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Morphological and Molecular Identification of species of Catfish Genus *Cranoglanis* from Lam River, Nghe an, Vietnam

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ABSTRACT: Cranoglanidid catfish are known to be typical of some fish fauna and well known for their delicious and nutritious meat. In Vietnam, they are found in the major river systems such as the Bang Giang river system (Bằng river and KyCung river), Thai Binh river system, Lo Gam river system, Chay river, Red river, Da river, Ma River, Ca River (Song Lam). Diversity of cranoglanidid catfish remains unclear and their identification by morphology has given different views. Cranoglanidid use of morphological identification and molecular identification has recently been a new approach. Our present study using both these methods of identification is to elucidate the identity of Cranoglanidid catfish species living in Lam river system based on specimens collected in Tuong Duong, Con Cuong, Thanh Chuong and Nam Dan (Lam river system, Nghe An, Vietnam).

Keywords: Cranoglanidid catfish, identification, morphology, molecular identification.

INTRODUCTION

Cranoglanidid catfish are known to be typical of the South China and Northern Vietnam fish fauna. They live at bottom and near bottom, preferring moderately and slowly running waters with much sandy and muddy bottom. They usually live in colonies and are found mainly in the downstream of rivers in Northern provinces. Cranoglanidid catfish are famous for their tasty and nutritious meat. Their local names are Ngạnh fish (large fish), hau fish (small fish), haumùn fish, hautrunghoa fish (Vietnamese name), Papé (Thai name). *Cranoglanis* catfish are categorized as VU in the IUCN Red List.

In the world, the catfish *Cranoglanis henrici* is distributed in Thailand, Philippines, Indonesia, China (Hainan island, Guangdong, Guangxi, Yunnan) and Vietnam (Pravdin, 1963, Red Book of Vietnam). In Vietnam, Cranoglanidid catfish are found in all river systems from the North to the South of central Vietnam, but not found in the South. In the North, catfish can be found in major river systems such as the Bang Giang river system (Bang river and KyCung river), Thai Binh river system, Lo Gam river system, Chay river, Red river, Da river, Ma River, Ca River (Song Lam). According to Mai Dinh Yen (1979), Nguyen Huu Duc (1995); only *C. sinensis* Peters, 1881 was recorded from Northern Vietnam. However, Nguyen Van Hao (2005) reported four species *C. bouderius* (Richardson, 1846); *C. henrici* (Vaillant, 1893); *C. caolangensis* Nguyen, 2005; *C. songhongensis* Nguyen, 2005 from Northern Vietnam. Particularly *C. sinensi* was synonyzed with *C. bouderius*. The identification by these authors was based only on morphology.

The combination of morphological and molecular identification will give reliable result and a new approach in identification of plants, animals in general and aquatic animals in particular. For *C. bouderius*, the COI gene sequence was published in the genBank. In this study, we collected Cranoglanidid catfish from localities Tuong Duong, Con Cuong, ThanhChuong and Nam Dan (in the Lam river system, Nghe An province, Vietnam) and employed both morphological identification method and molecular identification method to elucidate the identity of the Cranoglanidid catfish from the Lam river system. Result obtained will be of great significance in science and practice as well as contribute to the better understanding of the world and Vietnam about identification of Cranoglanidid catfish from the Lam River, Vietnam.

MATERIAL AND METHODS

A. Method of sampling

Cranoglanidid catfish specimens were directly bought from fishermen who caught them from various localities in the river in Tuong Duong, Con Cuong, Thanh Chuong and Nam Dan districts. The catfish were domesticated in cement tanks at Vinh University of Nghe An and the whole fish were then frozen and taken to Research Institute for Aquaculture 1- Bac Ninh for morphological identification. Before the catfish were treated with 10% formalin, their fins had been removed and preserved in alcohol of 98^{o}C to extract DNA for molecular identification.

B. Method of morphological identification

- Method of count and measurement of morphological characters:

A procedure was applied as follows:

- Preliminary classification: common, easily visible and specific characters of cranoglanidid catfish species were observed and identified.

Counts and measurements of morphological characters followed “A guide of fish study” by Pravdin (1963) and relevant papers published in the international scientific journals on catfish species of the order Siluriformes (Table 1). Measurements used in this study included: head length (HL), head width (HW), head depth (HD), preanallength (PAL), predorsallength (PDL), body depth at anus (BDa), length of caudal peduncle (LCP), depth of caudal peduncle (DCP), pectoral fin length (PL), the dorsal longest spike length (DSL) dorsal fin length (DL), anal fin length (AL), ventral fin length (VL), jaw barbell length (JBL). These measurements were compared to the standard length (SL). Measurements compared to the length of the head included snout length (SnL), snout width (RM), and interorbital distance (OO). Counts included number of dorsal-fin rays (D), number of anal fin rays (A), and number of pectoral fin rays (P).

- Morphological characters were examined and compared with those in references by Mai Dinh Yen (1978); Vaillant (1893), Ng & Kottelat (2000); Nguyen Van Hao (2005).

- Data was processed using the Excel software with descriptive statistics; measurements were calculated as ratiosagainst the standard length of the body and the length of the head.

- Method of radiography

According to Ng and Kottelat (2000), number of vertebrae (ver) and number of anal fin rays (A) are indicators important for identification of the cranoglanidid catfish species. Therefore, we took X-rays of all 26 specimens in this study. X-ray results are examined by 3 independent persons and data obtained was then averaged. This data is relatively stable and unaffected by subjective factors (such as fixation and preservation, errors during measurement).

C. Method of identification by molecular markers

- Total DNA extraction from fin samples

The total DNA from fins of Cranoglanidid catfish was extracted using Qiagen's Deaasy Tissue kit. Quantity and quality of the extracted DNA samples waschecked by agarose gel electrophoresis (0.8%) and by Nanodrop 2000 spectrophotometer.

- PCR amplification of COI gene sequence:

PCR amplification of COI region was performed in the Mastercycler Pro Susing the FishF1-FishR1 primer pair (Ward et al., 2005). The sequence of FishF1 is TCAACCAACCACAAAGACATTGGCAC and that of FishR1 is TAGACTTCTGGGTGGCCAAAGAATCA. The Annealing temperature is 53°C. The amplification reaction was carried out in a total volume of 25 µl including 100 mMTris HCl (pH 8.3), 500 mMKCl (pH 8.3), 2.5 µlMgCl (25 mM), 1.0 µldNTPs(5mM) 0.5 µl each of forward primer and reverse primer (10 µm / µl per primer) and 1 µ / µlTaq Polymerase, 2 µl of template DNA (~100 ng / µl) and de-ionized water. Thermocycling included denaturation in 2 min at 94°C; 35 cycles of 30 s at 94°C, 45 s at 53°C and 1 min at 30 s 72°C, finally with a strand extension of 10 min at 72°C and held at 4°C.

- Sequencing COI of the mitochondrial gene:

PCR products were checked by 2% agarose gel electrophoresis and then purified using the TM PCR SV kit of Gene All Expinand subsequently sequenced using the CEQ ™ 8000 Genetic Analysis System. The purified products were labeled with the Bigeye Terminator v3.1 Cycle Sequencing Kit, with a 10 µl reaction mixture containing: 4.94 µl purified water, 1.94 µl Big Dye buffer 5 × (400 mMTris-HCl pH 9.0 and 10 mM MgCl2), 0.12 µlBigDye Terminator and 1 µlExoSAP products. Then, two-directional sequencing using Applied Biosystems was performed. Genomelab system analysis software was used to generate sequencing files and to read adjacent lengths.

- Sequence analysis and alignment:

Gene sequences were checked using Finch TV 1.4.0 (http://www.geospiza.com) and then compared and aligned by the ClustalWonBioEdit.

- Species identification:

Sample identification based on sequence similarity was carried out using the Genbank database. DNA sequences were compared and analyzed for similarity with sequences in the international gene bank via the BLAST (Basic Local Alignment Search Tool) software.

The sequences were annotated based on the BLAST results (the degree of similarity with known protein / nucleotide sequences). The decoded sequences can be correctly identified based on the BLAST results. Sequences similar to known sequences in Genbank were identified with parameters of coverage and identity included.

RESULTS AND DISCUSSION

A. Results of morphological identification by count and measurement

26 cranoglanidid catfish specimens from Tuong Duong, Con Cuong, Thanh Chuong, Nam Dan (Nghe An) were morphologically measured; results are shown in Table 1.

Table 1: Measurements of cranoglanidid catfish specimens from Nghe An.

Percentage (%) to the head length			Percentage (%) to the standard length															Code	Locality	N0
OO/HL	MW/HL	Snl/HL	JBL/SL	VL/SL	AL/SL	DL/SL	DSL/SL	PL/SL	DCP/SL	LCP/SL	BDa/SL	PDL/SL	PAL/SL	HD/SL	HW/SL	HL/SL	HL	SL (mm)			
47,9	34,2	43,6	39,3		32	7,8			6,5	13,4	24,9	39,3	58	16	16,7	25	44,5	178	Tuong Duong 1	Tuong Duong	1
48,7	31,6	46,2	39,3	14,1	31,3	8,6		20	9,1	11,8	22,9	38,9	55,3	15	16,3	25	46,8	187	Tuong Duong 2		2
55,2	37,7	47,6	39,3	14,5	30,7	9,4	22	20	9	12,1	26,5	41,4	63	15,7	18	26,6	71,7	270	Tuong Duong 3		3
48,3	34,5	42,2	31,7	11,8	31	8,5	21,8	18	8,4	12,1	24	40,7	58,6	15,3	17,5	25,5	78,2	307	Tuong Duong 4		4
46,7	31,3	46	34,3	11,7	25,2	8	16,9	17	8,7	13	22,8	42	58,8	17,5	18,2	26,6	59,8	225	Tuong Duong 5		5
44,2	32	43,9	31,1	13	33,4	8,9	19,2	16	8,4	10,9	22,8	39,6	56,5	16,8	17,5	26,2	59	225	Tuong Duong 6		6
45,9	35,1	45,4	36,5	13	29,4	8,6	21,4	20	8,3	11,9	20	38,5	59,7	16,5	16,1	26,2	53,8	205	Tuong Duong 7		7
43,5	39	41,1	37,8	14,7	31,1	8,3			7,9	11,7	20	37,7	60,6	15,4	16,8	25,7	46,2	180	Con Cuong 2	Con Cuong	8
45,8	33,2	42,0	41,4	13,6	30,8	9			8,6	12,9	23,5	37,7	57	16,8	18	24,4	45,2	185	Con Cuong 3		9
49,5	42,6	42,4	42,8	13,7	32,4	8,2			8,6	12,7	24,7	39,7	66	17,3	18,3	27,4	49,3	180	Con Cuong 4		10
44,5	31,5	44,3	39,5	13,8	33,3	8,5			8,2	12,7	21,9	37,4	55,9	16,3	17,2	26,1	50,8	195	Con Cuong 5		11
47,3	41,8	44,6	39,4	15,8	30,2	8,8			8,4	13,1	23,2	36,8	57,1	14,1	16,8	25	45,5	182	Con Cuong 6		12
47,8	34	44,2	47,6	13,4	33	8,9			7,8	11,1	22,6	38,7	56,4	14,9	18,2	26,2	45	172	Con Cuong 7		13
44,7	35,1	43,7	41,5	12,4	33,8	7,3	18,7	19	8,1	12,2	20,6	39	56,8	15,5	15,9	24,7	40,5	164	ThanhChuong 1	ThanhChuong	14
43,2	32,9	43,2	43,7	13,5	29,5	8,6			8,6	12,9	22,4	38,7	59,5	15,9	16,8	26,2	45,6	174	ThanhChuong 2		15
46,6	34,2	43	23	14,7	33,4	8,5			8,3	12,2	22,5	39,4	59,2	17	17,5	26,9	47,9	178	ThanhChuong 3		16
43,2	35,6	41,	45,7	12,3					8,3	11,1	21,9	39,7	56	14,6	15,1	25,7	45,8	178	ThanhChuong 4		17
54,1	34,9	45,6	35,7	11,9	33,6	9,2	20,2	17	8,9	13,6	26,4	37,4	57,6	16,6	18,8	26,3	62,5	238	ThanhChuong 5		18
47,9	33,7	44,6	34,7	9,02	31,1	9,1	19,3	15	8,7	12,4	22,9	38,8	59,8	17,2	17,8	25,7	57,8	225	ThanhChuong 6		19
48,4	34,1	43,6	47,4	14,1	29,3	8			9,6	12,6	23,3	38,6	57,3	15,4	14,5	25,1	44	175	Nam Đan 1	Nam Đan	20
Cả	32,3	40,5	39,2	13,3	30,9	7,7		17	9,4	12,8	23,3	38,2	60,3	16,1	16,6	25,6	46,4	181	Nam Đan 2		21
46,2	35,1	43,4	46,8	13,4	27,2	8,7			8,8	14,2	23,3	39,4	59,7	14,7	17,6	26	46,1	177	Nam Đan 3		22
53,6	31,6	42,8	45,7	Là	31,9	7,8			8,7	13,8	23,8	39,1	56,8	16,2	16,7	25,4	47,2	186	Nam Đan 4		23
43,6	34,8	49,2	33,5	13,5	28	8,8	22,5	17	8,3	11,4	22	41,7	63	16,5	17,8	27	58,9	218	Nam Đan 5		24
46,6	32	49,8	33,8	13,6	27,8	9,1	20,9	20	7,6	11,6	20,2	40,9	61,4	15,7	18,8	28,4	50	176	Nam Đan 6		25
45,3	31,4	48,3	35	13,6	28,3	8,5	22,7	19	8,2	11,8	21,5	39,8	62,6	16,8	16,9	25,9	57	220	Nam Đan 7		26

The catfish genus *Cranoglanis* currently includes three species, viz, *C. bouderius*, *C. henrici* and *C. multiradiatus*. In Vietnam, Nguyen Van Hao described 2 new species, namely *C. caolangensis* now being the synonym of *C. multiradiataus* (Koller 1927) and *C. songhongensis* maybe being the synonym of *C. henrici* (Vaillant, 1893; Kottelat, 2013). According to Ng and Kottelat (2000), *C. henrici* differs from *C. bouderius* by the longer anal fin base (30.2-35.0 vs. 27.6-30.0) and more branched rays (34-39 versus 28-32) or more vertebrae (46-47 vs. 41-44); differs from *C. multiradiatus* by a narrower mouth (34.5-36.4% HL versus 30.8) and a wider interorbital distance (47.0-55.0% HL vs. 41.9- 42,4).

Therefore, 26 specimens in Table 2 are divided into two groups based on the anal fin base length (AL), the snout width (MM), and the interorbital distance (OO): one group is *C. bouderius* with an AL / SL ratio (in %) less than 30 (eg. in specimens TD1, Nam Dan 3, ND10-12) and the another is possibly the remaining two species (Table 2).

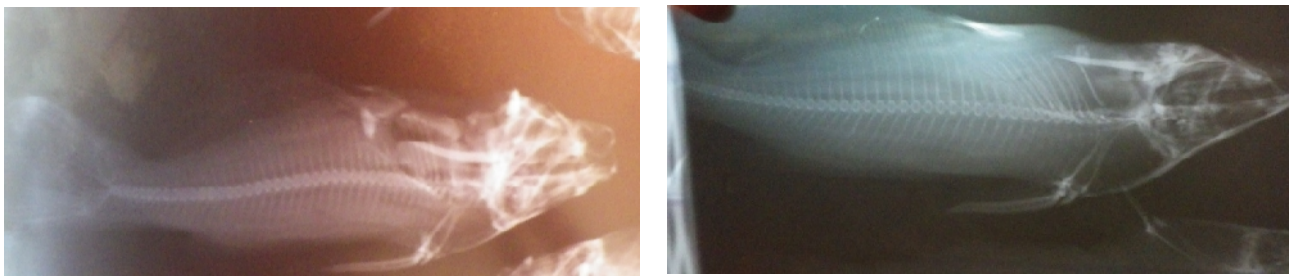


Fig. 1. X-ray films of specimens TD2 (left) and TD3 (right).

Table 2: Count data for cranoglanidid catfish specimens from Nghe An based on X-ray films.

Scientific name	**X-ray count**		**Visual count**			**SL (mm)**	**code**	**locality**	**no**
	A	Ver	P	A	D				
Cranoglanis bouderius	34	43	I, 10	35	I, 6	178	Tuong Duong 1	Tuong Duong	1
Cranoglanis bouderius	37^{H}	44		38^{H}	I, 6	187	Tuong Duong 2		2
Cranoglanis henrici	43^{H}	46^{H}	I, 11	38^{H}	I,6	270	Tuong Duong 3		3
Cranoglanis henrici	42^{H}	46^{H}	I, 11	38^{H}	I, 6	307	Tuong Duong 4		4
Cranoglanis bouderius	34	44	I, 11	31	I, 6	225	Tuong Duong 5		5
Cranoglanis bouderius	37^{H}	44	I, 12	36	I, 6	225	Tuong Duong 6		6
Cranoglanis bouderius	43^{H}	45	I, 12	35	I, 6	205	Tuong Duong 7		7
Cranoglanis bouderius	36	43	I, 11	38^{H}	I, 6	180	Con Cuong 2	Con Cuong	8
Cranoglanis bouderius	36	44	I, 12	34	I, 6	185	Con Cuong 3		9
Cranoglanis bouderius	38^{H}	43	I, 12	37^{H}	I, 6	180	Con Cuong 4		10
Cranoglanis bouderius	35	42	I, 11	35	I,6	195	Con Cuong 5		11
Cranoglanis bouderius	36	44		37^{H}	I, 6	182	Con Cuong 6		12
Cranoglanis bouderius	34	40		36	I,6	172	Con Cuong 7		13
Cranoglanis bouderius	30	40		35		164	Thanh Chuong 1	Thanh Chuong	14
Cranoglanis bouderius	32	44	I, 11	36	I, 6	174	Thanh Chuong 2		15
Cranoglanis bouderius	33	43	I, 11	34	I, 6	178	Thanh Chuong 3		16
Cranoglanis bouderius	37^{H}	41		38^{H}	I, 6	178	Thanh Chuong 4		17
Cranoglanis henrici	41^{H}	46^{H}	I, 11	37^{H}	I, 6	238	Thanh Chuong 5		18
Cranoglanis bouderius	36	44	I, 11	34	I, 6	225	Thanh Chuong 6		19
Cranoglanis bouderius	32	44	I, 11	34	I, 6	175	Nam Đan 1	Nam Đan	20
Cranoglanis bouderius	36	40	I, 11	34	I, 6	181	Nam Đan 2		21
Cranoglanis bouderius	32	43		26	I, 6	177	Nam Đan 3		22
Cranoglanis bouderius	32	43	I, 11	34	I, 6	186	Nam Đan 4		23
Cranoglanis bouderius	33	43	I, 11	29	I, 6	218	Nam Đan 5		24
Cranoglanis bouderius	35	41	I, 11	32	I, 6	176	Nam Đan 6		25
Cranoglanis henrici	40^{H}	46^{H}	I, 11	36	I, 6	220	Nam Đan 7		26

Further distinguishing between *C. henrici and C. multiradiatusis* based on the interorbital distance, identifying most of the remaining specimens as *C. henrici*. Thus, there are two species, *C. bouderius* and *C. henrici*, occurring in the study area. Due to errors possibly from measurements and specimen preservation, we take account of count data based on X-rays films for these 26 specimens.

In general, the X-ray images are quite clear that are very helpful for morphological identification. Data on number of vertebrae and number of anal fin rays (A) was obtained based on X-ray films (Table 2).

According to Nguyen Van Hao (2005), the total number of anal fin rays varied among species, ranging from 27 to 35 in *C. bouderius* and 39-43 in *C. henrici*. Meanwhile, according to Ng and Kottelat (2000), *C. henrici* had more branched rays of anal fin and also more vertebrae than *C. bouderius* (34-39 rays vs. 28-32and 46- 47 vertebrae vs. 41-44). Consequently, the total anal fin rays ranged from 37-43 in *C. henrici* and 31-36 in *C. bouderius* (Ng and Kottelat, 2000). Based on the number of anal fin rays by visual count, eight specimens were identified as *C. henrici*. Meanwhile, based on X-ray films, nine specimens were identified asthis species, including specimens TD2, TD3 and ND12, but excluding specimens Concuong 2 and CC5 that were *C. henrici* by visual count (Table 2). Among characters counted, the number of vertebrae is important for separating these 2 species. In table 3, 4 specimens with 46 vertebrae were identified as *C. henrici.* However, vertebrae may have geographic variation, thus molecular analysis is required to verify the results.

It can be concluded that morphological identificationdetermine4 of 26 specimens as *C. henrici,* corresponding to specimens TD 3, TD 4, TC 7 and ND 12. The remaining specimens (22 of 26 specimens) belong to *C. bouderius*.

B. Results of molecular identification

Fig. 2 shows the results of extraction of DNA of cranoglanidid catfish samples, DNA bands were distinct, bright. This proves that the total DNA extracted was eligible to perform PCR.

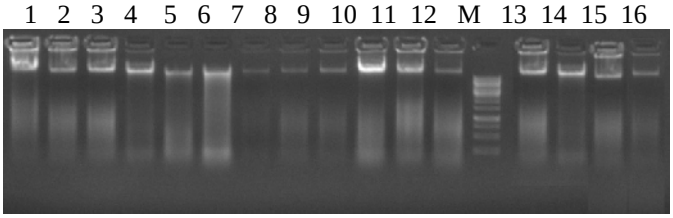


Fig. 2. Image of total DNA on 0,8% agarose gel.

Legend:

Wells 1-4: Tuong Duong; 5-8 Con Cuong; 9-12 Thanh Chuong; M: marker; 13-16: Nam Dan

DNA was checked for purity using Nanodrop 2000. A260/280 ratio of DNA was 1,96-1,98, indicating the good purity of DNA for further analysis.

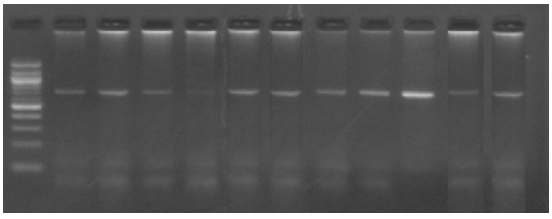


Fig. 3. Image of electrophoresis of PCR products on 2% agarose gel.

COI gene from 20 Cranoglanidid catfish samples was amplified and checked by 2% agarose gel electrophoresis; bands of PCR products were clearly visible, without extra bands; size of amplified gene was about 700bp.

Legend: M – ladder (standard fragments of 100 bp)

Wells 1,2,3 to 11 were PCR products from samples Tuong Duong 1 to 4, Con Cuong 1 to 4, Thanh Chuong 1 to 3.

C. Results of sequence analysis and comparison of COI gene region

The COI gene sequences of the 26 samples were compared to the COI gene sequences published at the NCBI Genbank (National Center for Biotechnology Information) to determine similarity via BLAST software. Results (Table 3) showed a high similarity (99% - 100%) of the COI nucleotide sequences of the cranoglanidid catfish samples in this study with the COI nucleotide sequence of *C. bouderius* published in Genbankby Wong *et al.* 2011.

Table 3: BLAST search results in NCBI genBank.

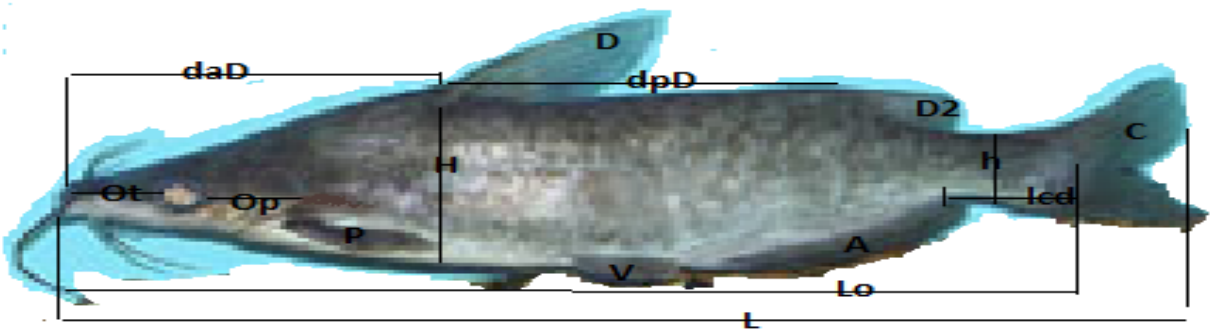
Percentage (%) to the head length			Percentage (%) to the standard length																Code	Locality	N0
OO/ HL	MW/ HL	Snl/H L	JBL/ SL	VL/S L	AL/S L	DL/ SL	DSL/ SL	PL/S L	DCP /SL	LC P/S L	BDa/ SL	PDL /SL	PAL/ SL	HD/S L	HW/ SL	HL/S L	HL	SL (mm			
47,9	34,2	43,6	39,3		32	7,8			6,5	13,4	24,9	39,3	58	16	16,7	25	44,5	178	Tuong Duong 1	Tuong Duong	1
48,7	31,6	46,2	39,3	14,1	31,3	8,6		20	9,1	11,8	22,9	38,9	55,3	15	16,3	25	46,8	187	Tuong Duong 2		2
55,2	37,7	47,6	39,3	14,5	30,7	9,4	22	20	9	12,1	26,5	41,4	63	15,7	18	26,6	71,7	270	Tuong Duong 3		3
48,3	34,5	42,2	31,7	11,8	31	8,5	21,8	18	8,4	12,1	24	40,7	58,6	15,3	17,5	25,5	78,2	307	Tuong Duong 4		4
46,7	31,3	46	34,3	11,7	25,2	8	16,9	17	8,7	13	22,8	42	58,8	17,5	18,2	26,6	59,8	225	Tuong Duong 5		5
44,2	32	43,9	31,1	13	33,4	8,9	19,2	16	8,4	10,9	22,8	39,6	56,5	16,8	17,5	26,2	59	225	Tuong Duong 6		6
45,9	35,1	45,4	36,5	13	29,4	8,6	21,4	20	8,3	11,9	20	38,5	59,7	16,5	16,1	26,2	53,8	205	Tuong Duong 7		7
43,5	39	41,1	37,8	14,7	31,1	8,3			7,9	11,7	20	37,7	60,6	15,4	16,8	25,7	46,2	180	Con Cuong 2	Con Cuong	8
45,8	33,2	42,0	41,4	13,6	30,8	9			8,6	12,9	23,5	37,7	57	16,8	18	24,4	45,2	185	Con Cuong 3		9
49,5	42,6	42,4	42,8	13,7	32,4	8,2			8,6	12,7	24,7	39,7	66	17,3	18,3	27,4	49,3	180	Con Cuong 4		10
44,5	31,5	44,3	39,5	13,8	33,3	8,5			8,2	12,7	21,9	37,4	55,9	16,3	17,2	26,1	50,8	195	Con Cuong 5		11
47,3	41,8	44,6	39,4	15,8	30,2	8,8			8,4	13,1	23,2	36,8	57,1	14,1	16,8	25	45,5	182	Con Cuong 6		12
47,8	34	44,2	47,6	13,4	33	8,9			7,8	11,1	22,6	38,7	56,4	14,9	18,2	26,2	45	172	Con Cuong 7		13
44,7	35,1	43,7	41,5	12,4	33,8	7,3	18,7	19	8,1	12,2	20,6	39	56,8	15,5	15,9	24,7	40,5	164	ThanhChuong 1	ThanhChuong	14
43,2	32,9	43,2	43,7	13,5	29,5	8,6			8,6	12,9	22,4	38,7	59,5	15,9	16,8	26,2	45,6	174	ThanhChuong 2		15
46,6	34,2	43	23	14,7	33,4	8,5			8,3	12,2	22,5	39,4	59,2	17	17,5	26,9	47,9	178	ThanhChuong 3		16
43,2	35,6	41,	45,7	12,3					8,3	11,1	21,9	39,7	56	14,6	15,1	25,7	45,8	178	ThanhChuong 4		17
54,1	34,9	45,6	35,7	11,9	33,6	9,2	20,2	17	8,9	13,6	26,4	37,4	57,6	16,6	18,8	26,3	62,5	238	ThanhChuong 5		18
47,9	33,7	44,6	34,7	9,02	31,1	9,1	19,3	15	8,7	12,4	22,9	38,8	59,8	17,2	17,8	25,7	57,8	225	ThanhChuong 6		19
48,4	34,1	43,6	47,4	14,1	29,3	8			9,6	12,6	23,3	38,6	57,3	15,4	14,5	25,1	44	175	Nam Đan 1	Nam Đan	20
Cả	32,3	40,5	39,2	13,3	30,9	7,7		17	9,4	12,8	23,3	38,2	60,3	16,1	16,6	25,6	46,4	181	Nam Đan 2		21
46,2	35,1	43,4	46,8	13,4	27,2	8,7			8,8	14,2	23,3	39,4	59,7	14,7	17,6	26	46,1	177	Nam Đan 3		22
53,6	31,6	42,8	45,7	Là	31,9	7,8			8,7	13,8	23,8	39,1	56,8	16,2	16,7	25,4	47,2	186	Nam Đan 4		23
43,6	34,8	49,2	33,5	13,5	28	8,8	22,5	17	8,3	11,4	22	41,7	63	16,5	17,8	27	58,9	218	Nam Đan 5		24
46,6	32	49,8	33,8	13,6	27,8	9,1	20,9	20	7,6	11,6	20,2	40,9	61,4	15,7	18,8	28,4	50	176	Nam Đan 6		25
45,3	31,4	48,3	35	13,6	28,3	8,5	22,7	19	8,2	11,8	21,5	39,8	62,6	16,8	16,9	25,9	57	220	Nam Đan 7		26

Table 3 showed that the gene size of the samples ranged from 634 bp to 689 bp. The coverage ranged from 83 to 97%, and the similarity was over 98% against the sample registered in the Genbank under the accession code JF292338.1. Therefore, it is confirmed that all 26 cranoglanidid catfish specimens from study sites belong to *C. bouderius* based on molecular identification.

CONCLUSION AND RECOMMENDATION

Conclusion: Cranoglanidid catfish living in Lam river are *Cranoglanis bouderius* (Richardson, 1846)

Recommendation: it is necessary to collect more Cranoglanidid catfish specimens from various geographical areas for morphological and molecular identification in order to obtain the better understanding of the diversity of the genus *Cranoglanis*.



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