PRELIMINARY TRIAL ON LABORATORY-INDUCED SPAWNING OF LOKAN POLYMESODA EROSA (SOLANDER 1786)

LEE KAR FEI

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELOR OF SCIENCE

MARINE SCIENCE PROGRAMME
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITY MALAYSIA SABAH

APRIL 2009

PUMS99:1

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS@

JUDUL: Preliminary trial on laboratory-induced spawning of Polymesoda erosa (Solander 1786)

IJAZAH: Degree of Bachelor of Science

SAYA LEE KAR FEI (HURUF BESAR) SESI PENGAJIAN: 2008/2009

mengaku membenarkan tesis (LPSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:-

1. Tesis adalah hakmilik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institutsi pengajian tinggi.
4. Sila tandakan (/)

☐ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau Kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

☐ TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

☑ TIDAK TERHAD

Disahkan Oleh

(TANDATANGAN PENULIS) (TANDATANGAN PUSTAKAWAN)

Alamat Tetap: 3260-C, JLN PASIR BEDAMAR, 36000 TELUK INTAN, PERAK.

DR. MABEL MANJAJI MATSUMOTO
Nama Penyelia

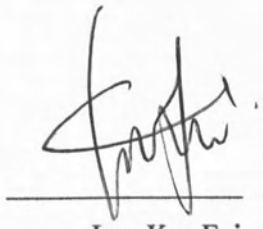
Tarikh: 11/5/2009. Tarikh: ___

CATATAN:- *Potong yang tidak berkenaan.
**Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa /organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.
@Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan atau disertai bagi pengajian secara kerja kursus dan Laporan Projek Sarjana Muda (LPSM).

DECLARATION

I declare that this dissertation is the result of my own independent work except where otherwise state.

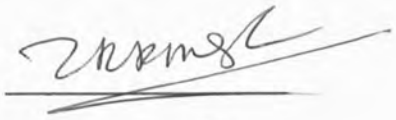
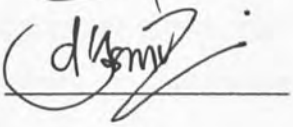
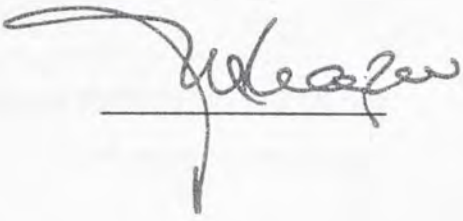
Date: 27 March 2009



Lee Kar Fei
HS2006-3002

AUTHENTATIVE

Lee Kar Fei this dissertation and was authorized by Dissertation Committee as follow the same requirement for the Degree of Bachelor of Science with honors.

Numbers of Dissertation Committee	Signature
1. CO-SUPERVISOR 1 Dr. Bernardette Mabel Manjaji Matsumoto	
2. CO-SUPERVISOR 2 Dr. Sitti Raehanah Muhamad Saleh	
3. EXAMINAR 1 DR. Sujjat Al-Azad	
4. EXAMINAR 2 Mrs. Madihah Jaffar Sidik	
5. DEAN OF SST Prof. Dr. Mohd. Harun Abdullah	

ACKNOWLEDGEMNET

This dissertation has accumulated many debt of gratitude throughout its completion. Thus, I would like to extend my heartiest appreciation to a great number of people who have contributed in my conquest of completing this dissertation would not have been successful without their full commitment.

First and foremost, I would like to give my highest gratitude to my first co-supervisor Dr. Bernardette Mabel Manjaji Matsumoto and second co-supervisor Dr. Sitti Raehanah Muhamad Saleh for giving me the opportunity to carrying out this research and their guidance and advice during the research was carried out. This project was also supported by Associate Prof. Dr. Yukinori Mukai for assisting with the histological study.

Further, gratitude is given to Devakie M. Nair, mollusc research officer from Fisheries Research Institute (FRI) in Penang for sharing species information, Dr. Annie Christianus, President of Malaysian Fisheries Society, lend a hand to identify maturity stage of species and Andrea McKey, Manager of Peter Spillett Library from Museum and Art Gallery of the Northern Territory Australia for electrical mailing me an article, after scanning it from the hard copy, which is useful to assist me completed my dissertation writing.

Lastly but not the least, appreciation is given to all the staffs in Borneo Marine Research Institute (BMRI), my family and friends for their assistance, supports and encouragement in completing this dissertation.

ABSTRACK

Kajian ini diadakan untuk mengenalpasti saiz dan kadar eksploitasi, saiz kematangan, dan percubaan peneluran aruhan terhadap lokan di dalam makmal. Tempat kajian ini terletak di Salut Bay, Kota Kinabalu (06° 06'05.5" N, 116° 09'58.5" E). Pensampelan mengadakan pada Jun-oktober 2008. Yang pertama, titik permulaan kajian terhadap lokan bermula secara temuduga daripada seorang penduduk tempatan dan menyertai aktiviti pengutipan lokan di tempat kajian. Terdapat kadar lokan dikutipkan ialah dua hingga tiga kali setiap minggu sepanjang masa kajian diadakan. Masa pengumpulan berkadar langsung dengan tempoh pasang surut dan qamari, dan frekuensi mengutip mungkin bertambah dengan permintaan pasaran. Setiap kutipan memerlukan tiga atau empat jam masa dengan "tangkapan setiap unit daya" (CPUE) 400 hingga 1000 individu lokan. Secara umumnya, lokan saiz kecil (<10 mm kelebaran cangkerang) bakal dilepaskan. Berdasarkan pemerhatian secara histologi, saiz kematangan untuk lokan adalah kira-kira 42 mm dengan kelebaran cangkerang. Dua percubaan peneluran aruhan memaparkan hasil negatif, walaupun semua pembiak baka terselamat semasa penyesuaian tempoh (34 dan 35 hari masing-masing) kecuali dua individu telah mati dari percubaan kedua. Selanjutnya bersifat histologi pemerhatian telah dikendalikan untuk menentukan peringkat kematangan pembiak baka. Keputusan berdasarkan enam spesimen (40 hingga 49 mm) daripada percubaan pertama, dan empat spesimen (50 hingga 59 mm) daripada percubaan kedua menunjukkan yang semua berada di peringkat kematangan kecuali dua spesimen iaitu satu menunjukkan fasa aktif yang lewat (Spesimen 3, 41.8 mm) manakala satu menunjukkan fasa peneluran separuh (Spesimen 6, 53.9 mm). Ini mencadangkan bahawa penyesuaian rawatan untuk pembiak baka telah berjaya, bagaimanapun, mereka menahankan gamet akibat alam mereka tersinkronisasi peneluran kelakuan. Penemuan-penemuan bagi kajian menyediakan satu gambaran jelas bagaimana lokan adalah sedang dituai dan juga kadar eksploitasi bagi sumber. Keputusan terdorong peneluran cubaan berkhidmat seperti satu perbandingan untuk kajian-kajian masa hadapan.

ABSTRACT

This research was conducted to determine the size and rate of exploitation, to determine size of maturity, and possibility of laboratory-induced spawning of lokan (*Polymesoda erosa*). The study site is nearby Salut Bay in Kota Kinabalu (06° 06'05.5" N, 116° 09'58.5" E). Sampling was conducted from June-October 2008. Baseline information about the resource was obtained primarily through interview with the locals, and actual participation at the collecting sites. Lokans were collected every week during study period, with a frequency of two to three times per week. The timing of the collecting coincided with tidal and lunar period, and the frequency of collecting might increase with market demand. Each collecting trip between three to four hours, with a catch per unit effort (CPUE) of 400 to 1000 individuals of lokans, in general, very small size (<1 cm shell width) lokans are not collected. Based on histological observations, the size of maturity of the lokan was determined to be approximately 42 mm shell width. The two induced spawning trials gave negative results, although all the broodstock survived the conditioning period (34 and 35 days, respectively) except two were dead from Trial 2. A further histological observation was conducted to determine the maturity stage of the broodstocks. The results based on six specimens (40 to 49 mm) from Trial 1, and four specimens (50 to 59 mm) from Trial 2 showed that all, except two specimens were in the ripe phase. Of the two (which were not in the ripe phase), one showed late active phase (Specimen 3, 41.8 mm), whilst the other showed partially-spawned phase (Specimen 6, 53.9 mm). This indicates that although broodstock conditioning treatment was successful, however, they retained their gametes due to their natural synchronized spawning behaviour. Findings of this study provide a clear picture how lokan are being harvested and also the exploitation rate of the resource. Results of the induced spawning trials serve as basic information for future studies.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF SYMBOLS, UNIT AND ABBREVIATIONS

%	percentage
°	Degree
°C	degree Celsius
'	minute
"	second
≤	less than or equal to
≥	more than or equal to
≈	Approximately to
N	North
E	East
mm	millimeter
Cm	centimeter
µm	micrometer
km	kilometer
mL	milliliter
L	Liter
X	multiply
a.m	Ante Meridiem
ADG	adipogranular
GPS	Global Positioning System device
VCT	vesicular connective tissue
SEAFDEC	Southeast Asian Fisheries Development Center

CHAPTER 1

INTRODUCTION

1.1 *Polymesoda erosa*

Solander is the first person who described this species from Indo-Pacific under a different genus (on it is known today) as *Vunus erosa* in 1786. Later a subgenus was introduced as *Geloina* by Gray in 1842. Present study, two synonym name of *Polymesoda (Geloina) erosa* and *Polymesoda (Geloina) coaxans* are in used.

Generally, *Polymesoda erosa* are widely distributed in Southeast Asia Countries (Carpenter and Niem, 1998). In Kota Kinabalu, Sabah, this marine organism can be commonly found in Salut Bay Sulaman Road, with the local name, known as "lokan" or commonly coined as geloina (Carpenter and Niem, 1998).

Common geloina is a brackish water mangrove clam which lives semi-infaunally on the soft sediment that accumulated around the roots of the mangrove trees

(Carpenter and Niem, 1998). In the mangrove forest of Salut Bay in Sabah, this clam can be found living together with other invertebrates such as mangrove crabs and other gastropods like *Telescopium* sp. (Ingole *et al.*, 2002). This species was closely related with other bivalve molluscs such as clams, scallops, oysters and mussels which belong to the class Bivalvia (Gosling, 2003).

Lokans are considered one of the popular commercially exploited marine organisms in Sabah. According to Morton (1976), it is a sturdy animal and has excellent attributes for mariculture. Literature reviews to date, no study has been done on the induced spawning of *Polymesoda erosa* in Sabah. However, in Hong Kong, this reproductive strategy (Morton, 1985) and reproductive biology (Gimin *et al.*, 2005) of *Polymesoda erosa* in Australia had been studied.

In the natural habitat, lokan spawned throughout the year (Morton, 1984). In Northern Australia, Gimin *et al.* (2005) stated that lokan has two spawning season which short season in September and extended season fallen on February to May. The maturation stage basically divided into active phase, ripe phase, partially-spawned phase and spent phase (Gosling, 2003; Gimin *et al.*, 2005). Moreover, during wet season, is the breeding season for *Polymesoda erosa*.

1.2 Conservation status

These common mangrove clams constitute significance shellfish resource in Southeast Asia (Morton, 1976). Presently, there is no large scale commercial fishery of lokan in Sabah, but in Salut Bay, lokan was collected at a subsistence level by the locals; these were sold as either fresh or as roasted, through road side stalls along Sulaman Road (Photo 1.1). Although the quantities harvested are small, they do represent the main source of income for a significant number of Sabah locals living near to Sulaman Road (Unid. Villager, pers.comm.). The wild stocks were quite abundant in these areas, and other mangrove-timed areas along west coast of Sabah (Manjaji Matsumoto, 2007). A sound management program of the mangrove clams can overcome future problems such as overexploitation, and could be useful for fisheries assessments and managements which were considered to be a benefit in the long term.

Photo 1.1 Lokan road side stalls along Sulaman Road.

1.3 Significance of study

In this study, preliminary survey found several locals up to five to ten packs at any one time selling lokan at road side stalls along the study area.

Lokan known has important commercial value in term of food source (Morton, 1984). The locals living in Salut Bay are basically generating income by selling lokan. Thus, this study can provide a clear picture to understand how lokan being harvested and the size and rate of exploitation being explored. Besides, there are only four published paper from internet, which is written by Brain Morton regarding the biology and morphology of the resource (1976), a review of *Polymesoda erosa* (1984), the reproductive strategy (1985), and lastly was population structure and age (1988). Gimin *et al.* (2005) has studied the aspect of the biology of *Polymesoda erosa* as well. Thus, there are no laboratory-induced spawning research has been conducted at the moment. In this study can provide base line data for conservation effort and fishery management. Further, a conservation effort such as sustainable use by restocking can be done as well. Hence, this research could give first hand information to overview the basic need structures and methods with the lowest cost to progress from this project.

1.4 Objectives of study

In this project, there are three objectives to be achieved:

1) To determine the rate and size of commercial exploitation of the resource.

2) To determine the maturation stage of *Polymesoda erosa.*

3) To determine the possibility of Lokan induced spawning by temperature shocking.

CHAPTER 2

LITERATURE REVIEW

2.1 General overview

2.1.1 Introduction of Phylum Mollusca

The phylum mollusca is one of largest, most diverse and important groups in the animal kingdom. molluscs are soft-bodied animals but most are protected by a hard protective shell or calcium carbonate shell. Inside the shell is a heavy fold tissue named as mantle. The mantle encloses the internal organs of the animal (Gosling, 2003).

There are normally divided nine classes under the phylum of Mollusca: there are class of Bivalvia, Caudofoveata, Cephalopoda, Gastropoda, Monoplacophora, polyplacophora and Scaphopoda, whereas the other two classes are known only from fossils which are the class of Helcionelloida and Rostroconchia. However, the most

important class of the living molluscs is the class Gastropoda comprising more than 80% of all living mollusc species. Table 2.1 are the classification of the phylum mollusca.

Table 2.1 The classification of the phylum mollusca.
(source: http://www.palaeos.com/Invertebrates/Molluscs/Mollusca.Phylogeny.html)

Class	**Major organisms**	**Distribution**
Caudofoveata	worm-like organisms	deep ocean
Polyplacophora	chitons	rocky marine shorelines
Monoplacophora	limpet-like organisms	deep ocean
Gastropoda	abalone, limpets, conch, nudibranchs, sea hares, sea butterfly, snails, slugs	marine, freshwater, land
Cephalopoda	squid, octopus, cuttlefish, nautilus	marine
Bivalvia	clams, oysters, scallops, mussels	marine
Scaphopoda	tusk shells	marine
Rostroconchia	fossils; probable ancestors of bivalves	—
Helcionelloida	fossils; snail-like organisms such as *Latouchella*	—

Lokan are bivalves which belong to class Bivalvia under phylum mollusca. Bivalves are the most highly modified of all the molluscs in some way. Over evolutionary time they have become flattened side to side. This class of bivalve has their shell made up of two parts or valve. The valves are drawn together by an anterior and posterior adductor muscle. When these are relaxed the shell is opened by elasticity of the ligament. Contraction of the adductor muscles closes the shell. When a bivalve dies these muscles

can no longer contract and the ligament force the shell open. A dead bivalve always has a gaping shell (Gosling, 2003).

Bivalves have no tentacle, radula, real eyes and head although they are equipped with sensory organs. Species determination is based mainly on shell characters (Cachia *et al*, 2004). Moreover, pharnyx is absent and coelom is reduced to a dorsally placed pericardium (Bhamrah and Juneja, 2001). In other words, lokan has a simple structure within the shells.

2.1.2 Distributions

Lokan are widely distributed in Southeast Asian countries (Figure 2.1), where are the blackish color highlight regions such as Indo-West Pacific region, from India to Vanuatu; north to southern islands of Japan, and south to Queensland and New Caledonia (Carpenter and Niem, 1998; Morton, 1976). Morton (1976) proposed that it is covered only by rainwater draining through the mangrove from the land *Geloina erosa* can withstand long periods of exposure, during which time it can use subterranean water contained in the burrow.

In Chorao Island, the population characteristics of this mangrove clam were studied in the intertidal mangrove intertidal habitat. The density of juvenile clams was higher in the sediment near the feeding creek, whereas the density was higher in the

REFERENCES

Avendaño, M. & Le Pennec, M. 1997. Intraspecific variation on gametogenesis in two populations of the Chilean molluscan bivalve, *Argopecten purpuratus* (Lamarck). *Aquaculture Research* **28**: 175-182.

Barber, B. J. & Blake, N. J. 1991. Reproductive physiology. In: S. Shumway (Ed.). Scallops; Biology, Ecology and Aquaculture. Elsevier, *Amsterdam* **41**: 377-428.

Bayne, B. L. Holland, D. L. Moore, M. N. Lowe, D. M. & Widdows, J. 1978. Further studies on the effects of stress in the adult on the eggs of Mytilus edulis. *Journal Malacological Biology Association* **58**: 825-841

Bhamrah, H. S. & Juneja, K. 2001. *An Introduction to Mollusca.* Anmol publications pvt. Ltd., New Delhi.

Bosch, I. 1996. Lunar periodicity of synchronous spawnings by Dreissena polymorpha in Conesus Lake, New York. Sixth International Zebra Mussel and Other Aquatic Nuisance Species Conference pg. 111

Cachia, C. Mifsud, C. & Sammut, P. M. 2004. *The Marine Mollusca of the Maltese Islands.* Backhuys publishers. Leiden.

Carpenter, K. E. & Niem, V. H. 1998. FAO species identification guide for fishery purposes: The Living Marine Resources of the Western central Pacific,seaweeds, corals, bivalves, and gastropods. *Food and Agriculture Organization of the United Nations*. Rome.

Cádenas, E. B. & Aranda, D. A. 2000. A review of reproductive pattern of bivalve mollusks from Mexico. *Bulletin of Marine Sience* **66**: 13-17

Chen, J. X. & Lovatelli, A. 1990. *Artificial Propagation of Bivalves:Techniques andMethods*. Fisheries and Aquaculture Department.

Culling, C. F. A. 1974. *Handbook of Histopathological and Hstochemical Techniques (including museum techniques).* 3rd ed. Butterworth & Co. (Publishers) Ltd. Great Britain.

Nair, D. M. June 2008. Personal Communication.

Ge´rard, A. & R. Robert. 1999. Bivalve hatchery technology: the current situation for the Pacific oyster *Crassostrea gigas* and the scallop *Pecten maximus* in France. *Aquatic Living Resource* **12**: 121-130

Gimin, R. Thinh, L. V. Mohan, R. & Griffiths, A. D. 2005. Aspects of the reproductive biology of *Polymesoda erosa* (Solander, 1786) (Bivalvia: Corbiculidae) in northern Australia. The Beagle. *Records of the Museums and Art Galleries of the Northern Territory* **21**: 37-46

Gimin, R. Mohan, R. Thinh, L. V. & Griffiths, A. D. 2004. The Relationship of Shell Dimensions and Shell Volume to Live Weight and Soft Tissue Weight in the Mangrove Clam, *Polymesoda erosa* (Solander, 1786) from northern Australia. NAGA, *WorldFish Center Quaterly* **27** No. 3 & 4.

Gosling, E. 2003. *Bivalve Mollusc: Biology Ecology and Culture.* Fishing new books. Oxford.

Groningen, R. 2007. Growth and Reproduction in Bivalves, an Energy Budget approach. Department of Marine Ecology and Evolution. Royal Netherlands Institute.

Helm, M. M. Bourne, N. & Lovatelli, A. 2004. *The Hatchery Culture of Bivalves: A Practical Manual.* Fisheries and Aquaculture Department.

Ingole, B. S. Naik, S. Furtado, R. Ansari, Z. A. & Chatterji, A. 2002. Population Characteristics of the Mangrove Clam *Polymesoda (Geloina) erosa* (Solander, 1786) in the Chorao Mangrove, Goa. National Institute of Oceanography, Dona Paula, Gao.

Joana, F. M. F. Cardosoa, D. L. José, F. L. Ana, R. M. Johannes, I. J. Wittea, P. T. & Santosc, H. W. van der Veera. 2007. Spatial Variability in Growth and Reproduction of the Pacific Oyster *Crassostrea gigas* (Thunberg, 1793) along the West European Coast. In: Groningen, R. (eds.). *Growth and Reproduction in Bivalves, an energy budget approach. Department of Marine Ecology and Evolution.* Royal Netherlands Institute. (5) 86-100.

Junelyn, S. D. L. R. 2004. *Archives.* Bar Digest research and development. Official Quarterly publication of the Burneau of Agriculture Research. **6**: No. 1.

Kim, Y. Ashton-Alcox, K. A. & Powell, E. N. 2006. Histological techniques for marine bivalve molluscs: Update. Silver Spring, MD. *National Oceanic and Atmospheric Administration Technical Memorandum National Ocean Service NCCOS* **27**: 1-76.

Manjaji Matsumoto, B. M. 2007. Fish and resources. In: Mustafa, S. & Saleh, E. (eds.). *Coastal Environmental Profile of Brunei Bay, Sabah.* Universiti Malaysia Sabah. 95-133.

Masseau, I. Bannon, P. Anctil, M. & Dubé, F. 2002. Localization and quantification of Gonad serotonin during gametogenesis of the surf clam, *Spisula solidissima. Biology bulletin* **202**: 23-33.

Modassir, Y. 2000. Effect of salinity on the toxicity of mercury in mangrove clam, *Polymesoda erosa* (lightfoot 1786). Asian Marine Society. *Asian Fisheries Science* **13**: 335-341.

Morton, B. 1976. The biology and functional morphology of the Southeast Asian mangrove bivalve, *Polymesoda (Geloina) erosa* (Solander, 1786 (Bivalvia: Corbiculidae). *Canadian Journal of Zoology* **54**: 482-500.

Morton, B. 1984. A Review of *Polymesoda (Geloina)* Gray 1842 (Bivalvia: Corbucilacae) From Indo-pacific mangrove. *Asian marine biology* **1**: 77-86.

Morton, B. 1985. The reproductive strategy of the mangrove bivalve *Polymesoda (Geloina) erosa* (Bivalvia: Corbiculidae) in Hong Kong. *Malacological Review* **18**: 83-89.

Morton, B. 1988. The population structure and age of *Polymesoda (Geloina) erosa* (Bivalvia: Corbuculacea) from a Hong Kong mangrove. *Asian Marine Biology* **5**: 107-113.

Nair, D. M. 2005. Propagation of abalone (*Haliotis asinine Linne'*) at the Fisheries Research Institute, *Penang. FRI Newsletter* **10**: No. 1.

Pronker, A. E. Nevejan, N. M. Peene, F. Geijsen, P. & Sorgeloos, P. 2008. Hatchery broodstock conditioning of the blue mussel Mytilus edulis (Linnaeus 1758). Part I. Impact of different micro-algae mixtures on broodstock performance. *Aquaculture International* **16**: 297-307

Utting, S. D. Helm, M. M. & Millican, P. F. 1991. Recent studies on the fecundity of European flat oyster (*Ostrea edulis*) spawning stock in the solent. *Journal Marine Biology Association* **71**: 909-911.

Utting, S. D. & B. E. Spencer. 1991. The hatchery culture of bivalve mollusc larvae and juveniles. MAFF Laboratory Leaflet Number 68. *Directorate of Fisheries Research* pg. 31

Utting, S. D. & P. F. Millican. 1997. Techniques for the hatchery conditioning of bivalve broodstocks and the subsequent effect on egg quality and larval viability. *Aquaculture* **155**: 45-54.

Smith, B. J. 1992. *Non-Marine Mollusca.* In Houston. W.W.K. Zoological Catalogue of Australia, Canberra: Australian Government Publishing Service.

W. Liu, A. O. Alabi & Pearce, C. M. 2008. Broodstock conditioning in the basket cockle, *Clinocardium nuttallii. Journal of Shellfish Research*, **27**: 399-404

Zaki, M. I. & Abdula, A. 1984. *The Reproduction and Development of Clarius gariepinus (Clariidae) From Lake Manzala (Egypt).* Oceanographic and Fisheries Institute, Alexandria, Arab Republic of Egypt.