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Morphometric and meristic variations in different fish species of family Bagridae from Harike wetland

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Abstract
The present study was conducted to assess the morphometric and meristic variations in different species of family Bagridae reported from Harike wetland, a Ramsar site in Punjab. During the study period, three major species of family Bagridae viz. *Sperata seenghala*, *Sperata aor* and *Rita rita* were encountered in fish catch from Harike wetland. Maximum catch contribution was recorded from *S. seenghala*, followed by *Rita rita* and *S.aor*. Thirty five morphometric and six meristic characters were recorded for all three species of Bagridae. Average body weight of *S. seenghala* was reported as 800 ± 0.04 g with the range of 342- 1720 g while total length as 53.72 ± 1.08 with the range of 41-69 cm. *S. aor* represented average weight of captured fish 820 ± 0.11g with the range of 326- 1082 g while total length as 55.9 ± 3.02 with the range of 42-62.5 cm. *Rita rita* represented average weight of captured fish 407 ± 0.04g with the range of 164- 728 g while total length as 31.01 ± 1.16 with the range of 24-33 cm. In reference to meristic characters, total four number of barbels viz. maxillary, inner mandibular, outer mandibular and nasal barbels were reported from *S. seenghala* and *S.aor* while *R. rita* was reported with three pairs with absence of one mandibular barble. All the reported species showed considerable variations in their morphometric and meristic characters and represented the role of morphometric studies in species identification and measuring discreteness and relationships among various taxonomic categories.

Keywords: Morphometry, catfishes, Bagridae, Harike wetland

Introduction

Among inland aquatic resources of the country, the wetlands are biologically rich sensitive ecosystems that support unique aquatic biodiversity and also recognized for their role in conserving fish diversity, as wetland environments are used by fishes as a refuge for breeding, feeding and nesting purposes [1]. Harike, one of the largest man made wetland of Northern India, is situated in the state of Punjab. This wetland was declared as 'Ramsar' site by International Union for Conservation of Nature (IUCN) in 1990 making it a wetland of international significance and priority zone for "Biodiversity conservation". Being at the confluence of two major rivers viz. Sutlej and Beas, this wetland is an important fisheries resource of the state. In year 2014, a total of 51 fish species have been recorded belonging to 17 families from Harike wetland [2], whereby year 2017, it was recorded to only 37 fish species and these belong to 14 families [3]. Maximum number of species (16) recorded under family Cyprinidae followed by Bagridae (4 species), Siluridae (3 species), Channidae, Cobitidae, Anabantidae, Mastacembalidae and Notopteridae, Sisoridae, Ambassidae, Schilbeidae, Poeciliidae, Gobidae, Nandidae, Belonidae.

Bagridae is the most dominant family of catfishes at Harike wetland. The major species belong to this family are *Sperata seenghala, S. aor* and *Rita rita* and various species of *Mystus*. Among them, *S. seenghala, S. aor and R. rita* forming a major fishery portion at Harike wetland. The morphometric parameters are used to differentiate the species taxonomically, identifying the stock of fish and separate different morphotypes [4, 5, 6]. Besides it, growth of different body parts is proportional to the total length of fish, in reference to this, morphometric measurement of fishes and the study of their relationship with total length is also essential for taxonomic study of a species [7]. The published data regarding morphometric studies of fishes from Harike wetland is negligible. In present study, analysis of relationship between total length (TL) and selected morphometric parameters of combined sexes of different bagrid species have been performed which will be helpful for correct identification of

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species, understanding their growth pattern and suitability of habitat at Harike wetland.

Materials and Methods

Fish catch composition from Harike wetland was observed at nearby landing centre / fish market. During the study period (March-Nov 2017), three major species of family Bagridae viz. *Sperata seenghala*, *Sperata aor* and *Rita rita* were encountered in fish catch from Harike wetland. Fishes encountered in catch were assessed up to species level with the help of taxonomic key [8, 9, 10]. These assessments were further revalidated with the information at www.fishbase.org. A total of 68 specimens of all three species of family Bagridae were collected for length-weight studies. Morphometric characters were measured with the help of wooden measuring board and measuring scales to the closest 0.1cm. All the fish samples were weighed on an electronic balance closest to 0.01g.

Morphometric and meristic characters were studied as per described method [11]. Linear regression analysis and coefficient of correlation (r) were calculated to determine the relationship between total body length (TL) and studied morphometric and meristic characters. These length relationships were represented by the equation as $Y = a + bX$

Where, Y= a dependent variable (various body lengths)
X = an independent variable (total length)
a = constant (intercept)
b = regression coefficient (slope)

The significance of regression was assessed by using ANOVA at 5% significance level ($p<0.05$). The p-values obtained indicated that the relationship between two variables was statistically significant at 5% level. The statistical analysis was performed using SPSS software ver. 16.0.

Results and Discussion

A total of three species of family Bagridae viz. *Sperata seenghala*, *S. aor* and *Rita rita* were recorded in catch composition from Harike wetland during the study period. Out of this, maximum catch contribution was recorded from *S. seenghala*, followed by *Rita rita* and minimum of *S. aor*. A total of thirty five morphometric and six meristic characters were recorded for all three species of Bagridae reported from Harike wetland. In present study, maximum weight among all three species captured from Harike wetland was recorded for *S. seenghala* (1720 g) followed by *S. aor* (1082 g) and *R. rita* (728 g). However, highest average weight was recorded for *S. aor* (820 g) followed by *S. seenghala* (800 g) and *R. rita* (407 g).

Table 1: Means and standard deviation of moprphometric characters and meristic counts among different species of family Bagridae at Harike wetland

S. No.	Characters	S. seenghala			S. aor			R. rita		
1		*Mean ±SE*	*Min*	*Max*	*Mean ±SE*	*Min*	*Max*	*Mean ±SE*	*Min*	*Max*
2	Weight (g)	800.00±0.04	342	1720	820±0.11	326	1082	407±0.04	164	728
3	Total length	53.72±1.08	41	69	55.9±3.02	42	62.5	31.01±1.16	24	33
4	Standard Length	41.86±0.89	32	56	42.91±2.35	32.5	48	25.41±0.99	23	27
5	Fork Length	43.58±0.93	33.5	57	44.53±2.37	34	49.5	27.1±1.05	22	28.5
6	Head length	10.39±0.20	8	16	10.33±0.66	8	12	7.11±0.25	6	8.5
7	Head depth	2.81±0.11	1.5	4	4.25±0.52	2.2	5.5	4.18±0.35	6	8.5
8	Snout length	4.30±0.14	2.4	7	4.33±0.40	3.2	5	3.4±0.36	1.5	4.3
9	Eye diameter	0.86±0.03	0.4	1.6	0.91±0.08	0.5	1.0	0.42±0.03	0.3	0.7
10	Inter-orbit length	3.05±0.10	2.2	5.1	3.35±0.17	3	4	3.56±0.16	3	4.1
11	Pre-dorsal length	17.33±0.40	11	24.1	14.3±1.62	10	20	10.96±0.36	9.5	14
12	Pre-pectoral length	35.07±0.22	8.5	17	10.85±0.55	9.5	12.5	6.35±0.27	5	8
13	Pre-pelvic length	23.00±0.48	18	32.3	22.33±1.17	18	26	14.13±0.51	11.5	18
14	Pre-anal length	32.52±0.77	25	47.5	33.16±1.95	25	38.5	19.18±0.78	16	25
15	Height of Dorsal fin	8.13±0.21	6	12.5	9.16±0.74	6	11	6.99±2.09	4.5	11
16	Body depth	6.67±0.17	4.5	12	7.08±0.31	6	8	5.03±0.41	3.5	7.4
17	Caudal fin depth	12.26±0.32	10.4	18	10.21±1.66	3.5	13	4.90±0.45	2.9	8.4
18	Caudal peduncle length	3.90±0.16	1.5	6	4.00±0.65	2	6.3	2.61±0.23	1.5	3.9
19	Anal fin length	5.04±0.36	2.5	15.2	5.65±1.23	2	11	3.55±0.17	3	4.5
20	Caudal peduncle depth	2.30±0.05	1.6	3	2.73±0.63	2	4	1.87±0.13	1.5	2.5
21	Upper jaw length	5.34±0.23	4.5	6	3.60±0.30	3	4	3.17±0.30	2.4	3.8
22	Lower jaw length	0.79±0.18	3.5	5	0.52±0.33	2.5	3.5	2.62±0.24	2	3.1
23	Depth b/w upper &lower jaw	2.97±0.20	2	4.3	1.36±0.39	0.6	1.9	1.67±0.24	1	2.1
24	Pre-orbit length	4.30±0.14	2.4	7	4.33±040	3.2	5	3.4±0.36	1.5	4.3
25	Post- orbit length	4.13±0.17	2.5	6	4.06±0.56	3	4.9	3.17±0.46	2	4.5
26	Maxillary barbel length	18.77±0.36	14.5	22	28.86±1.44	31	26.1	4.7±0.27	4	5.9
27	Nasal barbel length	2.05±0.04	1.3	2.6	3.00±0.36	2.3	3.5	0.58±0.07	0.4	1
28	Inner mandibular barbel length	4.27±0.09	3	6	3.33±0.24	3	3.8	4.12±0.25	3.2	5
29	Outer mandibular barbel length	6.17±0.14	4	8	6.5±0.28	6	7	-	-	-
30	Length b/w adipose and dorsal fin	6.18±0.14	4.5	8	3.56±0.33	2.9	4	5.27±0.25	4.5	6.3
31	Length of dorsal fin base	4.82±0.08	3.5	6	5.9±0.55	5.2	7	3.96±0.18	3.2	4.5
32	Length of dorsal adipose	5.96±0.10	4.2	7.5	10.00±0.86	8.5	11.5	3.8±0.31	2.5	4.8
33	Adipose fin length	1.59±0.05	1	2.2	3.46±0.63	2.2	4.2	1.125±0.12	1	1.5
34	Pelvic fin length	2.83±0.25	1	5.8	5.66±0.35	5	6.2	2.18±0.33	1	3
35	Pectoral fin length	3.39±0.35	1	6	6.2±0.41	5.6	7	3.94±0.75	1.8	6
36	Anal fin length	5.04±0.36	2.5	15.2	5.65±1.74	2	11	3.55±0.17	3	4.5

All the lengths were measured in cm

Table 2: Means and standard deviation of meristic counts among different species of family Bagridae at Harike wetland

Meristic Characters			
Characters	*S. seenghala*	*S. aor*	*R. rita*
Number of barbels	04	04	03
Dorsal fin rays (spiny / soft)	9.00±0.17	8.00±0.23	8.00±0.28
Pectoral fin rays	10.00±0.14	10.00±1.41	9.00±0.15
Ventral fin rays	6.00±0.15	8.66±1.70	7.45±0.31
Anal fin rays	11.00±0.17	10.00±0.42	8.90±0.56
Caudal fin rays	20.00±0.27	18.00±0.89	17.72±0.93
Fin formula	D.1 /8 I 0, P. 1/9, V. 0/6, A.0 /10	D.1 /7 I 0, P. 1/9, V. 0/8, A.0 /10	D.1 /7 I 0, P. 1/8, V. 0/7 A.0 /9

In the present study, both morphometric and meristic characters were studied to identify the phenotypic differences among the three Bagrid species. Morphometric data were found to be continuous and more subjected to changes with environmental condition, while meristic data are discrete and fixed during the early stages of life [12]. These morphometric variations or biometric analysis has been studied by various researchers to identify and find out the variations in different

fish stocks at species level [13, 14, 15]. The fact is observed universally that growth of the fish or any other organism was found to be increased with increase in body length. Hence growth of various body parts is interconnected with body length [16]. In this study, the linear regression equation was observed to observe the relation between different morphological parameters (assumed as 'Y') and the total length (assumed as 'X') of different species (Table 4,5,6).

Table 3: Relative estimate of morphometric characters of different species of family Bagridae as a function of total length (TL)

S. No.	Morphometric Character	*S. seenghala* (%TL)	*S. aor* (%TL)	*R. rita* (%TL)
1	Standard Length	77	76	81
2	Fork Length	81	79	87
3	Head length	19	18	22
4	Head depth	5	7	13
5	Snout length	8	7	10
6	Eye diameter	1	1	1
7	Inter-orbit length	5	5	11
8	Pre-dorsal length	32	25	35
9	Pre-pectoral length	20	19	20
10	Pre-pelvic length	42	39	45
11	Pre-anal length	60	59	61
12	Height of Dorsal fin	15	16	22
13	Body depth	12	12	16
14	Caudal fin length	9	8	8
15	Caudal peduncle depth	12	6	7
16	Anal fin length	9	10	11
17	Caudal peduncle depth	24	18	17
18	Upper jaw length	9	6	10
19	Lower jaw length	8	5	8
20	Depth b/w upper &lower jaw	5	2	5
21	Pre-orbit length	5	6	5
22	Post- orbit length	7	7	10
23	Maxillary barbel length	34	51	15
24	Nasal barbel length	3	5	1
25	Inner mandibular barbel length	7	5	13
26	Outer mandibular barbel length	11	11	---
27	Length b/w adipose and dorsal fin	11	6	16
28	Length of dorsal fin base	8	10	12
29	Length of dorsal adipose	11	17	12
30	Adipose fin length	2	6	3
31	Pelvic fin length	5	10	7
32	Pectoral fin length	6	11	12
33	Anal fin length	9	10	11

All the lengths were measured in cm

In all three bagridae catfishes under present study, morphometric characters like fork length, standard length, pre-anal length were found to be highly correlated with that of the total length (TL) and the minimum correlation was observed with eye diameter (ED), nasal barble legth (NBL) and adipose fin length (AdFL). Similar findings were reported in all three species of family Bagridae from Harike wetland

[17]. The characters having a higher correlation with TL indicated their growth along with increase in TL. However, low correlation of different characters with TL revealed least growth changes in these characters with increasing TL.
Out of the major 14 morphometric characters, the highly significant correlation coefficients were observed with body weight, standard length, fork length and pre-pelvic length for

all three species (Table 4, 5, 6). Such significant relationships among the different morphometric parameters revealed that various fish species exhibited characteristic morphological features [18]. In contrary to this, the relationship recorded for remaining morphometric characters were found to be varied among the three species of family bagridae. All these body characters were growing with a different rate in all these studied species. The results were also supported by the fact that the growth rate of various morphological parameters in relation to total length was found to be varied from species to species [13]. The overall result of linear regression analysis of

various morphometric characters of the selected bagrid species showed varied relation with total length. In *S. seenghala*, selected maorphometric variables (wt, FL, SL, PrePL, PrePecL, PreAL,) showed strong correlation with the total length. The growth of all such parameters of *S. seenghala* was found to be in linear fashion with increase in total length of fish (Table 4) which was in agreement with other researchers who observed this linear relationship in other species [19]. Morphometric parameters like- body depth (BD), dorsal fin base length (DFBL), anal fin base length (AFBL) showed moderate correlation with increase in length.

Table 4: Linear regression relationship between total body length (TL) and various morphometric parameters *of S. seenghala* from Harike wetland

Relationships	a	b	r^2	r
TL vs Wt	-4.326	2.749	0.905	0.951
TL vs FL	0.017	0.939	0.857	0.926
TL vs SL	0.079	0.917	0.798	0.893
TL vs HL	2.496	0.634	0.814	0.860
TL vs SnoutL	-1.546	0.749	0.849	0.880
TL vs BD	-1.536	0.860	0.520	0.721
TL vs PDL	-0.282	0.779	0.482	0.694
TL vs PrePL	-0.610	0.940	0.861	0.931
TL vs PrePecL	-0.965	0.846	0.805	0.897
TL vs PreAL	-0.606	1.025	0.849	0.921
TL vs CPL	-2.392	0.932	0.168	0.409
TL vs CPD	-0.335	0.296	0.059	0.242
TL vs DFBL	-1.58	0.804	0.59	0.769
TL vs AFBL	-1.068	0.726	0.50	0.707

In case of *S. aor*, regression analysis of morphometric parameters showed varied correlation with total length of the fish presented in table 5. Most of the parameters showed strong correlation with 'r' value of >0.7. In case of *R. rita*,

head length (HL) of fish showed poor correlation with 'r' value of 0.45 (Table 6) which was in contrast to that of *S. seenghala* and *S. aor.*

Table 5: Linear regression relationship between total body length (TL) and different morphometric parameters *of S. aor* from Harike wetland

Relationships	a	b	r^2	r
TL vs Wt	-5.492	3.023	0.970	0.985
TL vs FL	0.017	0.939	0.940	0.969
TL vs SL	-0.219	0.988	0.961	0.980
TL vs HL	1.768	1.019	0.831	0.912
TL vs SnoutL	-5.51	1.73	0.849	0.922
TL vs BD	-0.45	0.598	0.629	0.793
TL vs PDL	0.028	2.5	0.00	0.715
TL vs PrePL	0.065	0.755	0.688	0.830
TL vs PrePecL	-0.84	0.613	0.508	0.713
TL vs PreAL	-0.505	0.995	0.876	0.936
TL vs CPL	-4.18	1.37	0.231	0.481
TL vs CPD	-1.669	7.72	0.103	0.321
TL vs DFBL	-6.82	2.11	0.969	0.940
TL vs AFBL	-5.15	1.83	0.772	0.879

Table 6: Linear regression relationship between total body length (TL) and various morphometric parameters of *Rita rita* from Harike wetland

Relationships	a	b	r^2	r
TL vs Wt	-4.519	3.050	0.843	0.918
TL vs SL	-0.179	0.994	0.942	0.970
TL vs FL	-0.107	0.992	0.957	0.978
TL vs HL	-0.305	0.659	0.452	0.872
TL vs SnoutL	-2.29	1.009	0.116	0.841
TL vs BD	-4.73	1.84	0.70	0.837
TL vs PDL	0.67	0.678	0.654	0.809
TL vs PrePL	-0.508	0.919	0.927	0.963
TL vs PrePecL	-0.804	0.771	0.468	0.684
TL vsPreAL	-0.358	0.964	0.844	0.919
TL vs CPL	-1.25	0.633	0.67	0.260
TL vs CPD	-2.42	0.871	0.166	0.407
TL vs DFBL	-2.25	1.034	0.460	0.678
TL vs AFBL	-2.24	1.014	0.166	0.407

In present study, the growth of many morphometric characters in all three bagrids was found to be linear, but did not always in proportional to the increase in the total length of fish. However, the correlation between other variables like weight, standard length, fork length, head length revealed positive and strong relationships with the total length (TL). Higher values of coefficient of determination (r^2>0.9) in regression analysis revealed confidence in the information generated. However, lower values of r^2 (<0.7) for some parameters might be due to inconsideration of outliers in the LWR calculation [20].

All meristic characters (including number of barbels, counts of soft and spiny rays of dorsal, pectoral, pelvic and anal fin) observed in the present study were in the same ranges with few modifications (in no. of rays) as described [8, 9, 10]. Significant differences (p<0.05) were also noted between the mean values observed for each morphometric character among the three bagaridae species, indicating that these species were phenotypically different from each other. Thus, morphometric analysis has been considered as useful tools for separating the species, populations or geographical variants.

In the present investigation, the studied bagrid species showed clear differentiation in their morphometric measurements and meristic counts. The present result was in agreement with other studies [14, 19, 21, 22], who also reported the linear relationships between TL versus different morphological characters for observing the phenotypic similarities or differences among the different fish species or populations.

Morphological variation, based on variation in body colour, length of mouth, snout, length of barbells and length between dorsal and adipose fin, suggested significant differentiation among the studied species. Meristic counts such as spines and soft rays of dorsal, anal, pectoral and pelvic fins will remain constant with changes in the body length of all three bagridae species in this study, indicating that meristic characters are independent of body size and therefore, will not be increases with increase in the length of fish, which was in consistency with studies for *Liza parsia* [19].

Conclusions
The morphometric measurements among the species of family bagridae showed variations indicating that these species are phenotypically different from each other. In present study, most of the morphometric parameters showed positive correlation with increase in total length indicating the normal growth pattern of bagrid catfishes in Harike wetland. Such studies will be helpful in determining the correlations of these morphological variables with the total length of fish and also give idea about the growth pattern and suitability of habitat for the fishes.

Acknowledgement

References
1. Wetzel RG. Light in Inland Waters. Limnology, 2001, 49-69.
2. Jindal R, Singh H, Sharma C. Fish diversity of Pong dam reservoir and Harike wetland. International Journal of Applied Sciences and Engineering Research. 2014; 3(1):232-240.
3. Kaur H, Datta SN, Singh A. Fish catch composition and biodiversity indices at Harike Wetland- A Ramsar Site in India. Journal of Animal Research. 2017; 7(5):935-941.
4. Jayaprakash AA. A note on a Sciaenid *Johnieops sina* with three anal spines. Indian Journal of Fisheries. 1974; 21(2):569-570.
5. Lourie SA, Pritchard JC, Casey S, Hall HJ, Vincent ACJ. The taxonomy of Vietnam's exploited seahorses (Family: Syngnathidae). Biological Journal of the Linnean Society. 1999; 66:231-256.
6. Kumar T, Chakraborty SK, Jaiswar AK, Panda D. Biometric studies on *Johnieops sina* along Ratnagiri coast of Maharashtra. Indian Journal of Fisheries. 2012; 59(1):7-13.
7. Tandon KK, Johal MS, Bala S. Morphometry of *Cirrhinus reba* from Kanjli wetland, Punjab, India. Res Bull Punjab Univ Sci. 1993; 43(1-4):73-78.
8. Jayaram KC. The Freshwater fishes of the Indian region. Narendra Publishing House, Delhi, India, 1999.
9. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. Oxford and IBH publishing co., New Delhi, 1991.
10. Jhingran VG. Fish & Fisheries of India. Hindustan Publication Corporation, New Delhi, 1999.
11. Manimegalai M, Karthikeyeni S, Vasanth S, Ganesh SA, Vijayakumar TS, Subramanian P. Morphometric Analysis – A tool to identify the different variants in a fish species *Etroplus maculatus*. International Journal of Environmental Sciences. 2010; 1(4):481-492.
12. Turan C, Oral M, Öztürk B, Düzgüneş E. Morphometric and meristic variation between stocks of Bluefish (*Pomatomus saltatrix*) in the Black, Marmara, Aegean and northeastern Mediterranean Seas. Fisheries Research. 2006; 79(1-2):139-147.
13. Begum M, Mamun AA, Islam ML, Alam MJ. Morphometric characters and their relationship in estuarine catfish. Journal of Bangladesh Agricultural University. 2008; 6(2):349-353.
14. Mekkawy IAA, Mohammad SA. Marphometrics and meristics of the three Epinepheline species: *Cephalopholis argus*, *Cephalopholis miniata* and *Variola louti* from the Red sea, Egypt. Journal of Biological Sciences. 2011; 11(1):10-21.
15. Satyanarayana Murthy CHV, Ratnakumari. Morphometric, meristic and comparative studies of Mystus three species (family- Bagridae) from two different habitats of Andhra Pradesh, India. Indian Journal of Biology. 2018; 5(1):44-52.
16. Ranjini PK, Bijoy NS. Length-weight relationship, condition factor and morphometry of gold spot mullet *Liza parsia* from Cochin estuary, Indian Journal of Geo-Marine Sciences. 2011; 40(4):567-571.
17. Singh A. Hydro-biological studies of Harike wetland, Punjab with special reference to biology, biometric characteristics and diversity of family Bagridae -Master's Thesis. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, 2017
18. Moutopoulos DK, Stergiou KI. Length-weight and length-length relationships of fish species from Aegean Sea (Greece), Journal of Applied Ichthyology. 2002; 18:200-203.
19. Zubia M, Rehana YF, Katselis G, Omer MT, Lakht-e-Zehra, Hossain YM *et al*. Comparative survey of morphometric and meristic studies of four mullet species

of family Mugilidae from Pakistan in relation to total body length. Indian Journal of Geo-Marine Sciences. 2015; 44(4):1-13.

20. Osborne JW, Amy O. The power of outliers (and why researchers should always check for them), Practical Assessment, Research and Evaluation. 2004; 9:1-12.

21. Iqbal MM, Alam MMM, Kabir MA, Palsson S. Morphological and mitochondrial DNA variation revealed an undescribed lineage under the genus *Sperata* (Bagridae) in Bangladesh. Acta Zool. 2018; 99:177-187.

22. Simon KD, Bakar Y, Temple SE, Mazlan AG. Morphometric and meristic variation in two congeneric archer fishes *Toxotes chatareus* and *Toxotes jaculatrix* inhabiting Malaysian coastal waters. Journal of Zhejiang University-SCIENCE B (Biomedicine & Biotechnology). 2010; 11(11):871-879.