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Yu-Hai Kong
*Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan, R.O.C.*

I-Shiung Chen
*Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan, R.O.C.*, isc@ntou.edu.tw

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# REPRODUCTIVE BIOLOGY OF INTERTIDAL FRILLFIN GOBY, *Bathygobius fuscus* IN KEELUNG, TAIWAN

Yu-Hai Kong and I-Shiung Chen

Key words: Gonadosomatic index, *Bathygobius*, Keelung, Taiwan.

## ABSTRACT

The reproductive biology of intertidal, black brown frillfin goby, *Bathygobius fuscus* (Rüppell) have been surveyed from the coastal region of Keelung, Taiwan. The species always belongs to the dominant species found in the fish community of the tidal pools for different seasons. The overall fecundity of adult female is from 2335 to 13332 eggs with the average of 5605 eggs with average eggs-size is 0.34 ± 0.06 mm. The female minimum measure body-size would be 40.4 mm SL. The higher reproductive season can be well observed from female GSI (Gonadosomatic Index) during May to September. During that time, there may represent more abundant food sources to host its offspring as well as more suitable climate.

## I. INTRODUCTION

Gobioid fishes are very important benthic fish fauna of intertidal especially for the most temperate and tropical Indo-pacific region. The genus of frillfin goby, *Bathygobius* belongs to the member of Family Gobiidae occurring in marine, brackish and freshwater of the tropical and temperate regions of the World [4, 5]. The genus, *Bathygobius* is also a very important member of gobiid fishes in shallow waters of West Pacific with body size about 3-10 cm long. In order to realize the seasonally ecological change for the breeding of intertidal gobies from northern Taiwan. Most of them are bottom dwelling carnivores of small benthic invertebrates, some are planktivores [4].

The black brown frillfin goby, *Bathygobius fuscus* (Rüppell, 1830) [14] is rather common species in western and northern coast of Taiwan. The reproduction pattern of this goby has never been surveyed in Taiwanese waters. Herein we started to investigate the reproductive biological features for the intertidal gobiid fish, *Bathygobius fuscus* by our recently monthly collected samples from intertidal regions from northern Taiwan since November, 2010. The round-year reproduction exchange of this goby for realizing those reproductive parameters will be presented and formally documented in this paper.

*Paper submitted 10/30/13; revised 12/10/13; accepted 12/19/13. Author for correspondence: I-Shiung Chen (e-mail: isc@ntou.edu.tw).*
*Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan, R.O.C.*

## II. MATERIALS AND METHODS

All *Bathygobius fuscus* were collected monthly by hand-net from the intertidal pools of northern Taiwan during 2010 to 2011 during the low tide period. The sampling site is located in the coastal region of Chiao-Jin, Keelung, Taiwan which is beach site of new construction building of National Museum of Marine Science and Technology. Three key parameters for reproduction of *Bathygobius* were conducted as following parameters. All fish specimens were preserved in 10% formalin then transferred into 70% alcohol before the use of sample analysis.

(1) Gonadosomatic Index (GSI)
GSI = $GW/BW \times 10^2$ (GW: gonad weight, BW: body weight)
(2) Hepatosomatic index (HSI)
HIS = $LW/BW \times 10^2$ (LW: liver weight; BW: boy weight)
(3) Condition factor (CF)
CF = $BW/SL^3 \times 10^5$ (BW: body weight; SL: standard length)

The ripe egg-size from ovary of adult female were measured and the number of eggs were calculated under the microscope. The male and female distinctions in adult can be used morphologically by the distinct shape patterns of urogenital papillae.

## III. RESULTS

In November 2010 to December 2011, the black brown frillfin goby, *Bathygobius fuscus* were collected monthly by hand-net from the tidal pools of Chiaojin, Keelung, Taiwan. *Bathygobius fuscus* is the dominant species of coexist gobiid

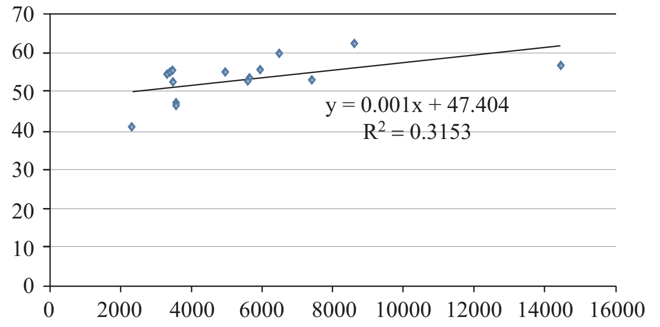


**Fig. 1. The inter-relationship of fecundity (X-axis) and body length (Y-axis) of adult female *Bathygobius fuscus.***

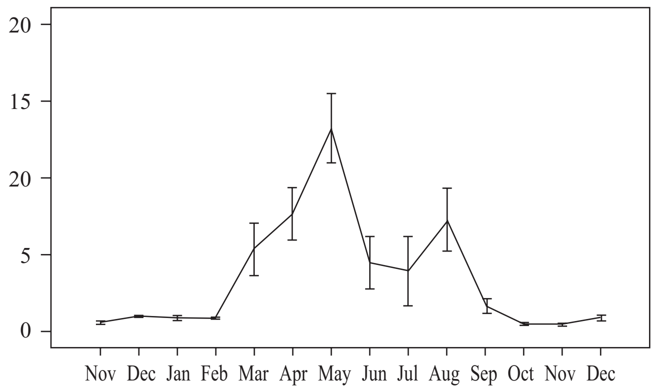


**Fig. 2. The monthly fluctuation of GSI (Y-axis) of *Bathygobius fuscus* in Keelung, Taiwan.**

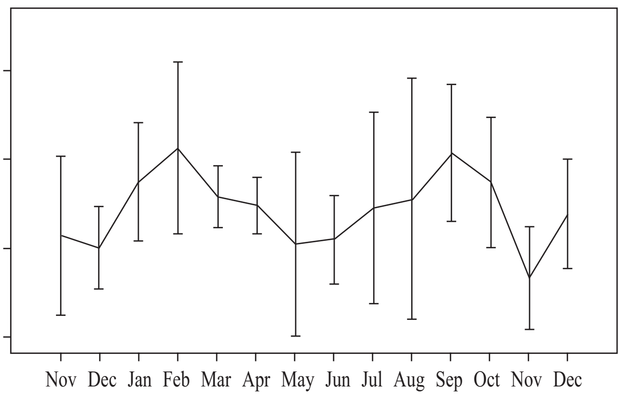


**Fig. 3. The monthly fluctuation of HSI (Y-axis) of *Bathygobius fuscus* in Keelung, Taiwan.**

fishes. The congeners of *Bathygobius* are also founded as both *Bathygobius cocosensis* and *Bathygobius cyclopterus* from the same locality of the year. The specimens of adult fishes were observed with very conspicuous sexual dimorphism as the fin pattern and the distinct urogenital apparatus which can be well recognized by these superficial characters.

### Minminal body-size measured from adult females

Among the 239 female individuals collected from field trips of the whole year, the minimal measured body size of matured female with ripe eggs would be as the minimal body size as 40.4 mm SL.

### Egg size and fecundity

The ripe egg size of female ranges would be 0.21-0.43 mm, the average size would be 0.34 ± 0.06 mm. The overall fecundity of adult female is ranging from 2335 to 13332 eggs. The average fecundity of females would be 5605 ± 2983 eggs. The inter-relationship of fecundity (X-axis) and body length (Y-axis) of adult female *Bathygobius fuscus* is shown in Fig. 1.

### Seasonal change of Gonadosomatic Index (GSI)

The range of real GSI fluctuation of *Bathygobius fuscus* would be 0.5-13.5. The monthly GSIs in female *B. fuscus* are represented in Fig. 2. The trend of distinct increase of GSI can be seen during February to May. The major peak is up to highest value in May (13.5). The trend of decrease of GSI during May to July, also August to September. It can be seen as the lower value as non-breeding season during the coming winter, from September to December, even to February if can be predicted as following months in next year. The result would strongly suggest that the breeding reason for *Bathygobius fuscus* is mainly occurred on the spring to summer: February to May (higher peak), then also July to September (lower peak) in northern Taiwan.

### Seasonal change of Hepatosomatic Index (HSI)

The range of HSI fluctuation would be 1.25-4.05. The monthly HSIs in female *B. fuscus* are represented in Fig. 3.

The value would be increased up to 4.05 in February. The trend of decrease during February to September. The lowest value would be during September to November down to 1.25. The increase trend would be started after November. The pattern of HSI fluctuation is rather reasonable, the fish is spending more energy for spawning from the spring, the higher cost is represented for lower HSI soon after its spawning season. The step by step increase of more energy for fish nutrition recruitment after breeding period would be very beneficial for preparing next year reproduction success.

### Condition Factor (CF)

The range of condition factor would be 2.03-2.72. The monthly CFs in female *B. fuscus* are represented in Fig. 4. The trend of increase would be started after June. The highest value would be seen in 2.72 in August. The trend of decrease would be in August to November.

## IV. DISCUSSION

The size of the fish egg diameter reproductive strategies play an important role, affecting the size of fish larvae, growth rate, survival rate, and the number of mature female fish fecundity, the small egg size of fish represents a smaller larvae with usually longer planktonic larval duration also require a

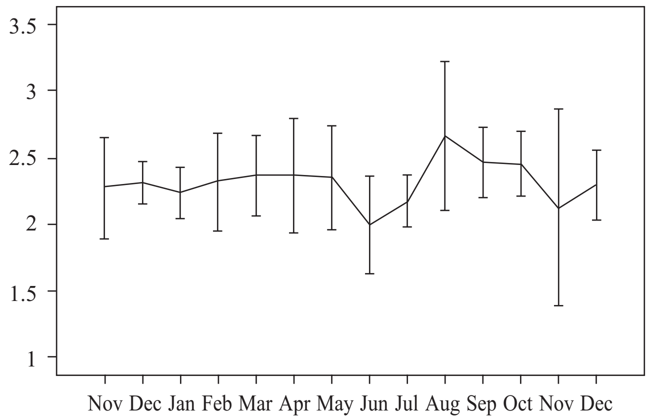


**Fig. 4. The monthly fluctuation of CF (Y-axis) of *Bathygobius fuscus* in Keelung, Taiwan.**

longer period drift in ocean [8-10]. The egg size of the frillfin goby is even smaller than the coastal, coral-reef goby, *Eviota prasina* [9]. However, its size is certainly much smaller than most land-locked members of freshwater *Rhinogobius* species [8, Chen, unpublished data].

GSI could be successfully employed to evaluate the real breeding seasons of fishes during the whole year [11, 12]; HSI and CF may reflect the status of fish energy storage, the HSI of the fish can reflect the physical condition of high index indicates fish store energy, may be ready to reproductive or overcoming the bad winter, the index is low which means fish consume large amounts of energy or in the shortage for food rescources [2]. While the food resources becnomes more plentiful, CF value would also increases [2, 13]. During the early reproductive season, HSI of the fish usually declines firstly [5, 7].

Unlike the congener, *Bathygobius soporator* in west Africa, the sex-ratio (male to female) from field collections of *Bathygobius fuscus* are about equal in all adult fish samples in Keelung, Taiwan (Kong, unpublished data), but *Bathygobius soporator* in Nigeria, Africa represents with strongly sex-ratio bias for 99% of male individuals from field collections [4]. It would also be suggested that *Bathygobius soporator* may belong to protandrous hermaphrodite [3, 4], a situation where at a certain age may change sex.

If the fishes in the lack of food, when females tend to produce larger, fewer eggs, when food is plentiful, the female then outputs the smaller, more eggs, and the reproductive energy an increase in the number of eggs investment [6, 7]. Within the intertidal zone, there are found with many nutrients, and it would provide a number of food sources for invertebrates, and these invertebrates would became the food source of the goby. The good CF during spring may restore better energy status for entering next coming breeding seasons.

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