Sindh Univ. Res. Jour. (Sci. Ser.) Vol.44 (2) 263-266 (2012)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)



Invasion of Channeled Apple Snail *Pomacea canaliculata*, Lamarck (Gastropoda: Ampullariidae) in Haleji Lake, Pakistan

W. A. BALOCH, U. N. MEMON, G. H. BURDI, A. N. SOOMRO, G. R. TUNIO , A. A. KHATIAN*

Department of Fresh Water Biology and Fisheries, University of Sindh, Jamshoro-76080, Sindh, Pakistan

*corresponding author: W. A. BALOCH, email: wabaloch@hotmail.com

Received 07th January 2011 and Revised 22nd March 2012)

Abstract: Golden apple snail *Pomacea canaliculata* is a highly invasive gastropod species. In Southeast Asia it was first introduced to Taiwan in 1981 for farming as food. Since then it has expanded to most of Asian countries except Indian Subcontinent. Recently it has invaded Haleji Lake, Sind, Pakistan. The invasion is linked to aquarium traders. At present dense populations can be seen along shallow beach area of the lake. To study shell morphology different body measurements including shell length, width and thickness, aperture length and width were measured. The results indicated that males are smaller than females. The coefficient of correlation showed a highly significant relationship of shell length and aperture length (r^2=0.95). The invasion of *P. canaliculata* in Indian Subcontinent puts India and Bangladesh on high risk.

Keywords: Apple Snail invasion, First record, Haleji Lake

1. INTRODUCTION

Genus *Pomacea* is native to South and Central America, parts of the Caribbean, and the southeastern U.S. It has become widely established in many areas within Southeast Asia, Sri Lanka, Guam, Hawaii, Papua New Guinea, the Dominican Republic, parts of the mainland U.S., and possibly Australia (Cowie, 2002;Joshi, 2007). The introductions of these snails have resulted mostly escape or release from plant or animal aquaculture operations or through the pet trade (Padilla, 2004).

Golden apple snail *Pomacea canaliculata* is non native mollusk to Indian subcontinent and it is believed to be native to Argentina (Joshi, 2007; Teo, 2004). It was introduced to Taiwan for the purpose of human food (Mochida, 1991) however; it became a pest of agricultural fields and brought great economic losses (Naylor, 1996). They have high reproduction rate and can even survive harsh environmental conditions such as pollution or low oxygen levels. They have demonstrated a tenacious ability to survive and spread rapidly in the freshwater habitats into which they have been introduced (Mochida, 1991). In result it is widely distributed throughout Asia (Anderson, 1993).

Haleji Lake is located at 24°47.230 N and 67°45.435 E, at an altitude of 20 m **(Fig. 1)**. Originally it was a salt-water lake. During World War II, additional water was required for troops stationed at Karachi. Salt water was drained out and an embankment was constructed around the lake which was fed by fresh water through a canal. Resultantly, Haleji Lake became one of the major sources of water supply to the increasing population as well as an exquisite refuge for waterfowl. Complete circuit of Haleji Lake is about 19 km. The main water reservoir covers an area of about 10.5 km^2 and the maximum depth being 17 feet. Shady trees surround it. Phragmites, Typha, Hydrilla and Lotus cover parts of the lake in swaying patches of colours.

Haleji Lake was declared a Wildlife Sanctuary in 1977 (Sindh Wildlife Protection Ordinance). It is a Ramsar site and hunting, fishing and recreational activities are prohibited.

* Sindh Irrigation and Drainage Authority, Hyderabad- 71000, Sindh, Pakistan

In Pakistan *Pomacea canaliculata* is recorded for the first time from Haleji Lake. It was probably introduced by the aquarium hobbyists couple of years ago. At present it is well established and widespread throughout the lake. The impact of the Apple snail population on Lake Ecosystem or on fisher folk is therefore, very important to study.

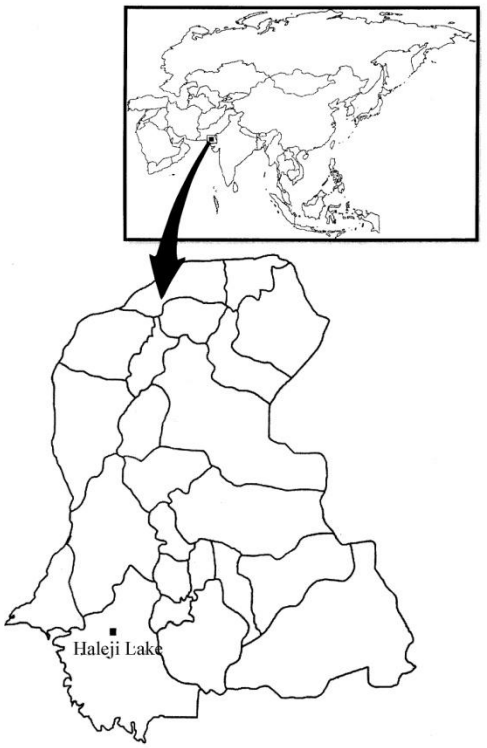


Fig. 1. Location of HALEJI LAKE (THATTA DISTRICT, SINDH, PAKISTAN).

2. MATERIALS AND METHODS

We collected live specimens by hand picking from the shallow beach near outlet of the lake. A total of 17 animals of different sizes were collected and placed in polythene bags half filled with lake water. These were brought to the laboratory where all animals were kept in aquarium for identifications and study. Different body measurements including shell length, width and thickness, aperture length and width, body whorl length and width, and operculum thickness were measured as per given measurement details **(Fig. 2)** by using Digital Vernier Caliper (Digital Caliper). The number of whorls was also counted using a magnifier equipped with light (Eschenbach). The weight of the animals was measured with an electric balance (GT 4000, OHAUS U.S.A). A description on the basis of above mentioned morphometric characters was established.

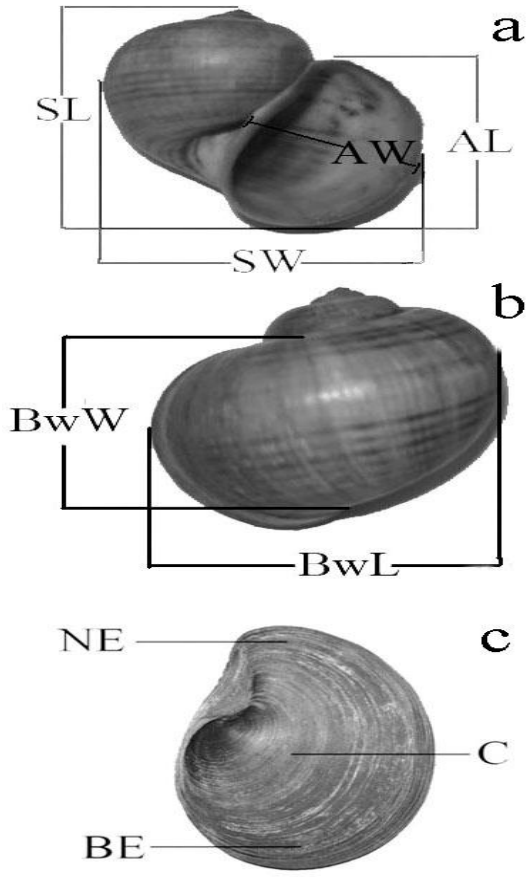


Fig. 2. Body measurements of *P. canaliculata*.

S.L= shell length, S.W= shell width, A.L= aperture length, A.W=aperture width, Bw. L=body whorl length, Bw. W=body whorl width, S.T=shell thickness, C=center, BE=broad end, NE=narrow end.

3. RESULTS AND DISCUSSION

Coloration: The color of body was yellow to brown, with horizontal black lining. In younger animals the black strips were wider than that of the older ones. These black strips narrow gradually as the snails grow. In adults the body color becomes yellowish golden with brown tinge.

***Shell size*:** The shell is rounded apparently having five whorls while a careful observation unveils very small sixth whorl when using a magnifier. The shell length (SL) varied from 36.97 to 80.21mm with an average 58.19. The shell width (SW) showed a range from 36.99 to 77.71 mm wide depending on the conditions **(Fig. 2a)**. The SL and SW showed more or less similar measurements while sometimes the width was even more than length. The operculum (aperture) is large and oval; it varied in length from 23.54 to 49.58mm whereas its width ranged in between 18.23-35.54 mm. The body whorl

is the largest portion of the body that varied in length from 26.91 to 52.30 mm, whereas its width ranged in between 31.29-54.16 mm **(Fig.2b).** Shell thickness was measured from the posterior portion. It showed a thickness range from 0.79 to 1.61mm with an average 1.13mm **(Table 1).** The operculum was moderately thick and corneous. The structure is concentric with the nucleus near the centre of the shell **(Fig. 2c)**. The mean measurements for thickness of centre, broad end and narrow end were, 0.96, 0.7 and 0.64 mm, respectively.

All the body measurements showed a significant positive relationship. Among all, the SL and OL (operculum length) showed a maximum linear correlation **(Table 2)**.

Table 1. Body measurements of *Pomacea canaliculata* from Haleji Lake.

S. No	Weight (g)	S.L (mm)	S.W (mm)	A.L (mm)	A.W (mm)	Bw.L (mm)	Bw.W (mm)	S.T (mm)
1	113	80.02	71.76	54.60	43.68	54.12	66.44	1.42
2	106	74.60	71.93	52.80	40.59	51.03	68.45	1.34
3	102.7	73.82	71.37	50.52	38.51	48.77	63.42	1.22
4	108.7	76.15	71.69	52.64	40.93	51.31	66.10	1.33
5	110	68.05	78.49	50.84	39.81	49.92	66.37	1.37
6	99.8	65.05	64.76	48.35	38.62	46.78	61.84	1.19
7	96.4	62.26	59.08	44.44	35.64	41.52	50.11	1.22
8	95.1	58.49	58.50	45.07	35.54	42.65	54.22	1.55
9	90	53.86	53.84	42.36	30.35	52.66	58.78	1.10
10	89.2	53.12	53.14	40.12	32.98	38.37	45.92	1.06
11	84.3	52.62	52.73	40.20	29.65	38.21	40.15	0.87
12	80.09	49.53	49.52	33.55	39.40	40.09	49.01	1.01
13	82	49.52	49.17	36.67	30.32	34.89	38.27	0.99
14	76	48.44	48.45	37.48	34.33	49.10	59.11	1.00
15	55.2	43.33	43.35	30.20	31.40	44.26	50.60	0.96
16	49.3	41.88	37.86	32.11	35.19	37.08	42.56	0.86
17	46	38.54	31.55	29.88	30.98	31.38	45.10	0.75
Average	87.28	58.19	56.89	42.46	35.76	44.24	54.50	1.13

S.L= shell length, S.W= shell width, A.L= aperture length, A.W= aperture width, Bw.L= body whorl length, Bw.W= body whorl width, S.T= shell thickness

Table 2. Linear Regression (coefficient of determination) for body measurements relationship.

S. No.	Measurements	r^2	S. No.	Measurements	r^2
1	W V/S SL	0.85	15	SW V/S AW	0.54
2	W V/S SW	0.91	16	SW V/S Bw.L	0.57
3	W V/S AL	0.89	17	SW V/S Bw.W	0.64
4	W V/S AW	0.42	18	SW V/S ST	0.71
5	W V/S Bw. L	0.48	19	AL V/S AW	0.52
6	W V/S Bw. W	0.49	20	AL V/S Bw.L	0.56
7	W V/S ST	0.71	21	AL V/S Bw.W	0.64
8	SL V/S SW	0.91	22	AL V/S ST	0.72
9	SL V/S AL	0.95	23	AW V/S Bw.L	0.37
10	SL V/S AW	0.63	24	AW V/S Bw.W	0.58
11	SL V/S Bw.L	0.55	25	AW V/S S.T	0.48
12	SL V/S Bw.W	0.65	26	BW.L V/S Bw.W	0.84
13	SL V/S ST	0.68	27	BW.L V/S S.T	0.45
14	SW V/S AL	0.92	28	BW.W V/S S.T	0.54

W= weight, S.L= shell length, S.W= shell width, A.L= aperture length, A.W= aperture width,,
Bw.L= body whorl length, Bw.W= body whorl width, S.T= shell thickness

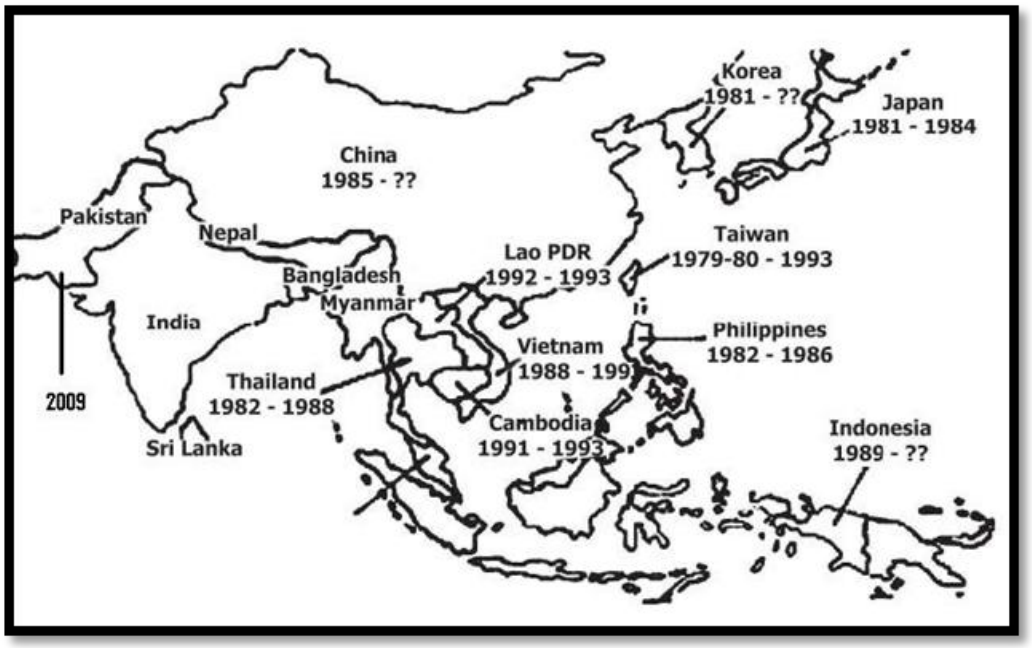


Fig. 3. Map of South-East Asia indicating the areas invaded by *P. canaliculata* (after Joshi, 2007)

The **(Fig. 4)** golden apple snail was introduced to Asia through Taiwan in 1979. Since then it has been expanding in Asia and at present it invaded most of the Asian countries in three decades. In Asia, only subcontinent was devoid of golden apple snail and Pakistan, India and Bangladesh were facing threats of invasion of this snail (Joshi, 2007). The invasion of *P. canaliculata* in Haleji Lake, Pakistan is probably a result of the pet trade. Since this snail is not yet discovered from India and Bangladesh so it did not come by nature. Invasion of *P. canaliculata* in Pakistan puts India and Bangladeh on high risk. In Bangladesh it will easily spread because that is a country of rivers and canals with frequent flooding. If invaded, it can be very harmful pest for rice fields and its control will be almost impossible. Since no study on any aspect of this snail in Haleji Lake has yet been undertaken a detailed study is therefore, required to unveil consequences or damage to the lake fauna after invasion of this exotic snail.

4. ACKNOWLEDGEMENTS

We thank Mr. Khalil-ur-Rehman Wagan and Mr. Ashraf Ali Shah, Assistant Directors Sindh Fisheries and Mr. Fazal Shah of Sindh Wildlife for providing access to lake and facilities to collect the specimens.

REFERENCES:

Anderson, B. (1993) The Philippine snail disaster. *Ecologist* **(23)**: 70-72.

Cowie, R.H. (2002) Apple snails as agricultural pests: their biology, impacts and management. In Molluscs as Crop Pests Edited by Barker GM. Wallingford: CAB International, Hawaii,145-192.

Joshi, R.C. (2007) Problems with the management of the Golden Apple Snail *Pomacea canaliculata*: an important exotic pest of rice in Asia. M.J.B. Vreysen, and J. Hendrichs (eds.) Area-wide Control of Insect Pests Springer, Netherland, 257-264.

Mochida, O. (1991) Spread of freshwater *Pomacea* snails (Pilidae, Mollusca) from Argentina to Asia**.** *Micronesica Suppl* **(3)**:51-62.

Naylor, R. (1996) Invasion in agriculture: assessing the cost of the golden apple snail in Asia. *Ambio* **(25)**: 443-448.

Padilla, D.K and S.L. (2004) Williams Beyond ballast water: aquarium and ornamental trades as sources of invasive species in aquatic ecosystems. *Front Ecol. Environ* **(2)**: 131-138.

Teo, S.S. (2004) Biology of the golden apple snail, *Pomacea canaliculata* (Lamarck, 1822), with emphasis on responses to certain environmental conditions in Sabah, Malaysia. *Molluscan Research* **(24)**: 139-148.