Effects of habitat geology and pH value on body color and morphology of Rhinogobius rubromaculatus and species identification

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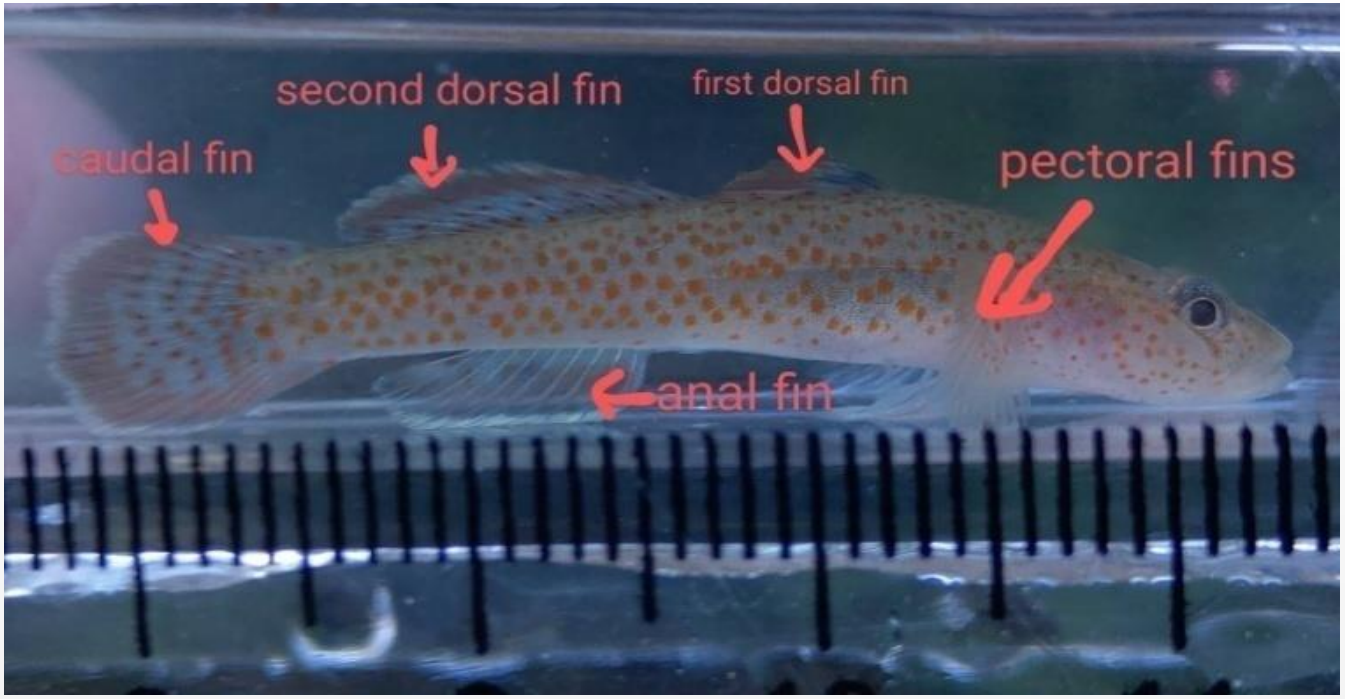
Research question and hypothesis

(1) Observe the differentiation of the phenotype of Rhinogobius rubromaculatus in various places and the correlation between water pH
(2) Observe the effect of environmental differences on the body color of Rhinogobius rubromaculatus in the Xindian area
(3) Discuss the association between the body size and habitat of Rhinogobius rubromaculatus in the Xindian area
(4) To explore whether the color of the bottom sand affects the body color of Rhinogobius rubromaculatus in the Xindian area.
(5) Whether there is a difference in appearance and habit between the Rhinogobius rubromaculatus and the Taichung potbelly creek pattern species in the Xindian area, and I want to know whether it belongs to Rhinogobius yangminshanensis or the alligator of the alligator with an alligator


second dorsal fin
first dorsal fin
caudal fin
pectoral fins
anal fin


pelvic fin

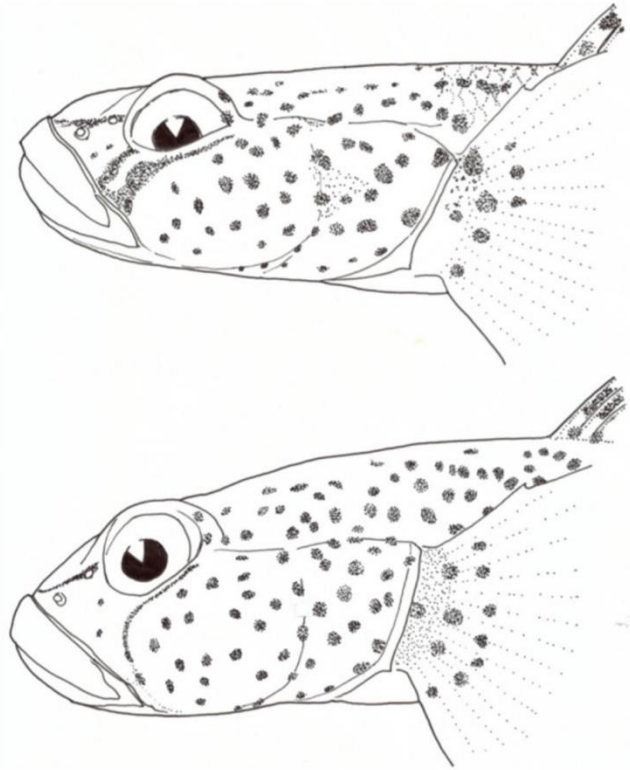


FIGURE 4. Head colour-pattern drawing of male specimens of *Rhinogobius yangminshanensis* (upper one), NTOUP-2017-06-325, 27.9 mm SL, the Tanshuei River basin, Taipei City; and *Rhinogobius rubromaculatus* (lower one), NTOUP-2017-06-321, 31.0 mm SL, the Wushi basin, Taichung City, Taiwan.

Rhinogobius yangminshanensis (top) and Rhinogobius rubromaculatus (bottom) head differences (image source: cited Chen Yixiong (2022). A new freshwater gobiid species of Rhinogobius Gill, 1859 (Teleostei: Gobiidae) from northern Taiwan ◦ ZOOTAXA)

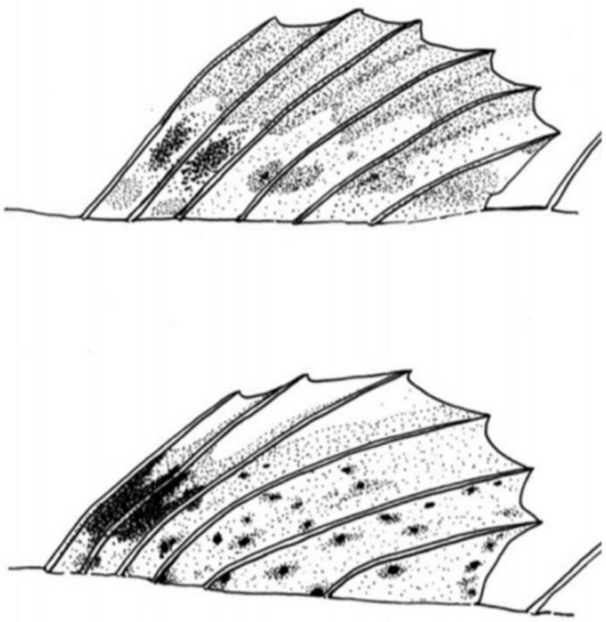


FIGURE 5. Pigmentation pattern on first dorsal fin of male specimens of *Rhinogobius yangminshanensis* (upper one), NTOUP-2017-06-325, 27.9 mm SL, the Tanshuei River basin, Taipei City; and *Rhinogobius rubromaculatus* (lower one) NTOUP-2017-06-321, 31.0 mm SL, the Wushi basin, Taichung City, Taiwan.

Rhinogobius yangminshanensis (top) differs from Rhinogobius rubromaculatus (bottom) with the first dorsal fin (Image: cited Chen Yixiong (2022). A new freshwater gobiid species of Rhinogobius Gill, 1859 (Teleostei: Gobiidae) from northern Taiwan ◦ ZOOTAXA)

Research methods and materials

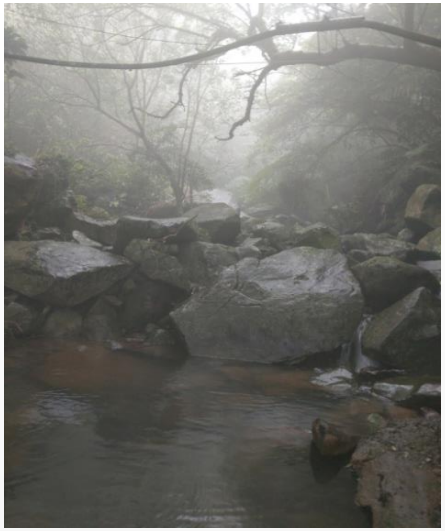
1. **Field observation and collection**

   The wild habitat of the alligator was observed, and the individuals of the alligator from all over Taiwan were collected for comparison, and the pH value in the water of each habitat was measured to investigate the differentiation of the phenotype of the alligator and whether it was affected by geology and water quality.

   In addition, the wild habitat of the alligator in the Xindian area was observed, and the correlation between several different habitats, topography, and companion species and the individual body color produced by its habitat was compared.

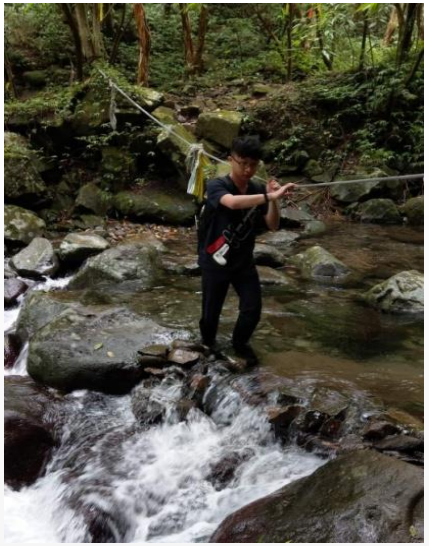
Equipment required:

- 2 fishing nets
- 1 pair of rain boots
- 1 observation box

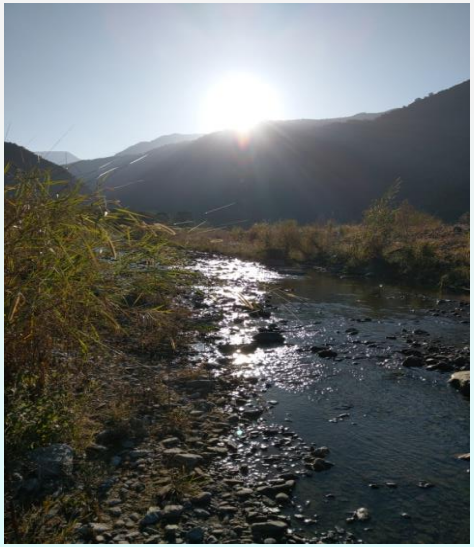


Wild Habitat (Shimen, Northern Taiwan)

Wild Individual

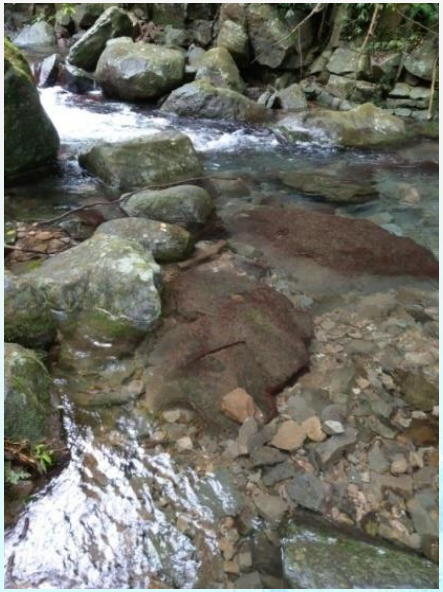


Field Survey



Wild Habitat (Pingtung, Southern Taiwan)

Hidden Wild Habitat of Shortnose Wrasse (Chromis interruptus)



Open Wild Habitat of Shortnose Wrasse (Chromis interruptus)

2. The color experiment of the bottom sand of the fish tank

Rhinogobius rubromaculatus selected for the cohabitation is placed into a fish tank paved with different bottom sand, and its body color is observed and recorded whether it changes.

1) Go to the original habitat to collect Rhinogobius rubromaculatus and the original ground sand.
2) Arrange fish tanks, lay three kinds of bottom sand, and erect lamps.
3) Measure the water temperature and water quality to confirm whether they are the same
4) Put three fish in each tank
5) Feed frozen bloodworms regularly every day, and continuously monitor the water temperature and water quality
6) And observe the body color change of the fish after one week of feeding

Equipment required

- Fish tank (length 30 cm, width 20 cm) 3 pcs
- Wide test strip 1 copy
- Lamp (60 cm) 1 pcs
- Black sand 1 liter
- Stream sand (original habitat) 1 liter
- White sand and gravel 1 litre
- Thermometer 3 x
- Filter 3 x
- Pump 1 x
- Rhinogobius rubromaculatus 9 pcs

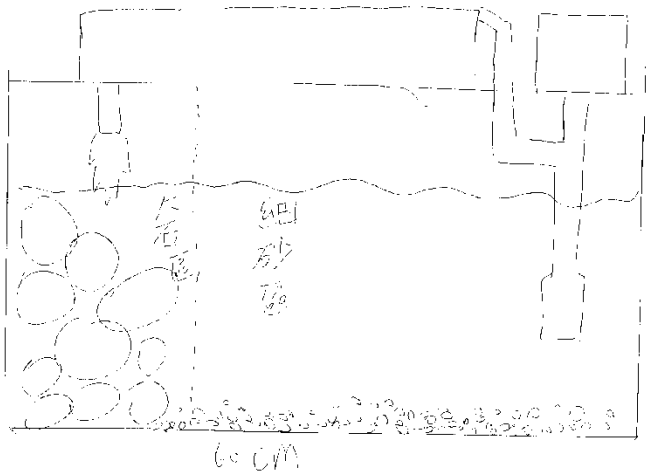
3. Experiment on liking the environment

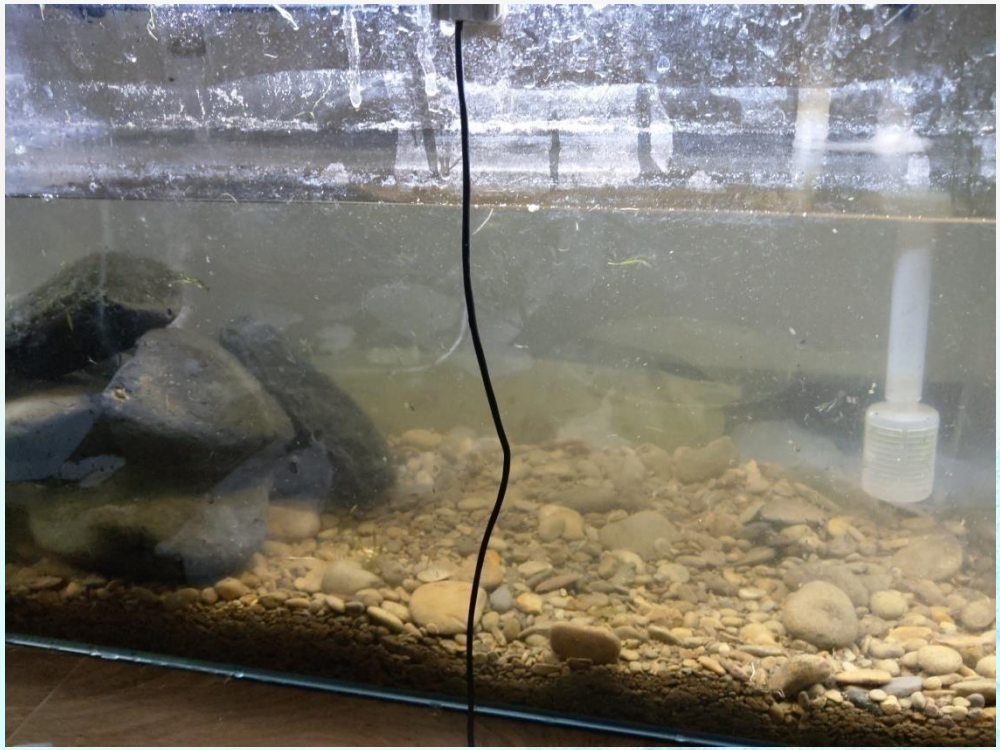
In the fish tank, the large stone area and the fine sand area were designed (Figures 7 and 8), and the alligator in the Xindian area and model origin was selected and put into the fish tank, and whether there was a difference in the environment preferred by the all-snouted red-spotted crocodile in the Xindian area and the Taichung Dabelly Creek model production area.

1) Go to the original habitat to collect short-snouted red-spotted crocodile tigers and native ground sand.
2) Arrange fish tanks, lay two kinds of bottom sand, and erect lamps.
3) Measure the water temperature and water quality to confirm whether they are the same
4) Put in the fish
5) Continuously monitor the water temperature and water quality, regularly feed the bloodworms in the right front corner of the fish tank, and time it for one minute, and observe that several alligators with short snouts gather to eat.
6) Observe for a week, compare the time when the fish gather in the right front corner of the fish tank to eat, and find out the better environment that the fish prefer, because if the fish only like to inhabit the big rock area, the time to swim to the right front corner of the fish tank to eat will be longer than the fish that prefer to inhabit the fine sand area.
7) Remove the fish, replace another batch of alligators from different origins, and repeat steps (1) to (6).

Equipment required:

- Fish tank (length 60 cm, width 30 cm) 1 pcs
- Wide use test strip 1
- computer 1 pcs
- Lamp (60 cm) 1 pcs
- Thermometer 3 pcs
- Upper fine filter 1 pcs
- Fine sand 5 kg
- Large stones
- Rhinogobius yangminshanensis 5
- Rhinogobius rubromaculatus (new store) 5
- Rhinogobius rubromaculatus (mode) 5



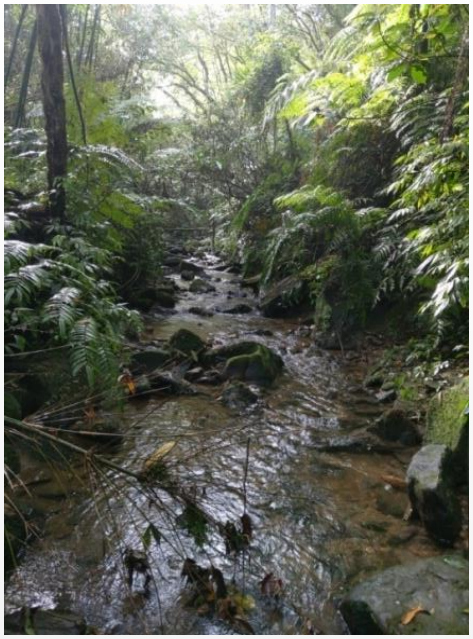
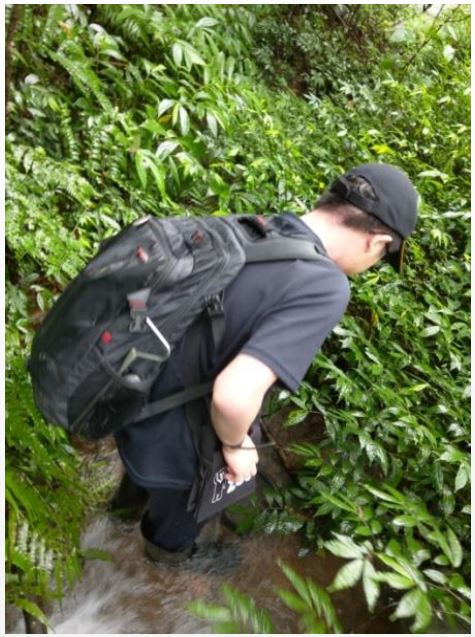
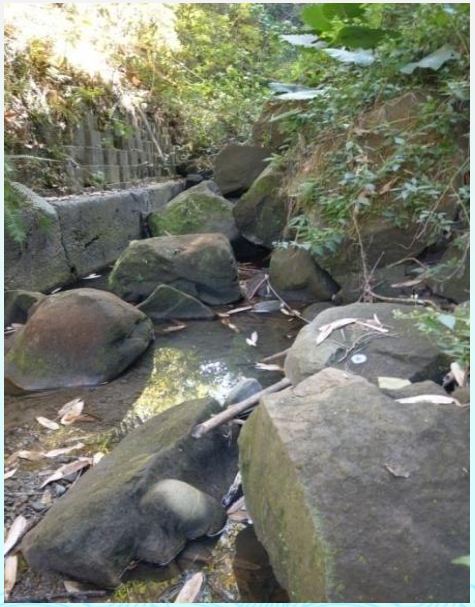


4. Comparison fish

Were collected in the wild habitat of the short-snouted red-spotted crocodile in the Xindian area, the waters around Yangmingshan and the Dabelly River model in Taichung, and whether there were differences in the appearance of the alligator of the alligator of different origins.

Equipment required:

- 1 dissecting microscope
- 3 Petri dishes
- 2 forceps
- Rhinogobius yangminshanensis several
- Rhinogobius rubromaculatus (new store) several
- Rhinogobius rubromaculatus (mode) several

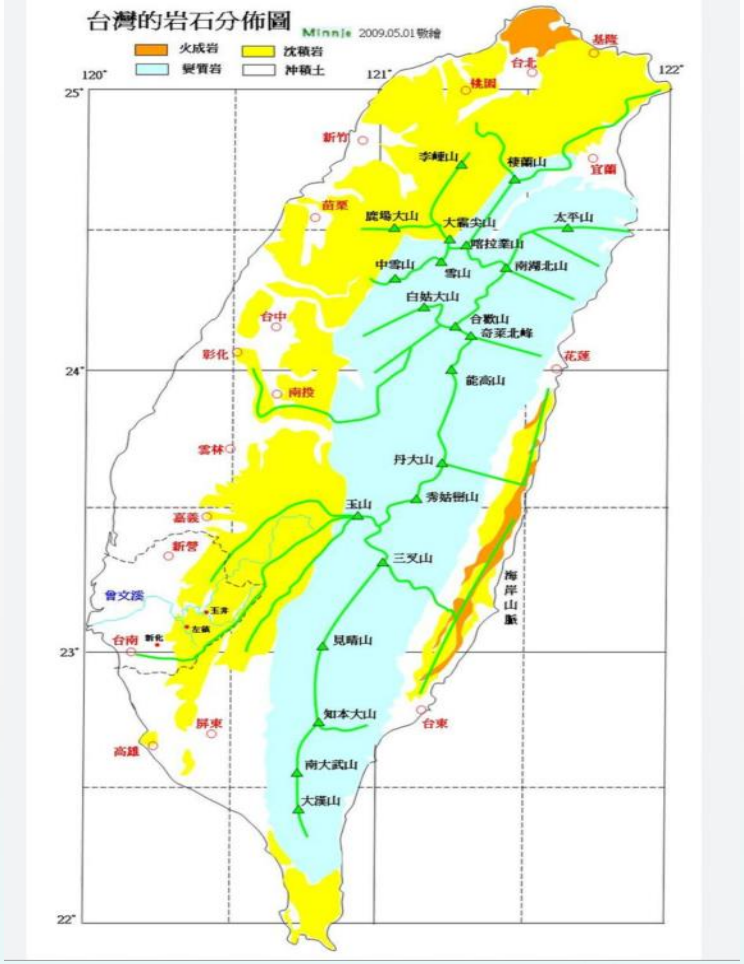





Results

1. Observe the phenotypic results of alligator alligators in various places

Location	PH	Geological area	Distribution of rock properties	Distribution of rock types	The body color of the Rhinogobius rubromaculatus (1 to 5 points, from light to dark)
Shimen Xiaokeng Creek	5	Geology of Northern Volcanoes	Igneous Rock	Andesite	1
Sanjhih Unnamed Wild Creek	6.3	Geology of Northern Volcanoes	Igneous Rock	Andesite	2
Tamsui Gongsi Tian Creek	7.2	Geology of Northern Volcanoes	Igneous Rock	Andesite	4
Xindian Meiziliao Creek	6.5	Geology of Western Foothills	Sedimentary Rock	Sandstone, Shale	3
Taichung Wu Creek	7.5	Geology of Western Coastal Plain	Alluvial Soil		4
Yunlin Zhuoshui River	7.7	Geology of Western Coastal Plain	Alluvial Soil		4
Chiayi Bazhang Creek	7.3	Geology of Western Foothills	Sedimentary Rock	Sandstone, Shale	3
Kaohsiung Gaoping River	7.7	Geology of Western Foothills	Sedimentary Rock	Sandstone, Shale	3
Pingtung Donggang Creek	7.2	Geology of Western Coastal Plain	Alluvial Soil		5
Pingtung Linbian Creek	8.4	Geology of Western Coastal Plain	Alluvial Soil		5

Picture: Taken from the Internet



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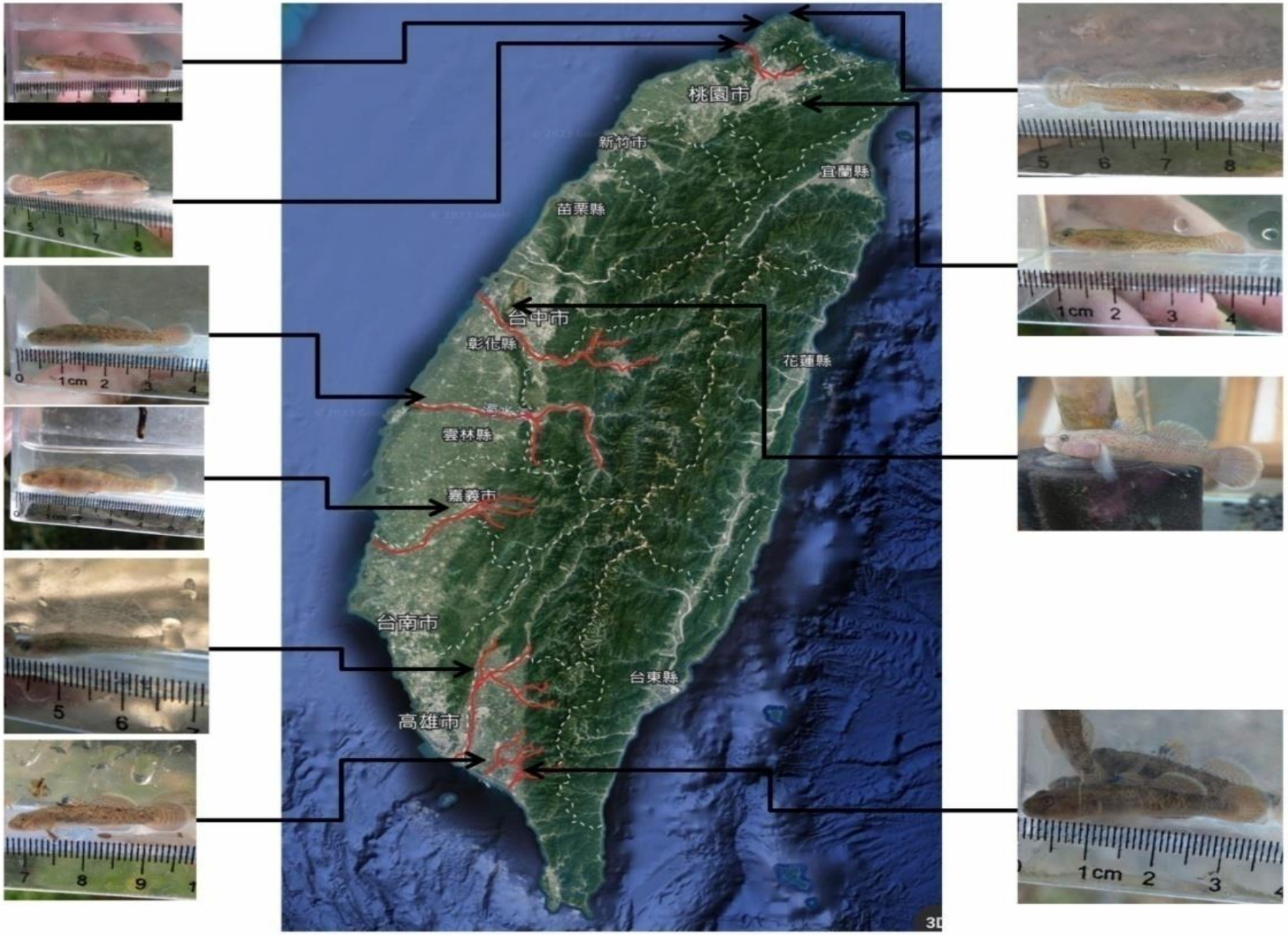
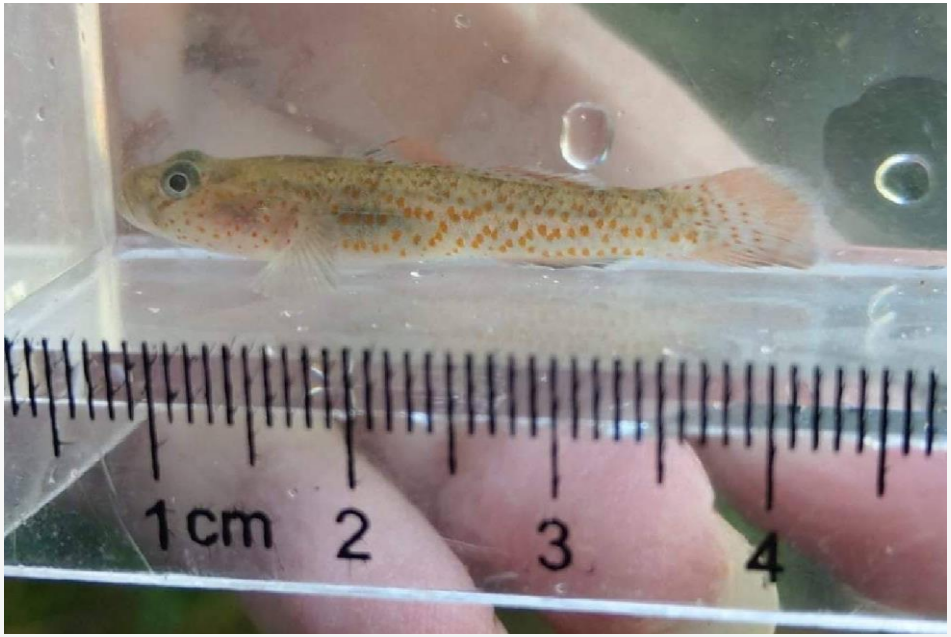
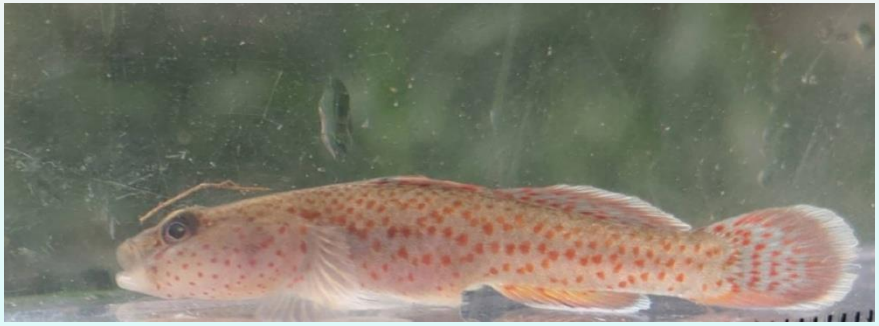

桃園市
新竹市
宜蘭縣
苗栗縣
台中市
彰化縣
花蓮縣
雲林縣
嘉義市
台南市
台東縣
高雄市

Picture: : Collected from PH8 waters



Picture: : Collected from PH6 waters



Picture: : Collected from PH7 waters

Picture: : Collected from PH5 waters

2. Field observation results in Xindian area

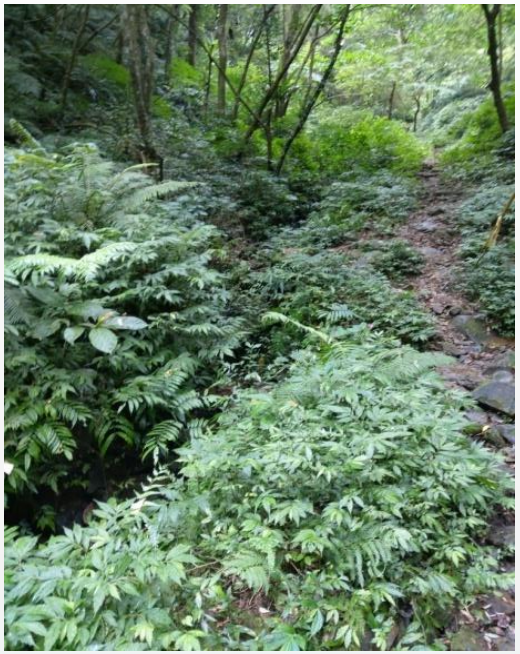
Comparison of amphibious environment and alligator morphology in Xindian area

	A habitat	B habitat	C habitat
Environment	Upstream	Mountain gully	Tributary
Vegetation	Open	Dense	Dense
Sunlight	Strong	Weak	Weak
Sediment load	Low	High	High
Competitors	3 type	1 type	1 type
Spotted coloration of Rhinogobius rubromaculatus	Tending towards yellow	Tending towards orange	Tending towards red
Body color of Rhinogobius rubromaculatus	Tending towards dark	Tending towards light	Tending towards light
Body shape of Rhinogobius rubromaculatus	3.2~4.3 cm	5~6.8 cm	4.5~5 cm

A

B

C



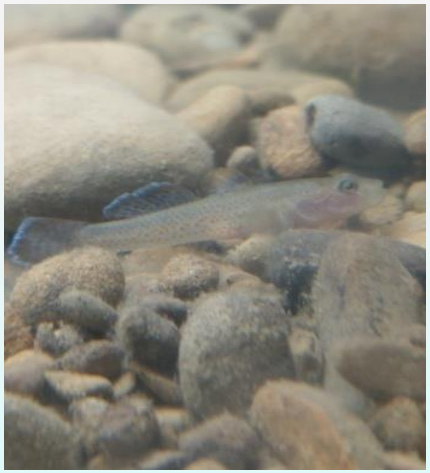
3. The observation results of the fish tank bottom sand color experiment

The six individuals were all from the same river section of the Qingtan River basin in Xindian District, and there was no obvious difference in body color when they were first collected, which was the difference after one week of feeding in a fish tank with the same water temperature and water quality but different bottom sand, it can be found that regardless of the obvious difference in body color and markings between male and female, the individuals raised in the fish tank with dark bottom sand color showed darker body color and more obvious markings, while the individuals in the fish tank with light bottom sand color showed lighter body color and inconspicuous markings

Original Habitat Male Sand Gob

Male Sand Goby on Dark Colored Sand

Male Sand Goby on Light Colored Sand



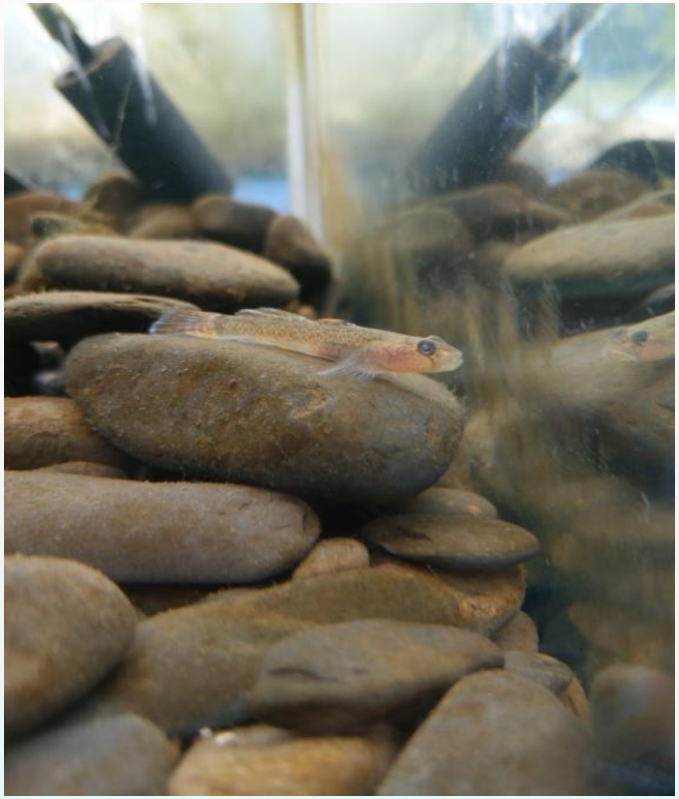
Female Sand Goby in Original Habitat Stream

Female Sand Goby on Dark Colored Sand

Female Sand Goby on light Colored Sand

4. Yangmingshan, Xindian and Taichung Dabelly Creek individual preference environmental experiment observation results

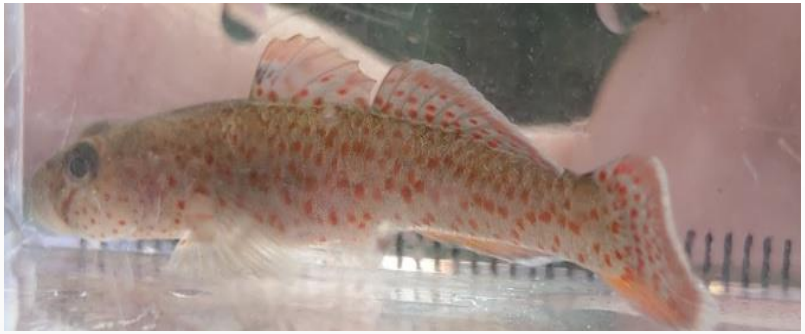
After experimental observation, it was learned that Rhinogobius rubromaculatus in the Xindian area and the waters around Yangmingshan prefers to inhabit the fine sand area and is less likely to drill into the gaps of large stones, while individuals in Taichung Dabelly Creek mode production area hide more in the gaps of large stones, unless lured by bloodworms, otherwise rarely swim to the fine sand area, experimental results can also prove this view, known from the experimental results, In terms of the time required to swim from the hiding place to the right front corner of the fish tank to feed, the time required by the individuals in the type origin is much greater than that of Rhinogobius yangminshanensis and Rhinogobius rubromaculatus in the Xindian area, which indicates that the place where the Rhinogobius rubromaculatus individuals in the type origin are active is in the big stone area, far from the right front corner of the fish tank belonging to the fine sand area. Therefore, it takes more time to swim over to forage than Rhinogobius yangminshanensis and Rhinogobius rubromaculatus in the Xindian area, and Rhinogobius yangminshanensis and Rhinogobius rubromaculatus in the Xindian area are originally active in the fine sand area, so when the red worms are placed in the right front corner of the fish tank that belongs to the fine sand area, They can come together in a shorter period of time.



5. Compare the appearance of fish

The appearance of Rhinogobius rubromaculatus in the Xindian area, whether in the number of fins, head pattern and pattern and the first dorsal fin spot, is more consistent with the individual type of Rhinogobius yangminshanensis, and is different from the Rhinogobius rubromaculatus Taichung potbelly creek model origin species.

1) Rhinogobius rubromaculatus in the Xindian area has two stripes under the eyes, and the Rhinogobius rubromaculatus model has only one individual
2) The Rhinogobius rubromaculatus male in the Xindian area has a mouth split that only reaches the anterior edge of the pupil, and the male fish in the Rhinogobius rubromaculatus model has only reached the anterior edge of the pupil reaches the middle of the eye.
3) The first dorsal fin dark spot of the Rhinogobius rubromaculatus individual in the Xindian area is lighter and scattered than that of the Rhinogobius rubromaculatus model origin individual
4) The Rhinogobius rubromaculatus individual in the Xindian area has an orange band above the first dorsal fin, which can reach 1/3 of the first dorsal fin area. The first dorsal fin of Rhinogobius rubromaculatus native individuals has no orange band and is translucent.
5) The second dorsal fin of the alligator individual in the Xindian area has ten rays, and the first dorsal fin of the Rhinogobius rubromaculatus type individual has only nine dorsal fins
6) The fin of the Rhinogobius rubromaculatus individual in the Xindian area has nine fin bars, and the fin of the Rhinogobius rubromaculatus model individual has only eight fins
7) Rhinogobius rubromaculatus in the Xindian area has a brown body color, Rhinogobius rubromaculat ...



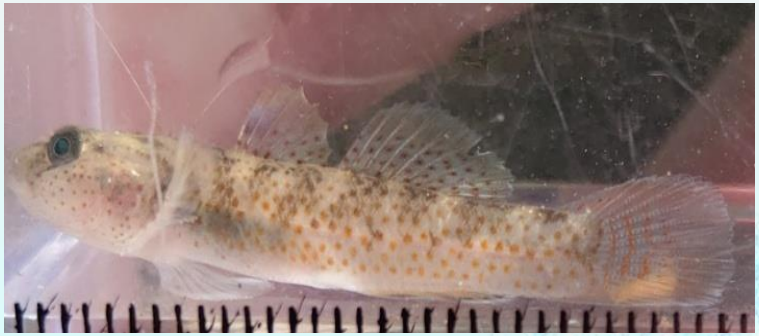
Male Fish in Yangmingshan Surrounding Area

Female Fish in Yangmingshan Surrounding Area

Male Fish in Xindian Area

Female Fish in Xindian Area

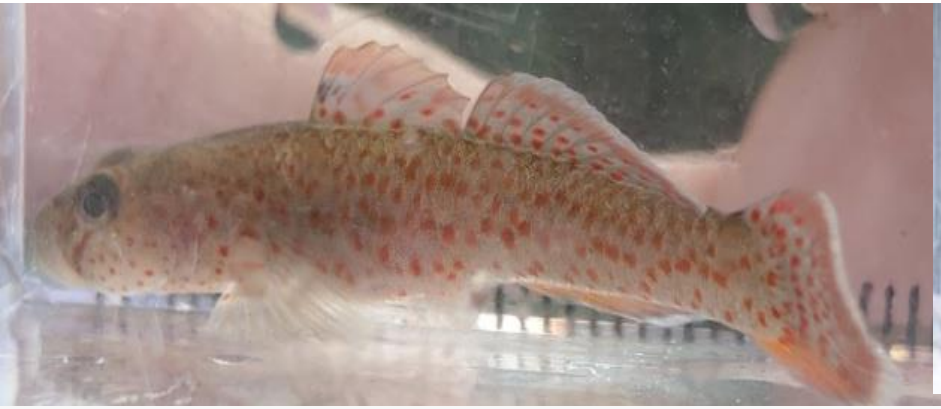
Male Fish in Dadu River Breeding Ground in Taichung

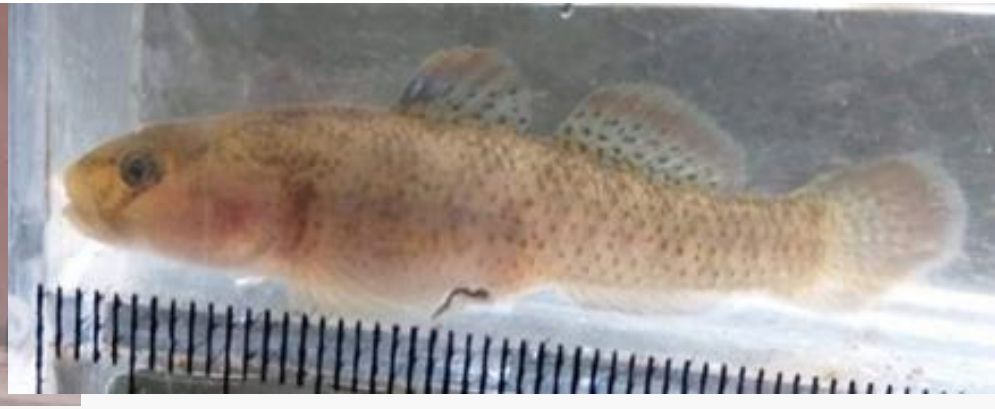


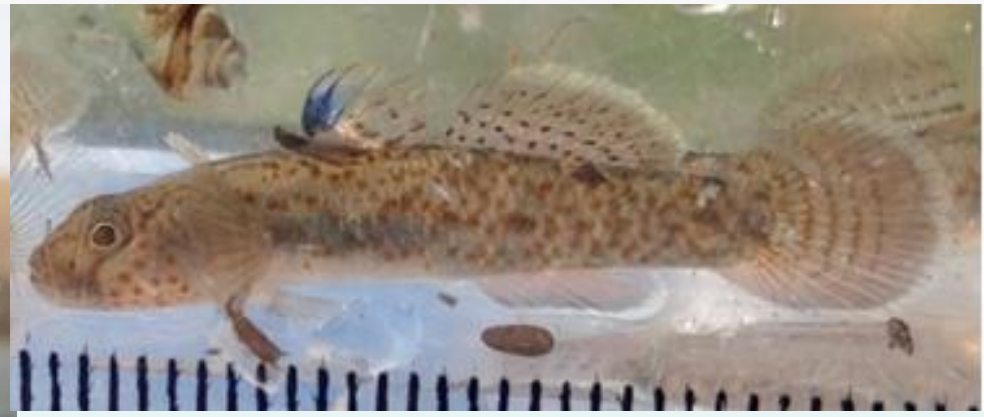
Female Fish in Dadu River Breeding Ground in Taichung

Conclusion

1. from field observation to know that Taiwan's Rhinogobius rubromaculatus can be roughly divided into four phenotypes, Hsinchu north of the type (now independent into a new species Rhinogobius yangminshanensis), Miaoli south to the north of the cloud forest type, this is the model type, the south of the cloud forest to the north of Gaoping Creek, the south of Gaoping Creek type, and the pH value of the water will also have a resonance on its body color, generally speaking, the more acidic the water quality, the lighter the body color, The alkaline the body color, the darker the color.
2. In the more hidden and shady the habitat, due to the low pressure of predation, the more vivid the body color and markings, on the contrary, in the open and sunny habitat, Rhinogobius rubromaculatus generally shows a darker body color to avoid natural predators.
3. Rhinogobius rubromaculatus in the Xindian area has nothing to do with the size of the river channel in the Xindian area, but is mainly related to the habitat environment and the situation of the associated species.
4. In environments where the water temperature and water quality are the same but the color of the bottom sand is different, Rhinogobius rubromaculatus will form a protective color by changing the body color slightly into the environment.
5. Individuals of Rhinogobius rubromaculatus and Taichung potbelly creek type species in various parts of the Xindian area are different in the number of second dorsal fin and fin rays, head pattern and pattern, and first dorsal fin spots, so if classified by type species, it is preliminarily judged that the Rhinogobius rubromaculatus population in the Xindian area should belong to the newly classified Rhinogobius yangminshanensis







Bibliography and citations

周銘泰、高瑞卿、張瑞宗、廖峻(2020)。臺灣淡水及河口魚蝦圖鑑。晨星出版社。

汪靜明(1993)。臺中縣魚類資源。臺中縣政府。

詹見平(1994)。臺中縣大甲溪魚類誌。臺中縣立文化中心。

林春吉(2007)。臺灣淡水魚蝦大圖鑑(下)。天下文化。

張大慶、曾偉杰(2014)。鰕虎圖典。魚雜誌社。

佐土哲也、關慎太郎、廖德裕、徐瑜芳(2020)。世界溫帶淡水魚圖鑑。臺灣東販出版。

陶天麟(2004)。臺灣淡水魚地圖。晨星出版。

陶天麟(2006)。臺灣淡水魚圖鑑。人人出版。

沈世傑、吳高逸(2011)。臺灣魚類圖鑑。國立海洋生物博物館。

沈世傑(1984)。臺灣魚類檢索。南天書局。

沈世傑(1993)。臺灣魚類誌。國立臺灣大學動物學系

楊正雄、曾子榮、林瑞興、曾晴賢、廖德裕(2017)。臺灣淡水魚類紅皮書。行政院農業　委員會特有生物研究保育中心、行政院農業委員會林務局。

陳義雄、方力行(1999)。臺灣淡水及河口魚類誌。國立海洋生物博物館。

陳義雄、陳天任(2018)。陽明魚蝦蟹。陽明山國家公園管理處

陳義雄(2009)。臺灣河川溪流的指標魚類 第一冊 初級淡水魚類。國立臺灣海洋大學。

I-Seiung Chen,Shen-Chin Wang & Kwong-Tsao Shao(2022)。A new freshwater gobiid species of Rhinogobius Gill, 1859 (Teleostei: Gobiidae) from northern Taiwan。*ZOOTAXA*,5189(1),29-44 。file:///C:/Users/lalab/Desktop/47067-Article%20Text-50570-54563-10-20220923.pdf

田口哲(2021)。日本の淡水魚図鑑。誠文堂新光社。