. Scott is also illustrating Dr Bill Pfligers soon-to-be-published Crayfish of Missouri handbook. The crayfish is *Orconectes ozarkae* which is endemic to the Missouri Arkansas Ozarks.

Australia). The project is designed to address two research needs:

- (1) To provide a remedy for stunting of yabbies in farm dams and
- (2) To identify and provide means for remedying dam environmental factors limiting production.

Research facilities are located at the Avondale Research Station in Beverly and consist of 25 clay dams of 100 cubic meters each. There are three specific aims of the research program:

- (1) Develop population control method(s), which increase the proportion of yabbies of marketable weights;
- (2) Develop quantified methods for managing dam environmental factors limiting yabbie production and causing variation in dam productivity; and
- (3) Develop a manual of methods for stocking and managing farm dams to increase harvest per dam.

Cajun crayfish make a meal of Kenyan snails

This is the title of a short article written by S. K. Miller in the 9 July 1994 issue of New Scientist Magazine. According Ms. Miller, hundreds of *Procambarus clarkii* will be released in Kenyan ponds and canals in a trial to determine their usefulness in controlling schistosomiasis by devouring the snails that are intermediate hosts for the parasite. The project involves Armand Kuris (Univ. of California, Santa Barbara - USA), Sam Loker and Bruce Hofkin (Univ. of New Mexico, USA), and Gerald Mkoji (Kenyan Medical Research Institute,

Nairobi, Kenya). The group was impressed with the consumption of snails by this crayfish and want to stock them into isolated water sources where most infections are transmitted. The crayfish are to come from Kenyan crayfish farms. Ms. Miller notes that there are those who feel that the snails can avoid the crayfish and others concerned about extension of the crayfish's range in Africa where it is not native. The project is being funded by the US Agency for International Development and has been approved by the Kenyan Government.

Crayfish notes from Zambia

East African correspondent C. J. Grubb (P.O. Box 60287, Livingstone, Zambia) cultivates *Procambarus clarkii*, *Cherax "destructor"*, and *Cherax quadricarinatus*. Mr. Grubb reports record low temperatures in his region in late June/early July of this year. He provided the following commentary in two different letters. "...The frosts at our place were minus 3, minus 5 and one farm minus 17 [Celsius]. I managed to save my redclaw [*C. quadricarinatus*] through running a borehole pump all night and putting tarp sheet plus a geyser heater in the tank...." "...I only just made it with my redclaw as the temperature was minus 7 ambient of course and at one time water temperatures as low as 16 C. I had to pump warm water from my wells in and out of the tanks to keep them going. Some did perish but it was always at a moult stage as each dead one had the carapace lifted...."

Mr. Grubb sent the following information about freezing of crayfishes and relative merits of the three crayfishes. "...I find that when I freeze a few yabbies [*C. destructor*] and thaw them out, all the legs and pinchers seem too brittle and break off. The *P. clarkii* don't seem to do that or the redclaw. I think I told you that the big redclaw seem to have shells like armoured plating...."

"...I feel that yabbies are a better crayfish for boiling as the shell of the redclaw is very difficult to get off. There is not much difference in taste and good purged *P. clarkii* are just as good...."

Crayfish introductions in South Africa

Past-President Ossi Lindqvist (Univ. of Kuopio, P.O.B. 1627, FIN-70211 Kuopio, Finland) received information about the status of crayfish introductions in SA from Irene de Moor (J.L.B. Smith Institute of Ichthyology, Somerset Street, Private Bag 1015, Grahamstown 6140, South Africa). Excerpts from Dr. de Moor's 31 August 1994 letter to Dr. Lindqvist follow:

"We are also very concerned about the possibility of the introduction of freshwater crayfish into Africa. At the moment there is intense pressure from aquaculturists to introduce Australian crayfish (particularly *Cherax* species) into southern Africa. We are very worried about this, especially since our nature conservation departments do not yet have a clear policy on how to deal with such applications. A number of species of crayfish have already been imported into the country and are currently being kept in captivity. Of particular concern is *Cherax albidus* which was illegally imported into the Orange Free State province, and has similar burrowing habits to *C. destructor* (Sokol, pers. comm.).

"Two species of crayfish have already been found in natural waters in South Africa. These are *Procambarus clarkii* which you mentioned in your letter, and the Australian "marron", *Cherax tenuimanus*. The former species has only recently been discovered in natural waters, and appears to have established a viable population in the Transvaal province. Fortunately the latter species (*C. tenuimanus*) does not appear to have established a self-sustaining population...."

Soybeans as crayfish feed

The University of Southwestern Crawfish Research Center has received a \$10,000 grant from the Louisiana Soybean and Small Grain Promotion and Research Board to evaluate the use of raw soybeans as crayfish feed and crayfish bait. According to

center director Jay Huner, the project got underway in mid-spring 1994 and is continuing now studying reproduction and survival of crawfish fed soybeans before the burrowing season began in May. He noted that crawfish production was increased about 25% in research ponds fed with soybeans in March. However, results are too preliminary to make any advisory recommendations for the coming crayfish season. Huner also said that soybeans were not especially good crawfish bait but might have some application at the end of the crawfish season in May. Contact Huner for further information at: Crawfish Research Center, University of Southwestern Louisiana, Lafayette, Louisiana 70504 USA. Note: cooperators in the project include T. Blair Shields and Mark Konikoff, both IAA members.

Crayfish feed recommendations from Texas

Member Doyle Schaer (DSR Box 127A, El Campo, Texas 77437 USA) has cultivated crayfish, *Procambarus* spp., in southeastern Texas for over 15 years. His thoughts about feeding crayfish in perpetuating population systems are based on this long experience and may be of value to those cultivating various *Cherax* spp. Doyle sent the following information in an August 3, 1994 letter.

"I fed with my [crawfish] bait this year. It is all natural 20% protein. We stayed at 10 lbs [4.54 kg] per acre [0.4 ha] weekly in the trap lanes. We started early and harvested longer than the other farms. We are done this week. I think good food and bait enhances growth, population and a constant catch. Calcium in the baits and feed is A+ [excellent]. I think a perfect pond would be rice, good water, flood in September, broadcast 25% [protein] feed in October around 3 times at 10 lbs [4.54 kg] per acre [0.4 ha], also 20% [protein] [crawfish bait] in trap lines. This would enhance growth and would keep cannibalism down. As a result you have more population to work with.

"Ahead of each cold spell, broadcast feed during the winter. This gives healthier animals and better harvest during cold times. Feed whole grains at the end of February, again in March and in April to help growth and sustain vegetation as long as possible towards June-July. As long as you are on suitable soil, the food is the key.

"If a shrimp farmer can raise 8000 lbs [3636 kg] of 21 count [22 g] shrimp per acre [0.4 ha], the crawfish industry can surpass that with the right feed combination...."

Advances in crayfish culture

Member Eric Rudolph (Facturar a Instituto Profesional de Osorno, Rut 70.772.100-6, Casilla 933, Osorno, Chile) has sent the following information about crayfish culture studies in Chile. The investigators include Ch. Iracabal, E. Rudolph, P. Alvarado, and J. Yanez.

Six research ponds are now available for research. Two are for growth studies. This system permits small scale research to determine the commercial value and marketability of *Samastacus spinifrons* (Philippi, 1882). Data have been presented at the "Sea Science Symposium in Chile." Many Argentinian and Chilean professionals attend the successful event.

Although cultural studies have not yet begun, studies of the biology of *S. spinifrons* strongly suggest that this species will be an excellent cultural candidate. Sex ratios are consistently 1:1 and fecundity is greater than that of any other Chilean crayfish. The species is very large and has a high meat yield. It is widely distributed in Chile and reproduces throughout the year. It adapts well to laboratory cultural systems.

The crayfish mystique in Finland reported

Juha Tantt is author of a cover story about crayfish consumption in Finland that appeared in the FinnAir inflight magazine Blue Wings (August-September 1994). Entitled "Come Out of Your Shell, It's Crayfish Time." The subhead continues "Is it a lobster, a prawn, a langouste or a crab? Not exactly: it's the crayfish, less commonly known as *Astacus astacus*. Along with the new potatoes, mushrooms, fish and berries, it's one of the great culinary experiences of the Finnish summer. The beautiful cover shows a closeup of boiled noble crayfish arranged for serving with fresh crown dill. This issue of Blue Wings is certainly a collector's item for the serious astacologist.

Great Britain protect habitats from non-native crayfish

The following article appears in the September 1994 (Volume 21, Number 9, pages 50-51) of the London-based aquaculture publication Fish Farming International:

Crayfish Farmers Need Protection from Greens and Bureaucrats by Eric Edwards.

The article refers to a developing controversy amongst those in the United Kingdom who cultivate introduced crayfishes, principally *Pacifastacus leniusculus*, and those who seek to protect the native

Austropotamobius pallipes. Proposed legislation would place new controls on keeping live crayfish and establish no-go areas in the whole of Scotland, Wales, Northern Ireland, and the north and midlands of England. The proposal by the UK's Joint Nature Conservation Committee will also severely restrict the import non-native species of crayfish.

Dr. Edwards writes eloquently about the need to support the 50 or so licensed British crayfish farmers. He suggests that the new rules would/will severely impact their ability to cultivate crayfishes commercially. Long-term members of IAA, however, will have read many papers dealing with the biology of native and introduced crayfishes in the British Isles. The papers and reports chronicle the development of permanent populations of introduced crayfishes and physical and plague related (*Aphanomyces astaci*) displacement of the native crayfish in many areas.

Readers may find of interest a consultation letter dated 3 August 1994 from Neil Sinclair (The Scottish Office, Agriculture and Fisheries Department, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TW (Scotland), United Kingdom). Entitled "Protection of Aquatic Habitats from Non-Native Crayfish," the detailed 7 page document should be consulted by those concerned about this matter.

It does provide for continued production of non-native crayfish by farmers in no-go areas if they meet very strict guidelines to prevent escape. Dr. Edwards is concerned about regulations that would add to production costs and restrict the expansion that the industry feels is necessary to generate a critical mass of product to properly commercialize crayfish.

Open and rational communications must be maintained between the groups who have opposing views on crayfish introductions throughout the world. This newsletter will make every effort to provide a forum for such communications.

Recent crayfish thesis and dissertations

The following list of recent crayfish theses and dissertations was provided by member Robert Romaire (Louisiana State University Agricultural Experiment Station, Baton Rouge, Louisiana 70803 USA).

Belhadjali, Karim. 1994. Effects of supplemental feeding and rotational trapping on yield and size at harvest of crayfish in ponds. MS Thesis, 46 pp.

Medley, Paul B. 1994. Production capabilities and

economic potential of an Australian redclaw crayfish (*Cherax quadricarinatus*) hatchery in the United States. PhD Dissertation, 73 pp.

Merry, Gwen. 1991. Effects of supplemental mechanical aeration on water quality in crawfish ponds. MS Thesis, 50 pp.

Orellana, Francisco X. 1992. Characterization of effluents from commercial crawfish ponds in south Louisiana. MS Thesis, 98 pp.

Villagran, Erik R. 1993. Effects of stocking density, forage availability, and supplemental feeding on production of red swamp crawfish in pools. MS Thesis, 48 pp.

Chinese crayfish products in USA and Europe

International commerce in crayfish products has obvious economic implications for both the exporter and the importer. Dr. Kenneth Roberts (Louisiana Cooperative Extension Service, Knapp Hall - Louisiana State University, Baton Rouge, Louisiana 70803 USA) recently provided the following information about the importation of peeled crayfish meat into the USA from the People's Republic of China in 1993 and 1994. According to Dr. Roberts the data represent crayfish meat landed in Long Beach, California but additional, but unquantified, product was also landed in New York, New York.

Month	1993 (kg)	1994
January	--	15,273
February	13,636	58,451
March	--	5,636
April	--	--
May	--	--
June	--	24,205
July	68,729	91,050
August	44,165	208,792
September	71,295	177,955
October	141,802	////
November	61,691	////
December	18,425	////

Landed prices were reported at \$6.60 per kg in 1993 and \$4.75 per kg in 1994. Total Long Beach landings were around 420,000 kg in 1993 and projected landings for 1994 are 820,000 kg for 1994.

The August 1994 issue of Seafood International magazine has a news report on page 6 entitled, "Crayfish Tails from China." According to the arti-

cle a Danish firm F Uhrenholt Fisk A/S (DK 5500 Middelfart, Denmark) is importing frozen crayfish *Procambarus clarkii* tails from the People's Republic of China in 500 g blocks and 10 kg IQF cartons. The products are being marketed in Denmark, Sweden, Germany, and Norway.

Projections for the 1994-95 Louisiana season

Member Tom Hymel (P.O. Box 10407, New Iberia, Louisiana 70562 USA) recently made some projections for the coming Louisiana crayfish season. Tom could make no learned comments about the wild crop. That will not be possible until late winter when natural production areas are flooded. However, Tom pointed out that there have been two consecutive good natural crawfish seasons and it is unlikely that there will be third one. This bodes well for crayfish farmers. Other good omens are the overall scarcity of frozen crayfish meat both domestic and imported and strengthening of prices for imported Chinese crayfish meat. This means that there will be stronger than normal demand for early crayfish from both processing and live markets keeping prices up.

New *P. clarkii* culture manual to be published

Member Wendell Lorio (Louisiana Cooperative Extension Service, Knapp Hall - Louisiana State University, Baton Rouge, Louisiana 70803-1900 USA) is writing an advisory manual on the latest crayfish - *Procambarus clarkii*/*Procambarus zonangulus* - culture manual. The last such advisory manual was published in the 1970s. Thus, this will be a most significant contribution. Inquiries about the manual should be directed to Dr. Lorio.

Zebra mussel imperil N. American crayfish?

The zebra mussel has become well established in North America and is rapidly expanding its range. It has recently become a significant factor in biofouling of vessels and water intakes in southern Louisiana. This was reported in several articles by Bob Anderson, Environmental Editor for The Advocate, a Baton Rouge, Louisiana USA newspaper, on 25 September 1994.

Mr. Anderson makes one comment about crayfish and zebra mussels. He states that "Literature on zebra mussels indicates they can be a special problem for crawfish by attaching themselves to the pincers and eyes, causing crawfish to starve." Any reader familiar with literature documenting this as a significant problem is invited to send copies and comments to the editor.

A note on *Psorospermium* studies

President-elect Paula Henttonen (Dept. Applied Zoology, Univ. Kuopio, FIN-70211 Kuopio, Finland) sent a short note that Jouni Tulonen of the Finnish Game and Fisheries Research Institute noted that summerling juvenile *Astacus astacus* became infested with *Psorospermium haeckeli* in a plastic tank with infected females. The infection was noted at the end of August when the crayfish were 2.5-3.0 months old.

Bibliographies on benthic biology

The North American Benthological Society publishes the referenced bibliographies annually. Freshwater crayfishes are omitted from the listings. Dr. Donald W. Webb, Editor of the series (Illinois Natural History Survey, 607 East Peabody Drive, Champaign, Illinois 61820 USA) has been contacted to determine if IAA and NABS can collaborate to ensure that crayfishes are included in future bibliographies.

O. limosus in Lithuania

Ceslovas Koreiva (Fisheries Dept., Juozapaviciaus 9 - 806, LT-2009 Vilnius, Lithuania) reports that *O. limosus* Rafinesque was caught for the first time in Lithuania in September 1994. *O. limosus* has since its introduction in Germany around 1890 spread to at least 9 countries. In Lithuania they have additionally three crayfish species; noble crayfish *Astacus astacus*, narrow-clawed crayfish *A. leptodactylus* and signal crayfish *Pacifastacus leniusculus*. *O. limosus* ere caught in the small lake Ruskis situated 70 km from Klaipeda. Lake Ruskis is a shallow eutrophic lake. Koreiva visited the lake in September together with IAA-member Aloyzas Burba and they caught 1-2 crayfish per trap and the mean length of males were 96 mm TL and for females 91 mm TL. They will continue studies of the population in 1995. The population is probably the results from introductions by man and previously the lake were populated with the native noble crayfish.

News from Russia

Member V. P. Fedotov (Valerij Pavlovich Fedotov Timrovskaja Street 22/1 - 147, St. Petersburg, 195297 Russia) has send some information on crayfish aquaculture and studies in Russia. Fedotov visited the Volgograd, Astrahan and Krasnodar regions in spring 1994. There is a crayfish farm of Brother's of Mamontov in Kasputin Yar (Astrahan region). The farm were initiated in 1993 based on three natu-

ral lakes. They catch adult narrow-clawed crayfish *Astacus leptodactylus* in the lakes and grow on juveniles in the lakes.

Some of the influxes to river Kuban in the Krasnodar region near the sea of Asov have a lot of crayfish and some farmers are planning to use this resource. The Caspian Research Institute (CaspNirh) do some research on crayfish and help farmers. Dr. V.B. Ushvitcev at this institute have made a film to demonstrate the effects of using light as a bait in the Caspian sea and the catches were high. Dr Ushvitcev and colleagues are also working on crayfish culture with narrow-clawed crayfish.

Fedotov also informs that a second factory for manufacturing crayfish products have been established in the Volgograd region in Russia and the first factory is near St Petersburg. The interest for crayfish and crayfish culturing seems to be increasing in Russia.



Illustration from a Russian article received from V.P. Fedotov

Recent publications of interest to astacologists

Please note: IAA is not able to provide copies of these publications to members. Please use traditional Library services. Address to many of the authors may be found in the IAA directory for orders of reprints directly from the author.

1. Anson, K. J. & D. B. Rouse. 1994. Effects of salinity on hatching and post-hatch survival of the Australian red claw crayfish *Cherax quadricarinatus*. J. World Aquaculture Soc. 25:277-280.
2. Akamatsu, M. et al. 1994. Structure-depolarizing activity relationship for achatin-I, a tetrapeptide with

D-Phe residue, and its derivatives toward the crayfish giant axon. *Bioscience Biotechnology and Biochemistry* 58(6):1123-1140.

3. Aonuma, H., T. Nagayama & M. Hisade. 1994. Output effects of identified ascending interneurons upon the abdominal postural system in the crayfish *P. clarkii* (Girard). *Zool. Sci.* 11(2):191-202.
4. Blake, M., P. Nyström & P. Hart. 1994. The effect of weed cover on juvenile signal crayfish (*Pacifastacus leniusculus* Dana) exposed to adult crayfish and non-predatory fish. *Ann. Zool. Fennici* 31:297-306.
5. Daniels, W.H., L.R. D'Bramo & K.F. Graves. 1994. Ovarian development of female red swamp crawfish (*Procambarus clarkii*) as influenced by temperature and photoperiod. *J. Crustacean Biol.* 14(3):530-537.
6. Dauble, D.D., R.M. Bean & R.W. Hanf. 1994. Disposition of quinoline in the crayfish *Pacifastacus leniusculus*. *Bull. Environ. Contam. Toxicol.* 53(3):426-433.
7. DiStefano, R. J. 1993. Ecology of stream-dwelling crayfish populations. A literature review. Final Report. Dingell-Johnson Project F-1-R-42, Study S-41. Missouri Dept. of Conservation, Fish & Wildlife Research Center, 1110 South College Avenue, Columbia, Missouri 65201 USA.
8. DiStefano, R.J., M.J. Roell, B.A. Wagner & J.J. Decoske. 1994. Relative performance of four preservatives on fish and crayfish. *Trans. Am. Fish. Soc.* 123(5):817-823.
9. Ellis, R. W. & J. Long. 1994. Metabolic flux in fed and fasted crayfish *Pacifastacus leniusculus*. *J. World Aquaculture Soc.* 25:326-332.
10. Gelder, S.R., G.B. Delmastro & M. Ferraguti. 1994. A report on Branchiobdellidians (Annelida, Clitellata) and a taxonomic key to the species in Northern Italy, including the 1st record of *Cambrincola mesochoreus* on the introduced American red swamp crayfish. *Bollettino di Zoologia* 61(2):179-184.
11. Gu, H. P. B. Mather, & M. F. Capra. 1994. The relative growth of chelipeds and abdomen and muscle production in male and female redclaw crayfish, *Cherax quadricarinatus* von Martens. *Aquaculture* 123:249-257.
12. Hart, C. W., Jr. 1994. A dictionary of non-scientific names of freshwater crayfishes (Astacoidea and Parastacoidea), including other words and phrases incorporating crayfish names. *Smithsonian Contributions to Anthropology* 38:1-127.
13. Hazlett, B.A. 1994. Alarm responses in the crayfish *Orconectes virilis* and *Orconectes propinquus*.

quus. *J. Chemical Ecology* 20(7):1525-1536.

14. Huner, J. V. 1994. Crawfish in and around recreational fishponds. *Farm Pond Harvest Magazine* 28(3):13-15 & 27-28.
15. Huner, J. V. 1994. Freshwater crayfish farming in Australia. *Fish Farming Internat* 21(7):34-35.
16. Jeberg, M.V. & F.B. Jensen. 1994. Extracellular and intracellular ionic changes in crayfish *Astacus astacus* exposed to nitrite at 2 acclimation temperatures. *Aquatic Toxicology* 29(1-2):65-72.
17. Kirschner, L.B. 1994. Electrogenic action of calcium on crayfish gill. *J. Comp. Physiol. B* 164(3):215-221.
18. Lodge, D.M., M. W. Kershner & J.E. Aloi. 1994. Effects of an omnivorous crayfish (*Orconectes rusticus*) on a freshwater littoral food web. *Ecology* 75(5):1265-1281.
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