

## Fish composition in Dong Nai biosphere reserve in Vietnam

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### ARTICLE INFO

#### Research Paper

Received: September 03, 2019

Revised: October 07, 2019

Accepted: November 21, 2019

#### Keywords

Dong Nai biosphere reserve

Endanger

Fish biodiversity

Species compositions

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### ABSTRACT

Dong Nai biosphere reserve (DNBR) is well known for its high level of biodiversity and of global meaningful ecosystem. The fauna includes 84 species of mammals belonging to 28 families, 10 orders; 407 bird species; 141 reptile and amphibian species; 175 fish species; 2,017 insect species. The fish fauna of DNBR maintains many rare and endangered fish species recorded in the Vietnam red book and international union for conservation of nature red list (IUCN's red list) such as *Scleropages formosus* and many other rare fish species, such as *Morulus chrysophekadion*, *Chitala ornata*, *Probarbus jullieni*, *Cyclocheilichthys enoplos*... This study was aimed to identify fish composition distributed in DNBR. After the sampling period (01/2019 to 08/2019), a total of 114 fish species belonging to 11 orders and 28 families were recorded in DNBR. There were 09 species of fish on the list of rare and endangered fish species of Ministry of Agriculture and Rural Development of Vietnam, 3 species (*Chitala ornata*, *Cosmochilus harmandi* and *Hemibagrus filamentus*) on the Vietnam red list book; 01 species (*Ompok bimaculatus*) on the IUCN's red list, 11 exotic species, 78 commercial species and 13 species having potential as aquarium fish. In addition, the study also found the first presence of a species of phallostethid, *Phenacostethus smithi* in DNBR.

**Cited as:** Nguyen, T. T., Nguyen, L. N., Lam, B. Q., Huynh, T. C., Nguyen, D. H., Nguyen, N. B., Mai, T. D., & Nguyen, T. P. (2019). Fish composition in Dong Nai biosphere reserve in Vietnam. *The Journal of Agriculture and Development* 18(6), 30-37.

## 1. Introduction

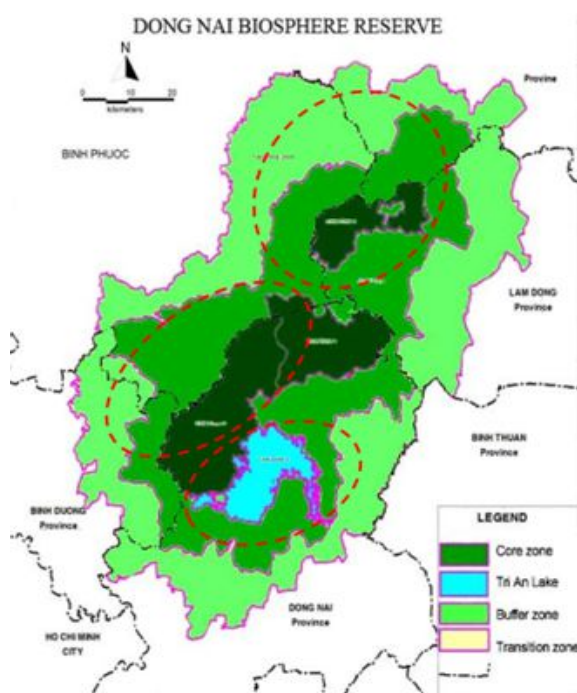
Dong Nai biosphere reserve (DNBR) is well known for its high level of biodiversity and of global meaningful ecosystem. The flora of DNBR includes 2,812 species of vascular plants belonging to 192 families, 99 orders. While the fauna includes 110 species of mammals belonging to 31 families, 12 orders; 348 bird species; 134 reptile and amphibian species; 175 fish species; 1,243 insect species (DNDNRE, 2017). The fish fauna of DNBR maintains many rare and endangered fish species recorded in the Vietnam red book and IUCN's red list such as *Scleropages formosus*, and high economic fish species included *Anguilla marmorata*, *Hemibagrus wyckioides*, *Oxyeleotris marmoratus*, and many other rare fish species,

such as *Morulus chrysophekadion*, *Chitala ornata*, *Probarbus jullieni*, *Cyclocheilichthys enoplos*... (Nguyen et al., 2009). However, this aquatic resource is facing many threats and is in danger of extinction if there are no timely and effective conservation and management measures. Main threats includes overexploitation, destructive exploitation such as using of electric fishing gears, small mesh nets, explosives... destruction of spawning and nursing grounds. In addition, the presence of a large number of exotic species, such as *Cichla ocellaris*, *Pterygoplichthys disjunctivus*, *Colosoma brachypomus* ... also greatly affects the natural aquatic resources in DNBR through competition for food and habitats, and predators of native species... In addition, DNBR also has many species of fish with colorful, beautiful shape

and unique which have great potential as aquarium fish. Therefore, the study on fish species with potential as ornamental fish helps to re-evaluate the value of these species and propose an efficient exploitation and use of biological resources contributing to increase income as well as to diverse livelihoods for people. Therefore, an up-to-date study of fish species composition at DNBR is necessary to provide an important scientific basis for the identification of rare species, endangered species, economic fish species, fish species are valuable for ornamental purposes. On that basis, proposing measures to conserve endangered species, protect and develop economic fish species, and efficiently use fish species of ornamental value. From there, helping people living in DNBR to develop economic, improve their livelihoods, as well as raise awareness in the sustainable use of aquatic resources and conservation of rare species.

## 2. Materials and Methods

The study on diversity of fish at DNBR (Figure 1) was conducted from January 2019 to August 2019.



**Figure 1.** Sampling areas at the Dong Nai biosphere reserve.

The secondary data were collected at DNBR,

Dong Nai Aquatic Resource Protection Department, Dong Nai Department of Agriculture and Rural Development ... as the basis for field investigation and survey. The content of collected data included the number of fishermen and registered fishing gears, the main fishing grounds, fish species composition and the annual catches on Tri An reservoir.

Primary data were collected through daily fishing logs of 30 fishermen (for 9 months). In addition, these fishermen were instructed on the sampling procedure (fish species that does not exist in the color photo album of fish species identified at DNBR) and how to fix fish samples in plastic bottles (5 L) containing formalin (10%). The content of collected data included species composition and catch yield of each species. The yield and species composition data were also collected from the fishing wharfs through interviews and copy the buying and selling notebooks of the owner, in addition to sorting, photographing and sampling the fish species there.

In addition, the sampling was conducted in different types of water bodies of the typical aquatic ecosystems of DNBR included Suoi Rang, Suoi Samach, Suoi Da Dung, Suoi Cop, Ba Hau, Tri An reservoir and Ramsar Bau Sau (Nam Cat Tien National Park) using dip nets, fishing net, fishing trap...

Fish samples were weighed and measured (according to the instructions of Pravdin, 1973). Fish samples were then photographed in the field, labeled with a local name, time, location, inserted into the mouth or gill, and stored in 10% formalin solution. Fish specimens were transferred to the laboratory of Faculty of Fisheries, Nong Lam University for analysis.

Fish were identified by measuring and counting different morphological parameters including total length, standard length, dorsal fin, pelvic fin, pectoral fin, lateral scale number... based on the taxonomic keys published by Vidthayanon (2008), Vasil'eva et al. (2013) and Nelson et al. (2016).

## 3. Results and Discussion

A total of 114 fish species belonging to 11 orders and 28 families were recorded (Table 1). These species belong to 28 families and 11 orders in which the Cypriniformes was the most abundant order with 50 species accounting for 43.9%

followed by the Perciformes and Siluriformes with 24 species (20%) and 21 species (18.4%), respectively (Figure 2).

**Table 1.** The fish species composition in DNBR, Dong Nai (2019)

Scientific name
Osteoglossiformes
Notopteridae
1 <i>Chitala ornata</i> (Gray, 1831)
2 <i>Notopterus notopterus</i> (Pallas, 1780)
Clupeiformes
Clupeidae
3 <i>Corica laciniata</i> Fowler, 1935
4 <i>Chupeichthys aesarnensis</i> Wongratana, 1983
5 <i>Chupeioides borneensis</i> Bleeker, 1852
Cypriniformes
Balitoridae
6 <i>Nemacheilus platiceps</i> Kottelat, 1990
Cobitidae
7 <i>Acantopsis dialuzoha</i> van Hasselt, 1823
8 <i>Lepidocephalichthys hasselti</i> (C&V, 1846)
Cyprinidae
9 <i>Barbonymus gonionotus</i> Bleeker, 1849
10 <i>Barbonymus schwanefeldi</i> Bleeker, 1854
11 <i>Barbonymus altus</i> Gunther, 1868
12 <i>Cosmochilus harmandi</i> Sauvage, 1878
13 <i>Chela laubuca</i> (Hamilton, 1822)
14 <i>Cirrhinus microlepis</i> Sauvage, 1878
15 <i>Crossocheilus reticulatus</i> Fowler, 1934
16 <i>Danio pulcher</i> Blyth, 1860
17 <i>Ctenopharyngodon idella</i> Valenciennes, 1844
18 <i>Cyclocheilichthys armatus</i> Valenciennes, 1842
19 <i>Cyclocheilichthys enoplos</i> Bleeker, 1849
20 <i>Cyclocheilichthys repasson</i> Bleeker, 1853
21 <i>Cyclocheilichthys apogon</i> Valenciennes, 1842
22 <i>Cyclocheilichthys</i> cf. <i>lagleri</i> Sontirat, 1989
23 <i>Cyprinus carpio</i> Linnaeus, 1758
24 <i>Leptobarbus hoevenii</i> Smith, 1945
25 <i>Poropuntius deauratus</i> (Valenciennes, 1842)
26 <i>Puntius</i> cf. <i>brevis</i> Bleeker, 1806
27 <i>Puntius rhombeus</i> Kottelat, 2000
28 <i>Hampala macrolepidota</i> van Hasselt, 1823
29 <i>Henicorhynchus caudimaculatus</i> Fowler, 1934
30 <i>Henicorhynchus lobatus</i> Smith, 1945
31 <i>Henicorhynchus siamensis</i> Sauvage, 1881

**Table 1.** The fish species composition in DNBR, Dong Nai (2019, con't)

Scientific name
32 <i>Labiobarbus lineatus</i> Smith, 1945
33 <i>Labiobarbus siamensis</i> Sauvage, 1881
34 <i>Thynnichthys thynnoides</i> Bleeker, 1852
35 <i>Hypophthalmichthys molitrix</i> Valenciennes, 1844
36 <i>Hypophthalmichthys nobilis</i> Richardson, 1845
37 <i>Labeo chrysophekadion</i> Bleeker, 1849
38 <i>Labeo rohita</i> Hamilton, 1822
39 <i>Osteochilus hasselti</i> Valenciennes, 1842
40 <i>Osteochilus lini</i> Fowler, 1935
41 <i>Osteochilus waandersi</i> (Bleeker, 1852)
42 <i>Osteochilus microcephalus</i> Valenciennes, 1842
43 <i>Paralaubuca barroni</i> Fowler, 1934
44 <i>Parachela maculicauda</i> Smith, 1934
45 <i>Puntioplites falcifer</i> Smith, 1929
46 <i>Puntioplites proctoysron</i> Bleeker, 1865
47 <i>Puntius orphoides</i> Valenciennes, 1842
48 <i>Rasbora trilineata</i> Steindachner, 1870
49 <i>Esomus metallicus</i> Ahl, 1923
50 <i>Rasbora paviana</i> syn. <i>R. paviei</i> Tirant, 1885
51 <i>Rasbora borapetensis</i> Smith, 1934
52 <i>Scaphognathops stejneri</i> Smith, 1931
53 <i>Mystacoleucus marginatus</i> Valenciennes, 1842
54 <i>Systemus aurotaeniatus</i> Tirant, 1885
Gyrinocheilidae
55 <i>Gyrinocheilus aymonieri</i> Tirant, 1883
Siluriformes
Bagridae
56 <i>Hemibagrus nemurus</i> (Valenciennes, 1839)
57 <i>Hemibagrus wyckioides</i> (Fang & Chaux, 1949)
58 <i>Hemibagrus filamentus</i> (Fang & Chaux, 1949)
59 <i>Mystus albolineatus</i> Roberts, 1994
60 <i>Mystus rhegma</i> Fowler, 1935
61 <i>Mystus mysticetus</i> Roberts, 1992
62 <i>Mystus nemurus</i> Valenciennes, 1840
63 <i>Mystus singaringan</i> Bleeker, 1846
64 <i>Pseudomystus siamensis</i> Regan, 1913
Bagriichthidae
65 <i>Bagrichthys obscurus</i> Ng, 1999
Clariidae
66 <i>Clarias batrachus</i> Linnaeus, 1758
67 <i>Clarias gariepinus</i> Burchell, 1822

**Table 1.** The fish species composition in DNBR, Dong Nai (2019, con't)

Scientific name
68 <i>Clarias macrocephalus</i> Gunther, 1864 Loricariidae
69 <i>Pterygoplichthys disjunctivus</i> Weber, 1991 Pangasiidae
70 <i>Pangasius macronema</i> Bleeker, 1850 Akysidae
71 <i>Akysis maculipinnis</i> Fowler, 1934 Siluridae
72 <i>Micronema bleekeri</i> Bocourt, 1866
73 <i>Micronema apogon</i> Bleeker, 1851
74 <i>Ompok siluroides</i> Lacepede, 1803
75 <i>Kryptopterus</i> sp.
76 <i>Wallago attu</i> Bloch & Schneider, 1801 Beloniformes Belonidae
77 <i>Xenentodon cancila</i> Hamilton, 1822
78 <i>Xenentodon canciloides</i> Bleeker, 1854 Hemiramphidae
79 <i>Dermogenys siamensis</i> Fowler, 1934
80 <i>Hyporhamphus limbatus</i> Valenciennes, 1847
81 <i>Zenarchopterus ectuntio</i> Hamilton, 1822
82 <i>Dermogenys pusilla</i> Kuhl & van Hasselt, 1823 Synbranchiformes Mastacembelidae
83 <i>Mastacembelus</i> cf. <i>circumcinctus</i> Hora, 1924
84 <i>Mastacembelus armatus</i> (Lacepede, 1800)
85 <i>Macrogathus siamensis</i> Gunther, 1861
86 <i>Mastacembelus favus</i> Hora, 1923 Synbranchiformes Synbranchidae
87 <i>Monopterus albus</i> Zuiew, 1793 Perciformes Anabantidae
88 <i>Anabas testudineus</i> Bloch, 1792 Ambassidae
89 <i>Parambassis siamensis</i> Fowler, 1937
90 <i>Parambassis apogonoides</i> Bleeker, 1851
91 <i>Parambassis wolffi</i> Bleeker, 1850 Channidae
92 <i>Channa lucius</i> Cuvier, 1831
93 <i>Channa striata</i> Bloch, 1793
94 <i>Channa</i> cf. <i>gachua</i> Hamilton, 1822 Cichlidae
95 <i>Cichla ocellaris</i> Bloch & Schneider, 1801
96 <i>Oreochromis mossambicus</i> Peters, 1852

**Table 1.** The fish species composition in DNBR, Dong Nai (2019, con't)

Scientific name
97 <i>Oreochromis niloticus</i> Linnaeus, 1758
98 <i>Oreochromis</i> red hybrid Eleotridae
99 <i>Oxyeleotris marmorata</i> Bleeker, 1852 Gobiidae
100 <i>Brachygobius sabanus</i> Inger, 1958
101 <i>Glossogobius aureus</i> Akihito & Meguro, 1975
102 <i>Glossogobius giuris</i> (Hamilton, 1822)
103 <i>Papuligobius ocellatus</i> (Fowler, 1937)
104 <i>Gobiopterus</i> cf. <i>chuno</i> Hamilton, 1822
105 <i>Brachygobius</i> cf. <i>nunus</i> Hamilton, 1822 Helostomatidae
106 <i>Helostoma temminckii</i> Cuvier, 1829 Pristolepididae
107 <i>Pristolepis fasciata</i> Bleeker, 1851 Belontiidae
108 <i>Trichopodus microlepis</i> Gunther, 1861
109 <i>Trichopsis vittata</i> Cuvier, 1831
110 <i>Trichopodus trichopterus</i> Pallas, 1770
111 <i>Betta prima</i> Kottelat, 1994 Tetraodontiformes Tetraodontidae
112 <i>Monotretete leiurus</i> (Bleeker, 1850) syn. <i>Tetraodon leiurus</i> (Bleeker, 1951)
113 <i>Carinotetraodon lorteri</i> (Tirant, 1885) Atheriniformes Phallostethidae
114 <i>Phallostethus</i> cf. <i>smithi</i>

The total number of species found in this study was more than that recorded by Nguyen (1987), Nguyen et al. (2005) and Nguyen et al. (2009) who reported the total number of 102, 109, 67 and 99 species, respectively (Table 2). The reason for the high number of species found in this study could be due to the combination of different research methods: photo-list interviews, indirect sampling from fishing wharfs and fishermen, and direct sampling for a long time on the field from different types of water bodies, especially from the restricted and prohibited fishing areas for commercial purposes.

The results noted the presence of two freshwater pufferfish species *Monotretete leiurus* (Bleeker, 1850) and *Carinotetraodon lorteri* (Tirant, 1885) which were not recorded by Nguyen et al. (2009). In addition, during field survey, a species of phallostethid fishes, *Phenacostethus smithi*, was col-

lected in the slow-flowing water body near to Tri An reservoir. This finding is very important and significant because this is the first time this species has been recorded in DNBR. In addition, the phallostethid fauna has not been well studied in Vietnam, especially in Dong Nai province. On the other hand, *Scleropages formosus*, *Wallago micropogon* and *Anguilla marmorata* are rare and high economic value species of DNBR. However, of all the field sampling trips in this study, none of individual of these species were collected.

**Table 2.** Similarity and difference in species number and composition between this study and previous studies

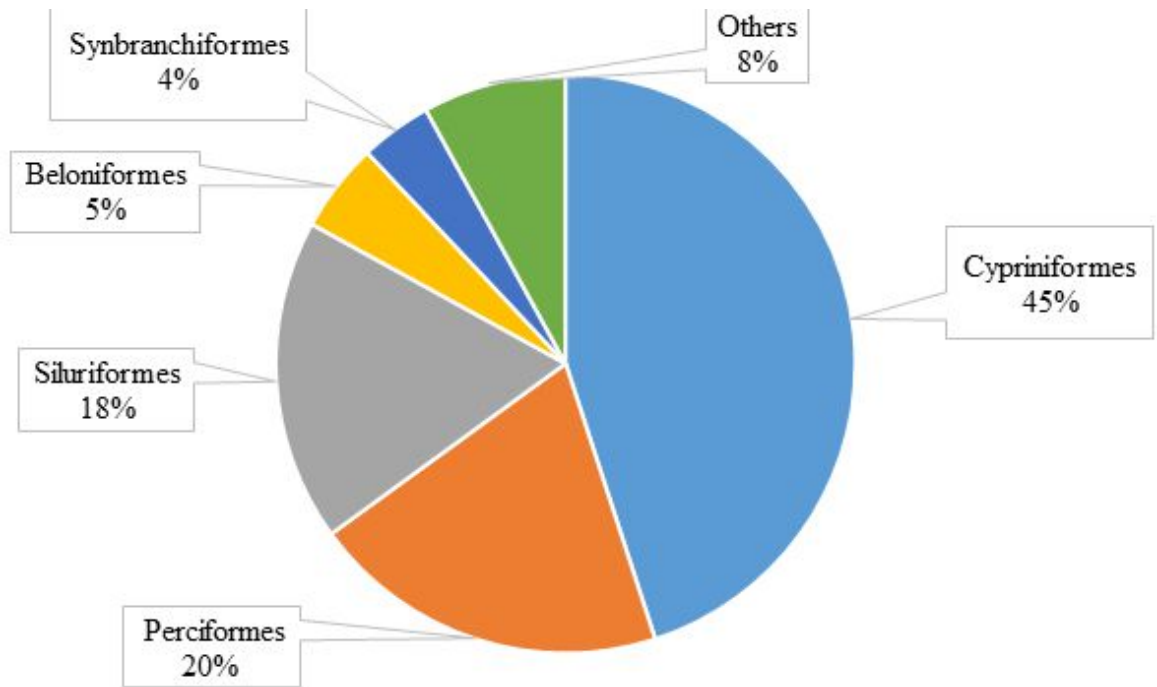
Author	No of species
Nguyen (1987)	102
Nguyen et al. (2005)	109
Nguyen (2005)	67
Nguyen et al. (2009)	99
Present study	114

Out of 114 recorded species, there were 09 species of fish on the list of rare and endangered fish species of Ministry of Agriculture and Rural Development of Vietnam (MARD, 2008), 3 species (*Chitala ornata*, *Cosmochilus harmandi* and *Hemibagrus filamentus*) on the Vietnam red list book (MOST, 2007), 01 species (*Ompok bimaculatus*) on the IUCN Red List (2015). *Ompok bimaculatus* (CR), *Clarias batrachus* (CR) *Chitala ornata* (EN) are in danger of extinction. The remaining species are in threaten of extinction if there are no timely and effective conservation and management measures (Table 3). Survey data also showed that *Ompok bimaculatus*, *Clarias batrachus*, *Cosmochilus harmandi*, *Hampala macrolepidota*, *Morulius chrysopeka-dion*, *Hemibagrus filamentus*, *Hemibagrus wyckioides* and *Gyrinocheilus aymonieri* were in high demand despite their high selling price. The main reasons are that these fish have delicious meat and very few tiny bones. The supply of these fish to the market mainly comes from wild fishing. However, the results of this study confirmed the finding of previous studies that the yield of these species is decreasing rapidly and the size of catches fish is very small as compared to before. The main causes of this decrease are overfishing, using destructive fishing gears, such as electric pulses, small mesh nets, explosives... destroying spawning and nursing grounds. Therefore, it is necessary to apply strict regulations and sanc-

tions to protect and conserve these species, such as banning destructive fishing gears, regulating the age (or size) of fish for catching, regulating the mesh size, regulating the fishing season, restricting or prohibiting seasonal fishing at spawning and nursing grounds... In addition, the diversification of cultured species also contributes to reducing the pressure of wild fishing. Therefore, it is necessary to develop a small-scale aquaculture system to culture these species to not only reduce the pressure of exploiting them in the wild, but also create more jobs and improve the income of the people living in DNBR. However, culture of these species for commercial purpose should rely on artificial seed and artificial feed, avoid using trash fish as feed. In addition, the annual release of artificial fingerlings also helps to restore their populations in the wild. Further, it is essential to establish conservation zones for indigenous aquatic species, endangered species in each ecological zone.

Contrary to the state of these species, the survey results showed that the catch of *Chitala ornata* at fish wharfs was relatively high with sizes of catches fish quite big. However, these individuals may not be pure and endemic species of DNBR but possibly crossbred species escaping from fish cages. The crossbred species has no conservation value. Therefore, it is necessary to examine the genes of the captured fish to determine whether it is endemic or not as well as their distribution area for conservation purposes.

Survey results also recorded the appearance of 11 exotic fish species (Table 4). The results at fishing wharfs indicated that the catches of these species were quite high, especially *Cyprinus carpio*, *Aristichthys nobilis*, *Hypostomus plecoftomus*, *Hypophthalmichthys molitrix*, *Oreochromis niloticus*... These species are imported into Vietnam for different purposes: to diversify cultured species such as *Cyprinus carpio*, *Ctenopharyngodon idellus*, *Aristichthys nobilis*, *Hypophthalmichthys molitrix*, *Labeo rohita*..., and to serve as ornamental species (*Cichla ocellaris*, *Hypostomus plecoftomus*...). Most alien species are omnivores fish which are well adapted and easily reproduce naturally in new habitats. Therefore, populations of these species grow very rapidly in the natural waters of DNBR. The increase in populations of *Cyprinus carpio*, *Ctenopharyngodon idellus*, *Aristichthys nobilis*, *Hypophthalmichthys molitrix*, *Labeo rohita*,



**Figure 2.** Fish species composition recorded at Dong Nai biosphere reserve.

**Table 3.** List of rare and endangered fish species<sup>1</sup>

Scientific name	MARD (QD-82/2008) (*)	VRB-2007 (*)	IUCN-2020 (*)
1 <i>Ompok bimaculatus</i> Bloch, 1794	CR		NT
2 <i>Clarias batrachus</i> Linnaeus, 1758	CR		LC
3 <i>Chitala ornata</i> Gray, 1831	EN	VU	LC
4 <i>Cosmochilus harmandi</i> Sauvage, 1878	VU	VU	LC
5 <i>Hampala macrolepidota</i> Kuhl&Van, 1823	VU		LC
6 <i>Morulius chrysophekadion</i> Bleeker, 1850	VU		LC
7 <i>Hemibagrus filamentus</i> Fang&Chaux, 1949	VU	VU	DD
8 <i>Hemibagrus wyckioides</i> Chaux&Fang, 1949	NT		LC
9 <i>Gyrinocheilus aymonieri</i> Tirant, 1883	VU		LC

<sup>1</sup>Sources: MARD (2008), Vietnam red list book (MOST, 2007), IUCN's red list (2015).

\*MARD: Ministry of Agriculture and Rural Development; VRB: Vietnam red list book; IUCN: International union for conservation of nature; CR: critically endangered; EN: endangered; VU: vulnerable; NT: near threatened (includes LR/nt-lower risk/near threatened); LC: Lowest concern; DD: data deficient.

*Helostoma temminckii*... has contributed to increasing aquatic resources in DNBR, especially in Tri An reservoir, thereby improving income and stabilizing people's livelihoods. However, the overgrowth of species, such as *Hypostomus plecoftomus*, *Oreochromis niloticus*, *Oreochromis spp.*... is considered a high risk to the populations of native fish species in term of food and habitat competition.

Survey results also recorded 78 economic fish species, accounting for 67.83% of the total fish species in DNBR. There were 10 species with an annual catches more than 200 tons/year including freshwater anchovy group (approx. 2500 tons/year, accounting for 35.3% of the total catch, mainly species of *Corica laciniata*, *Clupeichthys aesarnensis*, *Clupeoides borneensis*); Wrestling halfbeak group (1225 tons/year, accounting for 15.2% of the total catch, mainly

**Table 4.** List of exotic fish species

	Scientific name
1	<i>Cyprinus carpio</i> (Linnaeus, 1758)
2	<i>Ctenopharyngodon idellus</i> (Cuvier & Valenciennes, 1844)
3	<i>Aristichthys nobilis</i> (Richardson, 1844)
4	<i>Hypophthalmichthys molitrix</i> (Cuvier & Valenciennes, 1844)
5	<i>Labeo rohita</i> (Hamilton, 1822)
6	<i>Hypostomus plecoptomus</i> (Linnaeus, 1758)
7	<i>Oreochromis niloticus</i> (Linnaeus, 1757)
8	<i>Oreochromis</i> spp.
9	<i>Cichla ocellaris</i> Schneider, 1801
10	<i>Clarias gariepinus</i> (Burchell, 1822)
11	<i>Helostoma temminckii</i> (Cuvier, 1829)

**Table 5.** List of species with potential as aquarium fish

	Scientific name
1	<i>Channa</i> cf. <i>gachua</i> Hamilton, 1822
2	<i>Rasbora borapetensis</i> Smith, 1934
3	<i>Danio albolineatus</i> Blyth, 1860
4	<i>Trichopsis vittata</i> (Cuvier, 1831)
5	<i>Esomus metallicus</i> Ahl, 1924
6	<i>Rasbora trilineata</i> Steindachner, 1870
7	<i>Rasbora paviana</i> syn. <i>R. paviei</i> Tirant, 1885
8	<i>Chela laubuca</i> Hamilton, 1822
9	<i>Trichopodus trichopterus</i> Pallas, 1770
10	<i>Brachygobius nunus</i> Hamilton, 1822
11	<i>Hyporhamphus limbatus</i> Valenciennes, 1847
12	<i>Betta splendens</i> Regan, 1910
13	<i>Betta prima</i> Kottelat, 1994

species of *Dermogenys siamensis*, *Hyporhamphus limbatus*, *Zenarchopterus ectuntio*, *Dermogenys pusilla*); *Oreochromis mossambicus* (565 tons/year); *Cyprinus carpio* (412 tons/year); *Glossogobius giuris* (229 tons/year), etc. The results indicated that these species are the main fishing species and are contributing greatly to people's livelihoods. The results also showed that the catches of trash fish were relatively high at 574 tons/year. Trash fish is a by-product of fishing for higher value fish. Trash fish comprised the greatest amount of fish (Small mixed fish, low value fish, spoiled high value fish...) but included small molluscs, crustaceans... There are three terms for trash fish in Vietnamese: trash fish, trawler fish and pig fish, the latter being the lowest quality only and therefore having a more restricted meaning than the other two terms. The composition of trash fish will also vary depending on the type of gear set to fish

but most is from trawling. Trawling fish is often used for direct feeding to farmed fish or livestock. The results also showed that there is conflicting uses for trash fish for different purposes such as: aquaculture feed, livestock feed and direct human food. Some species identified as trash fish are currently being used as human food with high consumption demand at the high prices, especially *Dermogenys siamensis*, *Hyporhamphus limbatus*, *Zenarchopterus ectuntio*, *Dermogenys pusilla* species. In recent years, the catch composition is changing dramatically, with the rise of trash fish, especially from trawling. Although fishing technology has improved with better targeting of high value species, trash fish biomass continues to increase. If this continues, it will deplete aquatic resources in the area and directly affect people's livelihoods.

On the other hand, the results noted that many species of fish in DNBR have been exploited

for the ornamental fish trade such as *Chitala ornata*, *Mastacembelus armatus*, *Mastacembelus favus*, *Pseudomystus siamensis*, *Gyrinocheilus pennocki*... There are also still many species that have great ornamental fish potential included *Channa* cf. *gachua*, *Rasbora borapetensis*, *Danio albolineatus*, *Brachyogobius nunus*, *Hyporhamphus limbatus*, *Betta splendens*, *Betta prima*, *Nemacheilus* spp., *Lepidocephalichthys* sp., *Pangio* spp., *Barilius* cf. *koratensis*, (Table 5)... In addition, many of them have also been successfully bred in captivity and conserved for example *Channa* cf. *gachua*, *Chitala ornata*, *Mastacembelus armatus*, *Mastacembelus favus*, *Betta splendens*, *Betta prima*...

#### 4. Conclusions

The total number of fish species recorded in Dong Nai biosphere reserve was 114 species belonging to 28 families and 11 orders. There were 09 species of fish on the list of rare and endangered fish species of Ministry of Agriculture and Rural Development of Vietnam, 3 species (*Chitala ornata*, *Cosmochilus harmandi* and *Hemibagrus filamentus*) on the Vietnam red list book, 01 species (*Ompok bimaculatus*) on the international union for conservation of nature red list, 11 exotic species, 78 commercial species and 13 species having potential as aquarium fish. The study also found the first presence of a species of phallostethid, *Phenacostethus smithi* in Dong Nai biosphere reserve.

#### Acknowledgement

We are especially grateful to the staff of Dong Nai Culture Nature Reserve and Vinh Cuu Ranger County for assisting sampling and field trips. We thank also to Mr. Bui Huu Manh for identification the samples. This work was financially supported by Dong Nai Biosphere Reserve Management and student research funding of Nong Lam University – Ho Chi Minh City.

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