

DIVERSITY AND DISTRIBUTION OF FRESHWATER FISHES OF SON TRA PENINSULA, DA NANG CITY

ĐA DẠNG VÀ PHÂN BỐ CÁC LOÀI CÁ NƯỚC NGỌT TẠI BÁN ĐẢO SƠN TRÀ, THÀNH PHỐ ĐÀ NẴNG

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Abstract - Diversity of freshwater fishes from Son Tra Peninsula, Da Nang City is provided for the first time. Intensive field survey and laboratory analysis have revealed 16 species, belonging to 14 families of 10 orders of freshwater and brackish water fishes. Those fishes are distributed in two different areas like upper stream and from lower stream to the seashore habitats. Most of the species were collected at elevation below 100 meter above sea level. In 16 mentioned species, marbled eel is evaluated at Vulnerable level according to Vietnam Red Data Book (2007) while mosquito fish and tilapia are listed as invasive species in Vietnam. The diversity of fishes species is relatively low in comparison with other protected areas might be due to the small area and isolation of water bodies as well as steeply topography.

Key words - Son Tra Peninsula; freshwater fish; diversity; Da Nang

1. Introduction

Son Tra Peninsula where Son Tra Nature Reserve is located (established on year 1977) is evaluated as a “green lungs” of Da Nang City, a Vietnam's most livable city. One of the reasons for this reputation is that the peninsula has a relatively good environment in which biodiversity is one of the main components with the Red-shanked douc's symbol.

Despite the short distance to the city center, the freshwater fish fauna of this area has never been reported but only marine fishes [1, 2, 5, 16, 23]. Although there are 41 streams in Son Tra mountain, only three streams begin above 450 m with continuously flowing as important as year-round sources of water for ships and military bases; those streams are originated from natural vegetation as tropical rain forest which occurred between 300 and 650 m on the northern slopes [20]).

Freshwater fishes are commonly defined and accepted by almost ichthyologists as those that live all, or a critical part of their life in either freshwater or brackish water. Those are very important components in freshwater ecosystem that is facing with many pressures. Therefore, herein we provide the information of species diversity and distribution of freshwater fishes of Son Tra which is needed in development and conservation planning of this peninsula.

2. Methodology

2.1. Survey area

Field surveys were conducted in four periods: May 27th – June 03rd and October 16th – October 23rd, 2016; October 10th – October 14th and October 17th – October 25th, 2017. Sampling sites were all accessible to water bodies in Son Tra Peninsula, including streams, reservoirs and dams

Tóm tắt - Bài báo này giới thiệu những kết quả nghiên cứu về thành phần loài cá nước ngọt tại bán đảo Sơn Trà, thành phố Đà Nẵng. Thông qua các khảo sát thực địa và phân tích mẫu vật trong phòng thí nghiệm, đã có 16 loài thuộc 14 họ của 10 bộ cá nước ngọt và nước lợ được ghi nhận có sự phân bố tại các thủy vực thuộc bán đảo Sơn Trà. Các loài cá nước ngọt ở đây được chia làm hai nhóm chính: nhóm phân bố ở khu vực suối và nhóm phân bố ở khu vực cửa suối, ven biển, hầu hết các loài cá được thu thập tại độ cao dưới 100 mét trên mực nước biển. Trong 16 loài cá ghi nhận được, có một loài được đánh giá ở cấp độ Nguy cấp (Vulnerable) trong Sách Đỏ Việt Nam (2007) là loài Cá chình hoa và hai loài ngoại lai là Cá ăn muỗi và Cá rô phi. Tính đa dạng thành phần loài cá ở Sơn Trà khá thấp do phân bố trong phạm vi hẹp, giới hạn bởi các yếu tố thủy văn và địa hình.

Từ khóa - Bán đảo Sơn Trà; cá nước ngọt; đa dạng; Đà Nẵng

(Figure 1). By intensive field survey, we recorded 49 water bodies (creeks, ponds, lakes, streams) in which 07 year-round filled water sites had been sampled. Brief information of sampling sites is as in (Table 1):

Table 1. List of sampling sites for freshwater fishes at Son Tra Peninsula

Site	Location	Remarks
1	Da Stream	Reservoir, water supply
2	Da Stream	Stream' mouth
3	Ho Xanh Lake	Reservoir, water supply
4	Bai Rang Stream	Stream' mouth
5	Abandoned lake	Reservoir, water supply
6	Bai Bac Stream	Forest stream
7	Om Stream	Forest stream

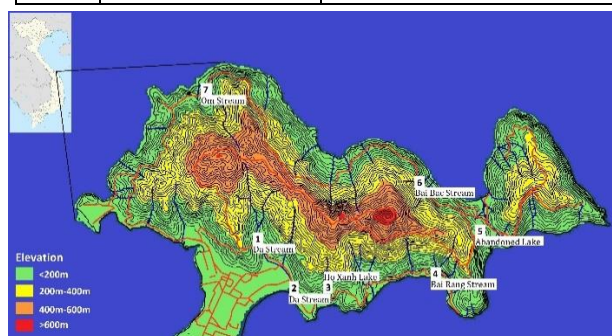


Figure 1. Sampling sites at Son Tra Peninsula

2.2. Methods

Fishes were caught from aquatic environment by hand net, cast net and electro-shocker where needed. Samples then being photographed before being fixed by formalin 10%, and subsequent submerged in ethanol 70% for long

term storage at Southern Institute of Ecology' collection. Forest type and elevation were recorded for discussion of fishes' distribution section, including changing of tide' position for fish habitat as freshwater, brackish water and seawater.

Identification was done based on morphological characters with references from professional documents such as Freshwater fishes of northern Vietnam [8]; The freshwater fishes of central Vietnam [21]; and Freshwater fishes of southern Vietnam [13].

Endangered species is evaluated using the Vietnam Red Data Book 2007 [15] and the IUCN Red list of Threaten Species 2018 [7] while alien species are based on the Global Invasive Species Database [4] and the Joint circular 27/2013 [14].

Checklist was made using order of the Catalog of Fishes [3] for order and family's level while species level followed alphabet order.

3. Results and discussions

3.1. Diversity of fishes from Son Tra Peninsula

Totally, there were 16 species living in freshwater and brackish water, belonging to 14 genera and 10 orders had been recorded from Son Tra Peninsula (Table 2). Particularly, the order Gobiiformes is dominant with 04 species (25%), followed by the order Perciformes with 03 species (19%) and order Cypriniformes with 02 species (13%) while the remaining orders with 1 species for each (6%). Four species that only distributed in freshwater environments, including: *Schistura* cf. *carbonaria*;

Barbodes semifasciolatus; *Channa striata* and *Gambusia affinis*. Five species that could migrate to and/or from the sea, including: *Anguilla marmorata*; *Mugil* sp.; *Ambassis gymnocephalus*; *Terapon jarbua* and *Carangoides chrysophrys* while the remaining species could be found in either freshwater or brackish water habitats.

The stream loach *Schistura* cf. *carbonaria* (Figure 2b) is predicted to distribute at coastal drainages from Quang Tri to Quang Ngai provinces and Sekong river in central Vietnam [6], original description is needed to confirm species level. At Son Tra Peninsula, this species inhabits at streams which are covered by primary forest. With high oxygen demand [6], it can be probably used as indicator species for the integrity of habitat or quality of stream. Only one specimen of the Spine-cheek Gudgeon *Eleotris* cf. *acanthopoma* has been obtained in this study. This species is widely distributed in west Pacific Ocean from Japan to French Polynesia [10], more specimens should be collected to confirm and report the occurrence of this species in Vietnam. Besides, adult individuals of mullet *Mugil* sp. are also needed for determination of exact species.

Among 49 water bodies, fishes could be found at 7 sites with permanent water, including: Da Stream (site 1&2), Ho Xanh Lake (site 3), Bai Rang Stream (site 4), abandoned lake inside tourist area (site 5), Bai Bac Stream (site 6) and Om Stream (site 7). Other creeks and streams are either limited on water volume and flow as well as the craggy coastline or under management of private companies. Two of above-mentioned streams (Bai Rang, and Da) could be easily accessed from the coastal mouths that house number of brackish water species.

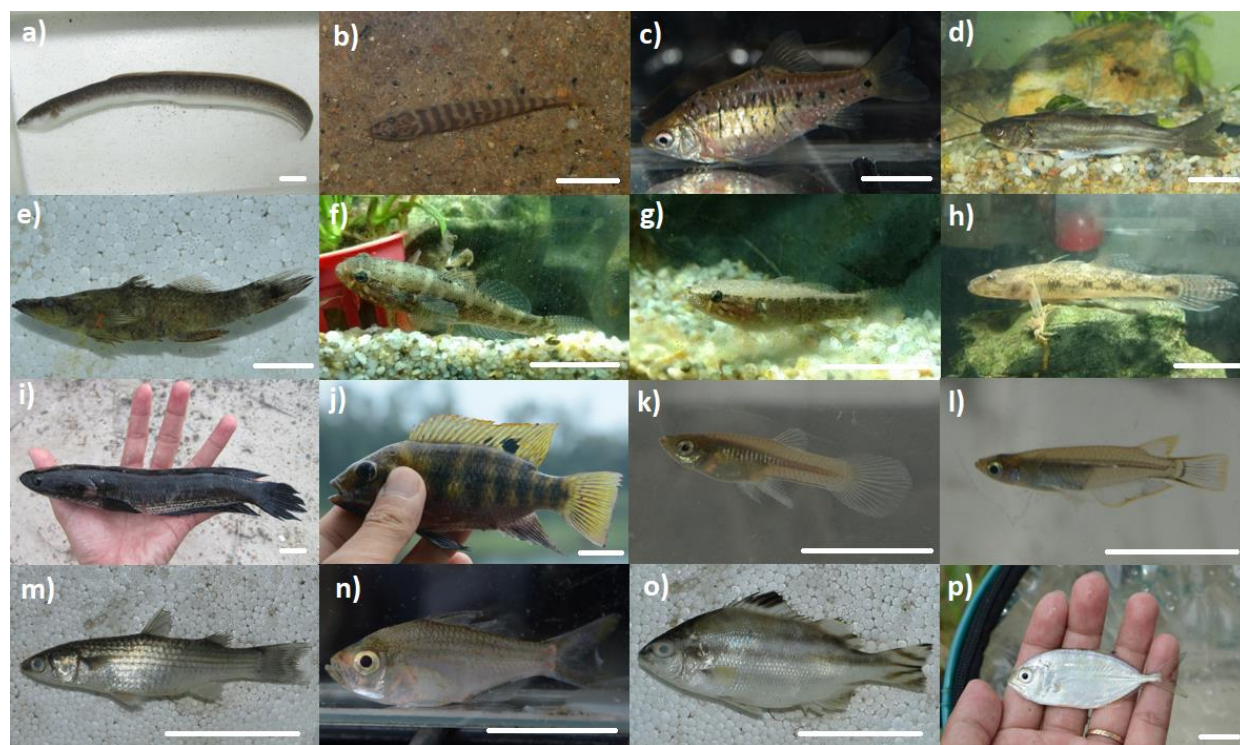


Figure 2. Illustration of recorded freshwater fishes from Son Tra Peninsula: a) *Anguilla marmorata*; b) *Schistura* cf. *carbonaria*; c) *Barbodes semifasciolatus*; d) *Mystus gulio*; e) *Butis butis*; f) *Eleotris* cf. *acanthopoma*; g) *Eleotris melanosoma*; h) *Glossogobius giurinus*; i) *Channa striata*; j) *Oreochromis* spp.; k) *Gambusia affinis*; l) *Oryzias latipes*; m) *Mugil* sp.; n) *Ambassis gymnocephalus*; o) *Terapon jarbua*; p) *Carangoides chrysophrys*. Scale bar is 1 centimeter

Table 2. List of freshwater fishes of Son Tra peninsula, Da Nang City. (F: freshwater; B: brackish; M: marine)

No.	Scientific name	Common name / Vietnamese name	Habitats	Sites
	ANGUILLIFORMES			
	Anguillidae			
1	<i>Anguilla marmorata</i> Quoy & Gaimard, 1824	Marbled eel / Cá chình hoa	F, B, M	Not mentioned
	CYPRINIFORMES			
	Nemacheilidae			
2	<i>Schistura cf. carbonaria</i> Freyhof & Serov, 2001	River loach / Cá chạch suối	F	6,7
	Cyprinidae			
3	<i>Barbodes semifasciolatus</i> (Günther, 1868)	Golden barb / Cá đòng chấm	F	1,2
	SILURIFORMES			
	Bagridae			
4	<i>Mystus gulio</i> (Hamilton, 1822)	Long whiskers catfish / Cá chột giấy	F, B	2
	GOBIIFORMES			
	Eleotridae			
5	<i>Butis butis</i> (Hamilton, 1822)	Crazy fish / Cá bóng trăn	F, B	4
6	<i>Eleotris cf. acanthopoma</i> Bleeker, 1853	Spinecheek gudgeon / Cá bóng sọc	F, B	4
7	<i>Eleotris melanosoma</i> Bleeker, 1853	Broadhead sleeper / Cá bóng trứng	F, B	4
	Gobiidae			
8	<i>Glossogobius giuris</i> (Hamilton, 1822)	Tank goby / Cá bóng cát	F, B	2,4
	ANABANTIFORMES			
	Channidae			
9	<i>Channa striata</i> (Bloch, 1793)	Striped snakehead / Cá lóc thường	F	1
	CICHLIFORMES			
	Cichlidae			
10	<i>Oreochromis</i> spp.	Tilapia / Cá rô phi lai	F, B	2,3,5
	CYPRINODONTIFORMES			
	Poeciliidae			
11	<i>Gambusia affinis</i> (Baird & Girard, 1853)	Western mosquitofish / Cá ăn muỗi	F	1
	BELONIFORMES			
	Adrianichthyidae			
12	<i>Oryzias latipes</i> (Temminck & Schlegel, 1846)	Medaka / Cá sọc	F	1
	MUGILIFORMES			
	Mugilidae			
13	<i>Mugil</i> sp.	Mullet / Cá đối	B, M	2,4
	PERCIFORMES			
	Ambassidae			
14	<i>Ambassis gymnocephalus</i> (Lacepède, 1802)	Bald glassy / Cá sơn	F, B, M	1,2,4
	Terapontidae			
15	<i>Terapon jarbua</i> (Forsskål, 1775)	Tiger bass / Cá cang	B, M	2,4
	Carangidae			
16	<i>Carangoides chrysophrys</i> (Cuvier, 1833)	Longnose trevally / Cá khế	B, M	2,4

3.2. Distribution of fishes at Son Tra peninsula

Our recorded data has shown that almost all species inhabit below 100 m elevation. This might be resulted from the topographical and hydrological conditions of the peninsula where only short and steep streams presented, seasonal streams could not support the presence of fishes. The loach *Schistura cf. carbonaria* was only recorded from site 6 and 7 which are continuously flowing streams

originated from the natural forest at the northern slope of peninsula. A species that expected to distribute from the sea to mountain streams is the marbled eel *Anguilla marmorata* where one juvenile individual has been collected at the stream's lower reach and believed to move further to the upper reach part. Together with the loach, the eel requires current water at the base of primary forest while most of species were collected from residential,

urban and tourist lands. Therefore, it is important to protect the remaining rain forest, not only for the fishes but for the whole ecosystem. The remaining species distributed mainly at downstream and lakes in the southern slopes of the peninsula.

3.3. Important fishes at Son Tra peninsula

The marbled eel *Anguilla marmorata* (Vietnamese: Cá chình hoa) has been recorded from a stream in Son Tra Peninsula. This species is listed at Vulnerable level according to Vietnam Red Data Book [15]. The occurrence of the eels in this area has been told by local residences. In this study, a juvenile individual had been collected (total length of 5 centimeters). Therefore, the existence of this important species in Son Tra Peninsula is confirmed.

Other two species should be noticed are mosquito fish *Gambusia affinis* (Vietnamese: Cá ăn muỗi) and hybrid tilapia *Oreochromis* spp. (Vietnamese: Cá rô phi). According to the Global Invasive Species Database 2018 [4], the mosquito fish is one of 100 worst invasive species. At national level, this species is mentioned in the appendix 1 of invasive species in Vietnam [14]. In Son Tra Peninsula, it can be found easily from the Da Stream which is currently used for water supply plant. The tilapia *Oreochromis* spp. is believed to be a hybrid form between *O. mossambicus* and *O. niloticus* or *O. hornorum* [4]. The Mozambique tilapia *O. mossambicus* originated from Africa is one of the world's worst invasive species [4] while this species and Nile tilapia have been listed in the Appendix 2 of invasive species in Vietnam [14]. In Son Tra Peninsula, it can be found from the Da Stream and Ho Xanh Lake as well as the abandoned lake in a tourist site. The occurrence of this species might be accidentally released and because tilapia could not do well in pure salt water [9]; together with the topographical and hydrological conditions of Son Tra Peninsula, the ability of expansion of this tilapia is likely to be low. Therefore, control activities can probably be conducted in order to exterminate these species.

There was no evidence for commercial activities related to freshwater fishes in Son Tra Peninsula. It is probably explained by the small population of relatively low number of species and the lack of economic species except the marbled eel which is presently listed as endangered and protected species in Vietnam. The diversity of freshwater fishes fauna of Son Tra Peninsula is relatively low in comparison with other nearby protected areas such as Phu Ninh Protection Forest (Quang Nam Province) [17], Ba Na – Nui Chua Nature Reserve (Da Nang City) [18, 19], Bach Ma National Park (Thua Thien Hue Province) [11, 12] (Table 3). It might be caused by small mountainous area that is isolated from big river systems while it is surrounded by urban parts of Da Nang City and ocean like Son Tra Peninsula.

Table 3. Comparison of area and species number between Son Tra Peninsula and closed protected areas

Sites	Area (ha)	Species number
Son Tra Peninsula	4,439	16
Phu Ninh Protection Forest	12,482	29

Ba Na - Nui Chua Nature Reserve	8,838	78
Bach Ma National Park	37,487	76

Despite this status, fishes and other aquatic animals in Son Tra might still play an important role in nutrient cycling in ecosystems: either recycling nutrients within a habitat, or translocating nutrients across habitats [22].

4. Conclusion

The present study has provided the list of 16 species of freshwater fishes from Son Tra Peninsula for the first time. Through our intensive field surveys, most of species are recorded under elevation of 100 meter height above sea level. This is not the final number of fishes from the area, more surveys are needed for waterbodies that are currently under management of private tourist companies and streams which only can be accessed from the shoreline.

Gobies belonging to order Gobiiformes are dominant species of Son Tra fish fauna. While important species are marbled eel (endangered at Vulnerable level); mosquito fish and hybrid tilapia (both invasive species).

Freshwater resource in Son Tra Peninsula is not only being daily used by local residences but also one of the important components with contribution of fish and other animals to complete nutrition cycles in the ecosystem. Therefore, urgent action is required for conservation of this resource under economic and tourist development.

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REFERENCES

- [1] Dinh Thi Phuong Anh, Nguyen Van Khanh, Phan Thi Thu Huyen, *The initial data of fish composition from Han River, Da Nang City*, University of Education, the University of Da Nang, 2005.
- [2] Dinh Thi Phuong Anh and Phan Thi Hoa, “Fish composition from southern part of ocean of Son Tra peninsula, Da Nang City”, *Journal of Sciences and Technology*, 36, the University of Da Nang, 2010, 56-64.
- [3] Fricke, R., Eschmeyer, W. N. & Fong, J. D., *Species by Family/Subfamily*, California Academy of Sciences, 2018.
- [4] Global Invasive Species Database, *100 of the World's Worst Invasive Alien Species*, Invasive Species Specialist Group, 2018.
- [5] Ho Thi Thanh Tam and Vo Van Phu, *The biodiversity of fish composition from Han River, Da Nang City*, University of Science, Vietnam National University Ho Chi Minh City, 2006.
- [6] Huckstorf, V., *Schistura carbonaria*, The IUCN Red List of Threatened Species, 2012.
- [7] IUCN, *The IUCN Red List of Threatened Species*, International Union for Conservation of Nature and Natural Resources, 2018.
- [8] Kottelat, M., *Freshwater Fishes of northern Vietnam*, The World Bank, 2001.
- [9] Lamboj, A., *The Cichlid Fishes of Western Africa*, Birgit Schmettkamp Verlag, 2004.
- [10] Larson, H., *Eleotris acanthopoma*, The IUCN Red List of Threatened Species, 2012.
- [11] Le Van Dan, Tran Nguyen Ngoc and Nguyen Tu Minh, *Checklist of fishes from expanded area of Bach Ma National Park*, Nong Lam

- University, 2013.
- [12] Le Vu Khoi, Vo Van Phu, Ngo Dac Chung and Le Trong Son, *Zoological diversity of Bach Ma National Park*, Thuan Hoa Publisher, 2004.
- [13] Mai Đình Yên (editor), Nguyen Van Trong, Nguyen Van Thien, Le Hoang Yen, Hua Bach Loan, *Identification of freshwater fishes from south Vietnam*, Sciences and Technology Publisher, 1992.
- [14] Ministry of Natural Resources and Environment – Ministry of Agriculture and Rural Development, *Joint circular 27/2013/TTLT-BTNMT-BNNPTNT "Specify the criteria for identifying invasive alien species and issue the list of invasive alien species"*, 2013.
- [15] Ministry of Science and Technology – Vietnam Academy of Science and Technology, *Vietnam Red Data Book*, Sciences and Technology Publisher, 2007.
- [16] Nguyen Thi Tuong Vi and Vo Van Quang, "Fish fingerling in the coral reef of Son Tra Peninsula, Da Nang, *Journal of Marine Science and Technology*, 4(15), Vietnam Academy of Science and Technology, 2015, 355-363.
- [17] Nguyen Van Khanh, Đinh Thị Phương Anh, Lưu Thị Tuyết, "Fish composition from Phu Ninh Protection Forest", *Journal of Sciences and Technology*, 4(21), the University of Da Nang, 2007, 12 – 16.
- [18] Nguyen Xuan Huan, Nguyen Viet Cuong, Thach Mai Hoang, "The initial data of fish composition from buffer zone of Ba Na – Núi Chua National Park", *Journal of Biology*, 25(2A), Natural Science and Technology Publisher, 2003, 21-26.
- [19] Nguyen Xuan Huan, Nguyen Viet Cuong, Thach Mai Hoang, *Fish composition at Ba Na – Núi Chua National Park*, Sciences and Technology Publisher, 2003.
- [20] Peenen, P. F. D., Light, R. H., and Duncan, J. F., "Observations on mammals of Mt. Sontra, south Vietnam", *Mammalia*, 35, De Gruyter, 1971, 126–143.
- [21] Serov, D.V., Nezdoliiy, V.K., Pavlov, D.S., *The freshwater fishes of central Vietnam*, KMK Scientific Press Ltd., 2006.
- [22] Vanni, M., "Nutrient Cycling by Animals in Freshwater Ecosystems", *Annual Review of Ecology and Systematics*, 33, Annual Reviews, 2002, 341-370.
- [23] Vo Van Quang, Le Thi Thu Thao, Nguyen Thi Tuong Vi, Tran Thi Hong Hoa, Nguyen Phi Uy Vu, Tran Cong Thinh, "Diversity and catching status of grouper (Serranidae) in coastal waters of Da Nang and Quang Nam", *Journal of Marine Science and Technology*, 4(16), Vietnam Academy of Science and Technology, 2016, 405-417.

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