



In recognition of being selected by your peers to present during the  
2014 Asian Conference on the Life Sciences and Sustainability

*Geographic Variation of Puntius lateristriga (C.V) From Sumatra and Adjacent  
Island*

**Dewi Roesma**

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Presented at ACLS 2014  
KKR Hotel, Hiroshima, Japan  
August 27<sup>th</sup>-29<sup>th</sup>, 2014



**Takayuki Yamada**  
*PRESDA Foundation*  
Chairman, ACLS 2014



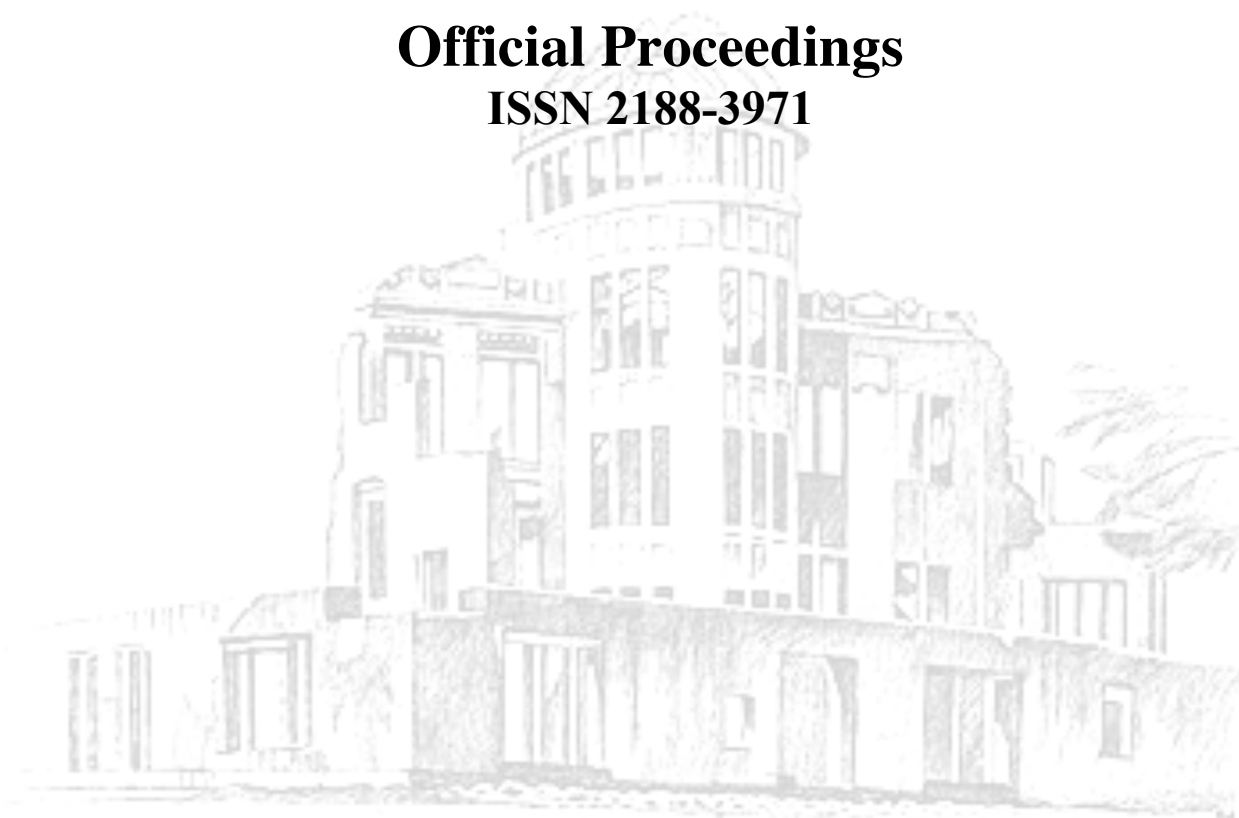
**ACLS 2014**

*Global Trends in the Life Sciences*

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# ACLS 2014 / WASH 2014

*The Inaugural Asian Conference on the Life Sciences & Sustainability (ACLS)*  
&  
*The Inaugural Asian Symposium on Water, Sanitation and Hygiene (WASH)*

## *Schedule & Agenda*

August 27-29, 2014 at the KKR Hotel Hiroshima, Japan



Sponsored by:  
**The PRESDA Foundation of Japan**  
[www.presdafoundation.org](http://www.presdafoundation.org)

## Welcome Letter from the Organizing Committee Chairperson

Dear Friends,

It is my sincere honor and privilege to welcome all of you to the Inaugural Asian Conference on the Life Sciences (ACLS) and its sister event the Inaugural Asian Symposium on Water, Sanitation and Hygiene (WASH).

Since the founding of PRESDA in 2010, we have endeavored to offer unique events every year in Hiroshima during the memorial period of the atomic bombing. Our first event in 2012, examined the future of sustainable energy following the nuclear accident in Fukushima.

Thus, we are quite pleased that more than 130 presenters, audience and invited guests from 30 countries have accepted our invitation to come to Hiroshima for these special events.

As always, the overarching goal is to provide an opportunity for academics, scholars, non-profit workers, students and others concerned with human rights and ESD to exchange views in a setting encouraging respectful dialogue.

The range of topics and caliber of presenters is impressive. We are confident that everyone will find reason to be inspired by the research presented during these combined events.

It is in this spirit of friendship, peace and international cooperation that we express our warmest welcome to every participant.

We hope you will have a memorable and fruitful experience here in Japan's City of Peace: Hiroshima!

Warmest regards,

**Takayuki Yamada**  
Chairman, Board of Governors  
PRESDA Foundation  
Co-Founder, Chubu Mirai Rotary  
Polio-Plus Committee, Rotary Japan



## Welcome Letter from the Editorial Committee

Dear ACLS/WASH Participants,

On behalf of the PRESDA Foundation and everyone else involved in the journey leading to this special event, it is with open arms and minds that we welcome you to the inaugural ACLS/WASH 2014 Conference on the Life Sciences and Sustainability, and Symposium on Water, Sanitation and Hygiene in Asia.

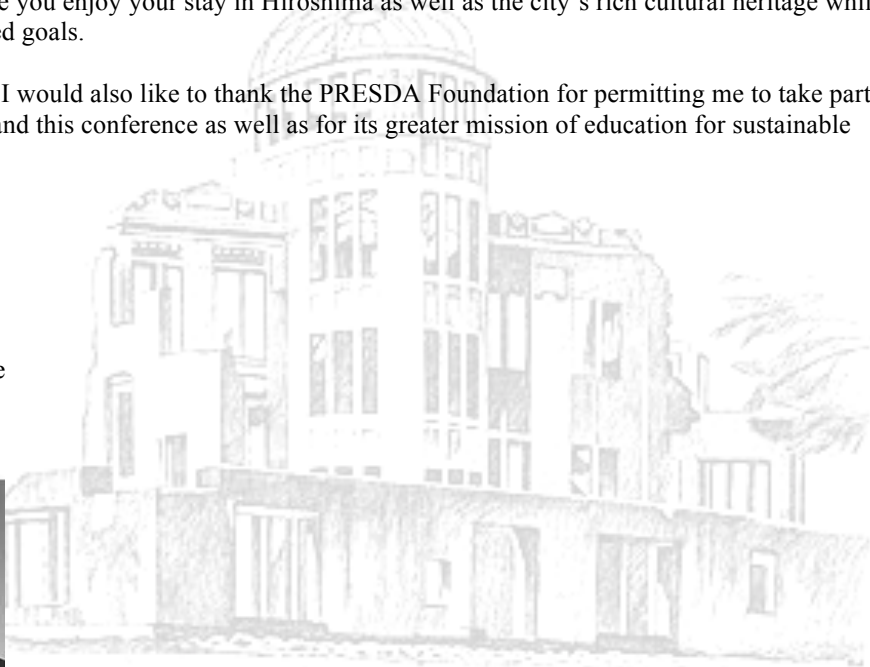
We have come here today united by our drive and shared vision of a better world in which scientific advances and water take center stage. And it is through this intersection of interests that meaningful discourse and change arise. Your commitment to these objectives and gathering at the KKR Hotel Hiroshima bring renewed hope and ideas to a continent.

We sincerely thank you for your participation in ACLS/WASH 2014 and for broadening the intellectual scope and understanding of the life sciences, water, and sustainability in Asia and elsewhere. We hope you enjoy your stay in Hiroshima as well as the city's rich cultural heritage while advancing our shared goals.

On a personal note, I would also like to thank the PRESDA Foundation for permitting me to take part in its development and this conference as well as for its greater mission of education for sustainable development.

Sincerely,

John Latzo  
Editorial Committee  
ACLS/WASH 2014  
Hiroshima, Japan





## Welcome Letter from the ACLS/WASH 2014 Conference Program Director

Dear Participants of ACLS/WASH 2014,

It is with great pleasure that I welcome each and every one of you to our jointly held Asian Conference on the Life Sciences and Sustainability and the Asian Symposium on Water, Sanitation and Hygiene here at the KKR Hotel in beautiful Hiroshima, Japan.

I'm very excited about the quality of the presentations that we have lined up as well as the fact that so many of our participants have traveled quite the distance to be here with us for this important joint event. My hope is that we not only come away with new knowledge and ideas from our time together, but also to create new networks and friendships that will last a lifetime.

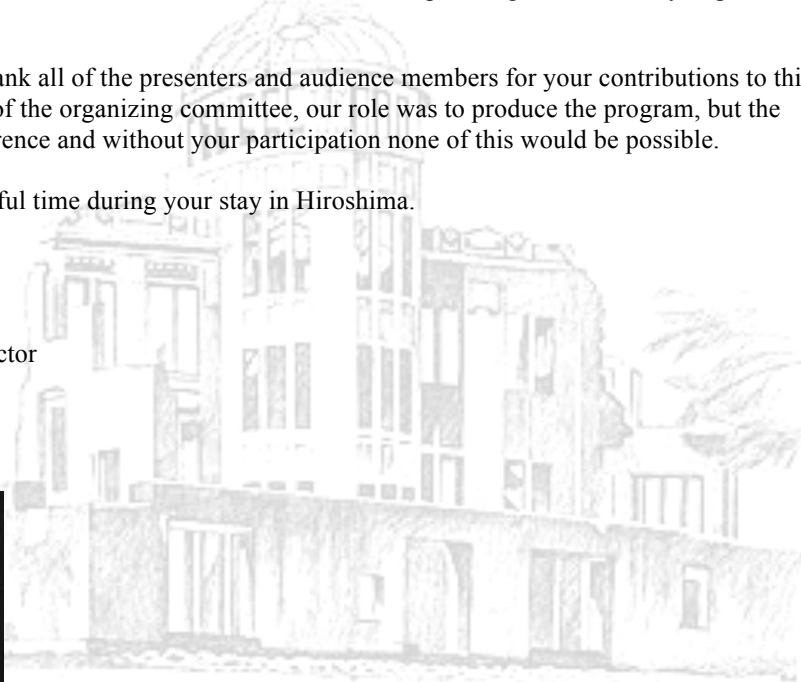
I would like to give thanks to the PRESDA Foundation as well as both the ACLS and WASH organizing committees for all their hard work and commitment in planning these two very important events.

Finally, I would like to thank all of the presenters and audience members for your contributions to this conference. As members of the organizing committee, our role was to produce the program, but the truth is, this is your conference and without your participation none of this would be possible.

I hope you have a wonderful time during your stay in Hiroshima.

Yours sincerely,

Michael Sasaoka  
Conference Program Director  
ACLS/WASH 2014  
Hiroshima, Japan





## **Letter of Welcome from the Organizing Committee Vice Chairperson**

Dear Colleagues,

I would like to thank everyone for traveling to Hiroshima to present and share your ideas with others from across Asia and around the world. I am sure that we will all learn a great deal from each other, but one thing I have known from the start is that our presenters are truly the heart and soul of this conference. We appreciate the great deal of time and effort that you have put in to make this a fantastic conference.

This conference brings together two very important subjects, which are pressing for many parts of today's world. As climate change continues to change weather patterns at an ever-increasing rate for many people access to clean and safe water supplies is reaching critical levels. Together with Life Sciences we can forge new avenues to help improve the lives of people everywhere. The ideas being presented here can help create solutions to many problems both in the future as well as in the present.

Before I close, I'd like to thank each of you for attending this conference and bringing your expertise here. You have the vision, the knowledge, the wherewithal and the experience to help pave the way into the future. You are truly our greatest asset today and tomorrow, and we could not accomplish what we do without your support and leadership. Throughout this conference, I ask you to stay engaged, keep us proactive and help us shape the future. My personal respect and thanks goes out to all of you.

Sincerely,

Gary Smith Hara

**The Asian Conferences on the Life Sciences & Sustainability**  
**The Asian Symposium on Water, Sanitation and Hygiene**  
August 27-29, 2014 at the KKR Hotel Hiroshima, Japan

**ACLS / WASH 2014 ACKNOWLEDGEMENTS**

We extend our deepest appreciation to the following institutions and people:

**ACLS / WASH 2014 Sponsor**

The PRESDA Foundation (Japan)

**ACLS / WASH 2014 Institutional Affiliates**

University of Guadalajara (Mexico)

Sonoma State University (USA)

The Institute for Environmental Science & Policy, University of Illinois at Chicago (USA)

Norwegian University of Life Sciences (Norway)

Dominican University of California (USA)

The Faculty of Agricultural Production at Maejo University (Thailand)

Cervelet Management and Strategy Consultants (USA)

The International Management Institute (India)

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**About the Sponsor**

The Pacific Rim Education for Sustainable Development Alliance (PRESDA) was established in 2010. We are an alliance of grassroots non-profit organizations, teachers, business people, and concerned citizens from around Asia and beyond who wish to make a difference. Incorporated under the laws of Japan, the PRESDA Foundation is an independent, not-for-profit foundation helping to fulfill the Millennium Development Goals by the year 2015.

For more information about the PRESDA Foundation and our projects, please visit our homepage at [www.presdafoundation.org](http://www.presdafoundation.org)

Finally, on behalf of the ACLS / WASH 2014 team, we would like to extend our deepest thanks to the people of Hiroshima City for their support and gracious hospitality.

**The Asian Conferences on the Life Sciences & Sustainability**  
**The Asian Symposium on Water, Sanitation and Hygiene**  
August 27-29, 2014 at the KKR Hotel Hiroshima, Japan

**ACLS / WASH 2014 GENERAL INFORMATION**

**DESIGNATED HOTEL – KKR Hotel Hiroshima**

All ACLS / WASH sessions will be held in the KKR Hotel Hiroshima, which is located a short distance from Hiroshima Castle and the government offices of Hiroshima Prefecture.

Three public transportation rail systems pass within a short distance of the KKR Hotel Hiroshima:

1. JOHOKU Station on the ASTRAM Rail Line is only 3 minutes west on foot.
2. HAKUSHIMA Station on the Dentetsu Streetcar Line (also known as the ‘Hiroden’) is also 3 minutes west on foot. Please transfer at “Hacchobori” to Hakushima-line and get off at the termination.
3. JR HIROSHIMA Station or JR YOKOGAWA Station is only 5 minutes by taxi

**VENUE**

As one of the largest cities in western Japan, Hiroshima has been a bustling, affluent and prosperous city with a rich history dating back to 1589, when it was established as the capital city of a powerful samurai warlord. Today, of course, Hiroshima is most well-known as the first city in the world to have suffered an atomic bombing, which occurred towards the end of World War II on August 6, 1945. Around the city of Hiroshima, you will find many well-used green spaces, none of which are more important than the poignant Peace Memorial Park, where various statues and monuments reside, as well as the A-Dome building, which has become a symbol of peace and has been registered as a UNESCO World Heritage Site. Apart from war memorials, Hiroshima boasts some of the best traditional Japanese landscaping, including the beautiful Shukkeien Garden complete with tea houses, ponds and bridges.

Finally, there is the iconic Miyajima Shrine Island, which is revered as one of the “three views of Japan” with its towering red torii gate standing in the midst of the inland sea. Built in 593, it was renovated to its current splendor in 1168. The main hall of the shrine is furnished with vermilion-lacquered columns and Japanese cypress bark roofing. The shrine pavilion is a unique example of Heian Period architecture and has been designated as a national treasure of Japan. The Miyajima Shrine is also a UNESCO World Heritage Site and its close proximity to Hiroshima makes for a wonderful afternoon visit.

**DRESS**

During conference sessions and receptions, the expected dress code is business casual.

**CLIMATE**

In general, expect Hiroshima to be hot and humid. August temperatures in Hiroshima can range from an average high of 37.9 C (100 F) to an average low of 24.8 C (76 F). The average daily temperature is 32.5 C (90 F).

When moving around outside we suggest wearing the following:

- light, casual clothes
- a hat (preferably with a wide brim)
- sunglasses
- comfortable walking shoes
- sun screen

In addition, you should drink plenty of fluids to remain hydrated and also consider carrying a hand towel or face towel.

**The Asian Conferences on the Life Sciences & Sustainability**  
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### **EQUIPMENT**

Presentation rooms are equipped with PC notebook computers, screens, projectors, laser pointers and microphones. We also provide onsite technical support, if needed.

If possible, please send us your presentation in advance, which we can upload to the computers, which will save time and avoid glitches.

### **POSTER SESSION STRUCTURE**

We will have two poster sessions during the conference. The first will be during the welcome dinner reception on August 27th. The second poster session will be during the networking reception on August 28th.

If you are giving a poster presentation, here are the instructions for poster presenters:

1. Poster boards mounted on stands will be provided with tape.
2. Posters must be set up 15 minutes before the start of the session and taken down after the session ends.
3. Poster materials should include the title of the presentation and the list of authors. Bring all illustrations needed — figures, tables, color photographs, charts.
4. Dimensions for posters should be A0 size portrait style 47 x 33 inches (118cm x 84cm). Portrait style is standard but if you need to use landscape that is fine.
5. Poster material should be well labeled and easy to read from a distance of one meter. Lettering should be bold. If you will be posting typed material, use a large font size (24 to 30 pt) on white, pale yellow or cream-colored non-glossy paper. Avoid use of non-standard fonts. Use 1-inch margins. Use upper and lower case letters.
6. No audiovisual equipment is permitted for poster presentations.
7. Please stay near your poster so that you are available to answer questions.

### **ORAL SESSION STRUCTURE**

Sessions A, B and C on August 28<sup>th</sup> will be 75 minutes in length with a 15-minute break before the next session begins. Presenters have been allotted 25 minutes, which includes time for questions and answers. If you need additional time for discussion, please do so during the recess periods or coffee breaks.

Session D on August 29<sup>th</sup> is a special featured session, which will last 2 hours and have 4 presenters. Each presenter has been allotted 30 minutes, which includes time for questions and answers.

*\* Please give your presentation within the allotted time on the schedule. If a presenter does not arrive at the scheduled time, please proceed with the next presenter.*

### **PROCEEDINGS**

Presenters will receive the proceedings in electronic format by September 5, 2014. As we are attempting to be a carbon-neutral conference as much as possible, we kindly request participants to understand the proceedings will be in electronic format only:

- **ACLS ISSN 2188-3971**
- **WASH ISSN 2188-3440**

**The Asian Conferences on the Life Sciences & Sustainability**  
**The Asian Symposium on Water, Sanitation and Hygiene**  
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**INTERNET ACCESS**

WIFI access is available in the KKR lobby area. Please see the front desk for login and password details. If you are staying in the KKR, then you can access the Internet free-of-charge in your room using the LAN cable provided.

*Having difficulty connecting to the WIFI inside the KKR?* Please note that the PRESCO organizers have no control over the WIFI access, so please inquire at the hotel front desk.

**PRINTING**

Photocopies can be made at the Lawson convenience store across from the KKR. Alternatively, for larger printing needs, there is a Kinko's located on Hon-Dori Avenue. See the KKR front desk for directions.

**STORES NEAR THE KKR**

There are two convenience stores within easy walk of the KKR: the nearest is a Lawson across from the KKR. Also, there is a 7-11 approximately 5 minutes on foot. Ask the front desk for a map and directions.

**Banks / ATM / Currency Exchange**

There is a bank that offers currency exchange within 5 minutes walk from the KKR. Please ask the hotel front desk for a map and directions.

All banks in Hiroshima are open until 3:00 p.m. Monday to Friday and closed on Saturday and Sunday. Please remember to bring your passport when exchanging money. International ATMs with English menus are also available at **7-Eleven** convenience stores, which are open 24 hours with locations throughout the city.

**Tour Options: UNESCO World Heritage Site of Miyajima**

**Half-Day Tour to Miyajima: 'The Shrine Island'**

Constructed in 593 A.D., Itsukushima (popularly known as Miyajima Shrine Island) was undamaged by the atomic bombing. The island consists of a series of temple buildings, teahouses and quaint shops. The long pier from which the torii in the sea can be seen offers majestic views of the inland sea and is considered one of Japan's three most iconic views. As a UNESCO World Heritage site, it is considered a 'must see' for travelers to Japan. The three-hour tour includes roundtrip transportation, temple fees and guidance in English. Due to the popularity of this tour, the number of participants is limited.

**Full-Day Tour to Miyajima: 'The Shrine Island' + Mt. Misen Hiking Trail**

The tour begins with a visit to Miyajima: The Shrine Island. After the tour of Miyajima, you will go to Mt Misen: at 500 meters above sea level, Mount Misen is the highest peak on Miyajima. It is also considered a holy mountain with a number of Buddhist structures near the peak, some of which are more than 1200 years old. It affords spectacular views of the Seto Inland Sea and as far as Hiroshima City. A ropeway leads up the mountain from town, but it is also possible to climb up on foot. There are three hiking trails leading up Misen. It takes 1.5 to 2 hours to reach the summit from town. The six-hour tour includes roundtrip transportation, ferry fees, lift fees and guidance in English. The hiking portion of the tour is led by an experienced guide, hiker and photographer.

*\* Details regarding tour dates, departure times and costs are available at the registration table.*

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# Geographic Variation of Morphological Characters in *Puntius lateristriga* (Valenciennes, 1842) From Sumatra and the Adjacent Island

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University of Andalas, West Sumatra, Indonesia

## ABSTRACT

*Puntius lateristriga* (Valenciennes, 1842) is a tropical freshwater fish belonging to the Cyprinidae. Intraspecific variation among *P. lateristriga* from Sumatra Island and Singkep as adjacent island was studied based on 23 morphological characters by using UPGMA (*Unweighted Pair Group Method Arithmetic Average*) analysis. The data consist of new data from west Sumatra subpopulations (valley of mount Tujuh) and the old data from Haryono's report (Aceh, Sekundur, Bahorok, Lampung and Singkep). The study aimed to analysis the morphological characters variation of *P. lateristriga* in Sumatra and the adjacent island populations. The present results show that there are morphological variation on characters of *P. lateristriga*. *P. lateristriga* from west Sumatra which represent the middle part of Sumatra population closely related to *P. lateristriga* from Singkep island with 0.10 Euclidean distance and hold in one cluster with Lampung population which represent the south part of Sumatra population, while the Aceh, Sekundur and Bahorok populations which represent the north part of Sumatra populations were existed in another one cluster. Geologically active regions create many geographically isolated areas which can reflect in morphological characters of *P. lateristriga*.

**Keywords:** Geographic; morphology; Cyprinidae

## 1 INTRODUCTION

*Puntius* is a genus of cyprinids, widespread in Sumatra, Bangka Belitung, Singkep, Java and Malaysia (Weber and Beaufort, 1916; Roberts, 1989), while Taki *et al.* (1978) wrote that *Puntius* occur throughout the region from Pakistan to southern China, inhabiting various types of fresh waters. *Puntius* consist of some species with interesting colour pattern. One of the species from this genus is *Puntius lateristriga* (Valenciennes, 1842). Fish of this species has colour pattern with a broad longitudinal stripe in addition to two cross band. *P. lateristriga* is a synonym to *Barbus lateristriga* (Valenciennes, 1842) and *Systemus lateristriga* (Valenciennes, 1842). According to Weber & Beaufort (1916) and Kottelat *et al.* (1993), this species distributed in Sundaland and their colour pattern showed geographically and ontogenetically variation. Tweedie (1961) found the variation of color pattern of six populations in Malaysia and found black reduction of colour pattern on the populations at the north of Kedah and Perlis. Other than high variation of colour pattern, morphological variation also exists in this species. Haryono (2001) found the existence of morphological and pattern of the color variations of *P. lateristriga* population in five places in Sumatra that is Aceh, Sekundur, Bahorok, Lampung and Singkep. Aceh, Sekundur and Bahorok were located at the north of Sumatra; Lampung was at the south of Sumatra while Singkep was an Island close to east Sumatra Island at the middle part (Figure 1.). There is no data from west or the middle part of Sumatra included in that report.

Sumatra is a unique island, at least there are two main barrier in Sumatra, first is Bukit Barisan mountain range that predicted formed around 2.5 million years ago (Miosen) and second is the eruption of Toba mount, as the biggest eruption in world history around 71.000 years ago and caused disruption of Bukit Barisan corridor (Hamilton, 1979; Whitten *et al.*, 1987). Bukit Barisan

mountain range divided the island becomes west and east Sumatra as unequally parts, and the north and the south parts of Sumatra could be influence by Toba eruption. It was predicted that so many variation of fresh water fish in Sumatra according to its geography history. In other to complete the information and to analyze the variation of morphology characters of *P. lateristriga* in Sumatra and the adjacent island we used the Haryono's data (2001) instead of our new data from west Sumatra subpopulations. The study aimed to analyze the morphological variation of *P. lateristriga* in Sumatra and the adjacent island populations.

## MATERIAL AND METHODS

Fish collection was made along 600-meters on each of six rivers in the valley of Mount of Tujuh in West Sumatra using standard procedures according to Cailliet *et al.* (1996) and specimens handling followed to procedures of Kottelat *et al.* (1993). Our new data were measured from 48 individuals while Haryono (2001) data as comparison initially from Sekundur (6 individuals), Bohorok (6 individuals), Aceh (2 individuals), Lampung (12 individuals) and Singkep Island (8 individuals). The distribution of samples is enclosed in Figure 1.

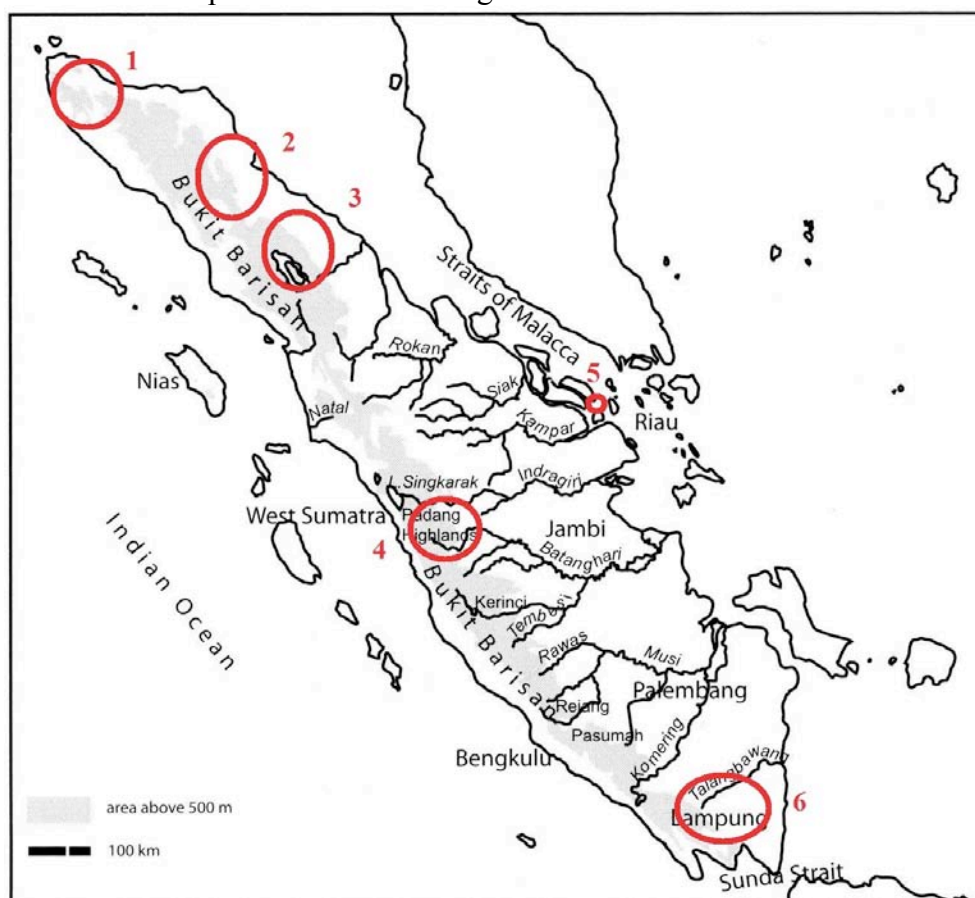


Figure 1. The location of samples of data (Note: 1. Aceh; 2. Sekundur; 3. Bohorok; 4. West Sumatra; 5. Singkep Island; dan 6. Lampung)

Each individual was measured based on Strauss and Bookstein (1982) with modification to nearest 0.1 mm using digital calipers on 23 morphometric characters. Those characters were also followed as Haryono (2001) did (Figure 2.). There were Total Length (TL), Standard Length (SL), Head Length (HL), Pre Dorsal Length (PDL), Pre Pelvic Length (PPL), Pre Anal Length (PAL), Head Depth(HD), Body Height (BD), Depth of Caudal Peduncle (DCP), Length of Caudal Peduncle (LCP), Snout Length (SNL), Body Width (BW), Eye Diameter (ED), Inter Orbital Width (IW), Length of Dorsal Base (LDB), Length of Anal Base (LAB), Length of Pelvic (LPVF), Length of Pectoral (LPCF), Length of Upper Caudal (LUCL), Length of Middle Caudal (LMCR), Length of Lower Caudal (LLCL), Maxillary Barbell Length (MXB), and Snout Barbell Length (SNB).

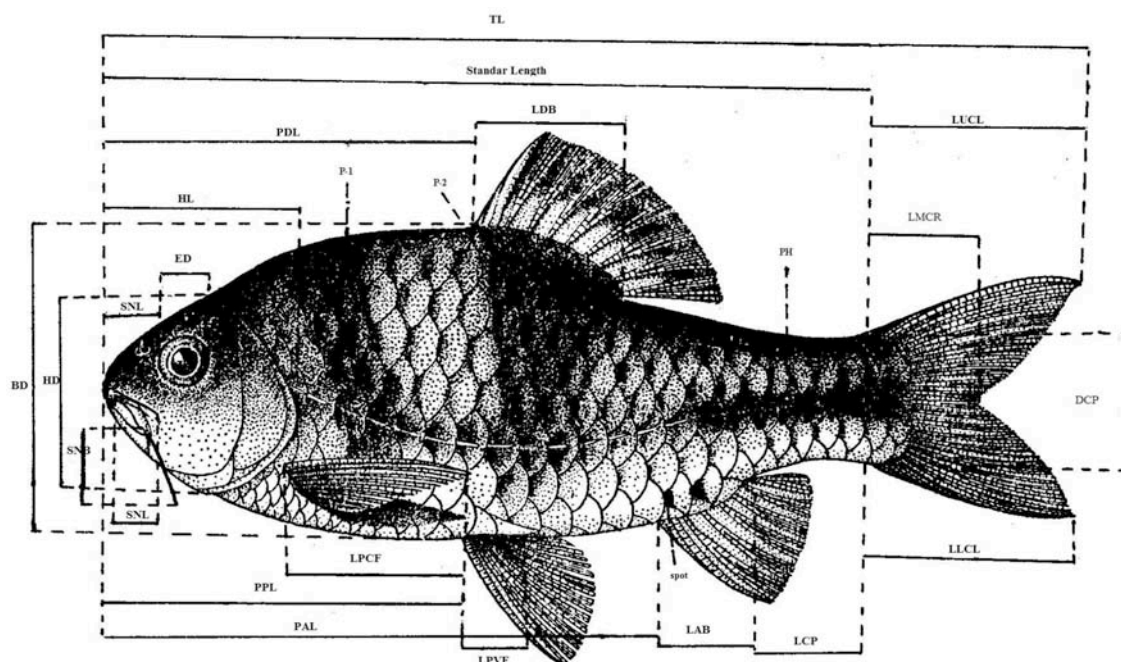


Figure 2. Morphometric characters measurement (Haryono, 2001)

The measured characters were transformed to percent of standard length (SL) and to common logarithms. In order to analyze the relationship of *P. lateristriga* population in Sumatra and the adjacent island based on new and Haryono (2001) data, cluster analysis was done by using NTSyst Ver. 2.0.2i program (Rohlf, 1998).

## RESULT

The result of the measurement of 23 characters morphometric included in Table 1. The data consist of Haryono's (2001) data from Aceh, Sekundur, Bahorok, Lampung, Singkep and from west Sumatra as a new data.

	ACEH	SEKUNDUR	BAHOROK	LAMPUNG	SINGKEP	WEST SUMATRA
	n=2	n=6	n=6	n=12	n=8	n=48
1 TL	134.02 ± 0.83	130.43 ± 1.99	134.89 ± 1.78	132.38 ± 1.37	131.52 ± 2.81	133.25 ± 0.22
2 SL	80.51 ± 10.45	80.02 ± 7.48	63.67 ± 6.75	64.62 ± 4.59	78.60 ± 10.59	66.81 ± 15.47
3 HL	29.78 ± 2.39	28.02 ± 1.46	29.18 ± 1.44	29.74 ± 2.01	25.17 ± 4.91	27.01 ± 0.02
4 PDL	51.71 ± 0.37	54.50 ± 0.96	55.33 ± 1.22	54.22 ± 1.16	53.49 ± 1.25	51.14 ± 0.04
5 PPL	55.36 ± 0.19	50.82 ± 1.65	49.61 ± 6.55	53.35 ± 1.55	51.73 ± 1.51	50.72 ± 0.02
6 PAL	76.91 ± 1.28	74.93 ± 1.15	74.62 ± 1.35	76.26 ± 1.61	75.89 ± 1.77	74.15 ± 0.02
7 HD	27.24 ± 1.60	24.90 ± 1.20	24.31 ± 0.75	24.31 ± 1.55	25.02 ± 1.27	23.44 ± 0.05
8 BD	41.80 ± 0.25	39.65 ± 1.61	40.89 ± 2.36	40.13 ± 1.19	40.77 ± 0.87	39.41 ± 0.03
9 DCP	14.60 ± 0.34	14.85 ± 0.33	15.74 ± 0.70	15.79 ± 0.39	15.24 ± 0.44	16.24 ± 0.01
10 LCP	19.30 ± 1.88	19.47 ± 1.65	18.06 ± 0.55	17.62 ± 1.04	17.93 ± 1.24	19.48 ± 0.02
11 SNL	9.46 ± 0.89	9.17 ± 0.64	9.41 ± 0.27	9.63 ± 0.91	9.78 ± 0.97	7.35 ± 0.01
12 BW	19.38 ± 0.92	19.85 ± 1.37	19.44 ± 1.07	19.69 ± 1.54	20.37 ± 1.63	14.91 ± 0.03
13 ED	7.24 ± 0.24	7.39 ± 0.56	8.13 ± 0.57	7.99 ± 0.36	6.91 ± 0.55	8.06 ± 0.01
14 IW	11.13 ± 0.86	11.09 ± 0.49	11.01 ± 0.41	10.79 ± 0.30	10.92 ± 0.52	10.90 ± 0.01
15 LDB	20.43 ± 0.29	19.82 ± 1.93	21.38 ± 1.62	21.68 ± 0.85	21.74 ± 0.53	19.48 ± 0.02
16 LAB	10.57 ± 0.13	10.08 ± 0.62	10.97 ± 1.07	11.84 ± 0.70	11.07 ± 0.60	9.85 ± 0.01
17 LPVF	22.41 ± 0.49	21.48 ± 1.02	22.99 ± 0.91	21.54 ± 0.71	20.17 ± 0.63	6.23 ± 0.01
18 LPCF	24.63 ± 0.28	23.68 ± 1.15	24.92 ± 0.38	22.26 ± 0.51	21.60 ± 1.61	23.35 ± 0.02
19 LUCL	34.07 ± 0.18	30.70 ± 1.46	33.57 ± 1.05	34.21 ± 1.53	31.74 ± 1.85	30.83 ± 0.03
20 LMCR	15.59 ± 1.48	15.04 ± 0.62	16.61 ± 1.32	16.32 ± 1.37	17.20 ± 1.93	13.85 ± 0.02

Table 1. Morphometric characters measurement of *P. lateristriga* new and Haryono (2001) data

The Total Length of *P. lateristriga* ranges from 130.43-134.89 mm and Standard Length from 63.67-80.51 mm. Based on the characters that have been measured, there was character divergence between populations. Those characters were: Standard Length (SL), Pre Pelvic Length (PPL), Body Width (BW), Length of Pelvic (LPVF), Length of Lower Caudal (LLCL) and Maxillary Barbell Length (MXB). To ascertain the existence of this character divergence, the analysis statistic such as Kruskal-Wallis and Mann-Whitney test to be needed. Because of acquirement data from Haryono (2001) was incomplete, and then prediction was conducted based on the result of analysis at level subpopulation of *P. lateristriga* in west Sumatra (Roesma, Chornelia & Putra, 2014 (unpublished). Analysis Kruskal-Wallis at those six subpopulations showed the character divergence between them. There were six characters found that experience of divergence that is Head Length (HL), Pre Anal Length (PAL), Depth of Caudal Peduncle (DCP), Body Width (BW), Eye Diameter (ED) and Length of Middle Caudal (LMCR). Analysis with Mann-Whitney test at subpopulations showed 1-8 characters differ between rivers in west Sumatra (subpopulations from six rivers).

Based on the value of Euclidean distance between six population of *P. lateristriga* in Sumatra and the adjacent island (Table 2.), it can be concluded that based on morphological characters, the most closely related populations was between *P. lateristriga* from West Sumatra and Singkep (0.10), followed by Bahorok-Sekundur (0.118) and Sekundur-Aceh (0.158). The smaller Euclidean distance value, the closer their relationship.

Tabel 2. Euclidean distance between six populations of *P. lateristriga* in Sumatra and the adjacent island.

Population	Aceh	Sekundur	Bahorok	Lampung	Singkep	WestSumatra
Aceh	-					
Sekundur	0.158	-				
Bahorok	0.58	0.118	-			
Lampung	0.21	0.21	0.21	-		
Singkep	0.21	0.21	0.21	0.14	-	
WestSum	0.21	0.21	0.21	0.14	0.10	-

Figure 3. show the result of UPGMA analysis on 23 morphological characters. There were two main cluster, first consist of *P. lateristriga* from West Sumatra, Singkep Island and Lampung, second consist of population from Aceh, Sekundur, and Bahorok. The Euclidean distance between those two groups was 0.21 (Table 2). All populations on each cluster also tend to subdividing, the first cluster was West Sumatra and Singkep populations held-up with Lampung population, and second cluster was Bahorok and Sekundur populations held-up with Aceh population.

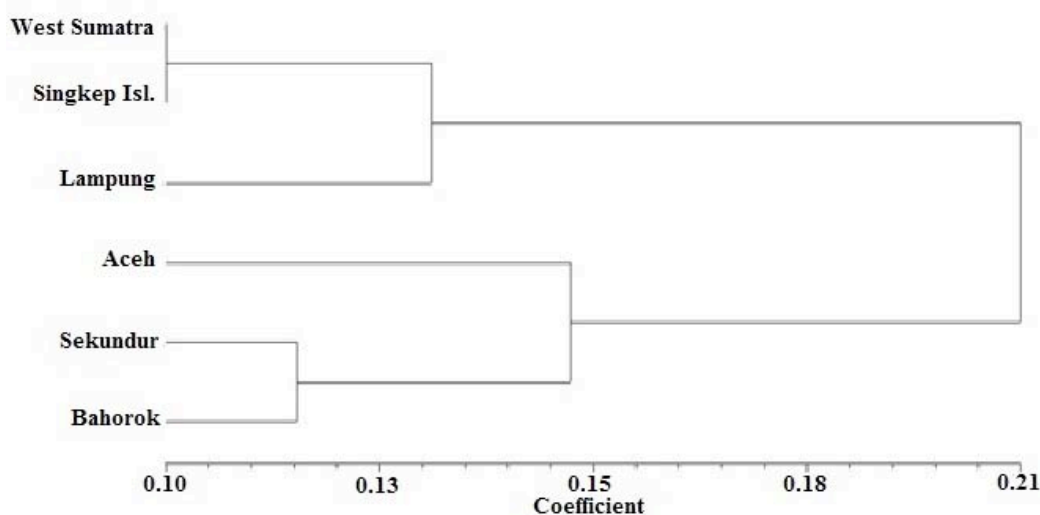


Figure 3. Dendrogram of *P. lateristriga* between populations in Sumatra and adjacent island.

## DISCUSSION

The existence of characters variation of morphology that found between *P. lateristriga* subpopulation in six rivers in West Sumatra (Roesma *et al.* 2014 unpublished) suggested that character divergence between populations were happened in Sumatera. Base on characters comparison that experience of divergence at subpopulation in west Sumatra and populations in the north and south Sumatra and Singkep Island, the Body Width (BW) was a character that constantly showed divergence between populations. It was predicted that those variation of character morphology caused of environmental pressure which vary geographically. It has been reported that the differences at body size character can be triggered by predator (Bronmark and Miner, 1992), territorial water condition (lotic or bentic) (Day *et al.*, 1994), temperature difference between rivers (Beacham, 1990) and food type and way to eat (Day, *et al.*, 1994; Robinson and Wilson, 1996).

According to Kondrashov and Kondrashov (1951) the characters variation of morphology that happened inter populations could be triggered by the process of speciation that caused by reproduction insulation. Losos and Glor (2003) stated that besides reproduction insulation, geographical insulation also supports the variation that tends to make subspecies or new species. Haryono (2001) concluded that pattern of widespread and morphology variation that emerges were caused by the different interregional of physical environment. There for it could be assumed that the primary factors which result in character divergence between populations are geographical factor, reproduction insulation and physical pressure from environment. According to Krukk (1999), the pressure of physical environment factors can result in divergence at individual in interpopulation. Those factors can be in form of ecological selection, sexual selection and natural selection. As a consequence, adaptation to the environment will be done and adaptation or non adaptation process could be happen. According to Haryono (2001) the environmentally pressure which produce changes and adjustments is physical factor like water temperature, pH, salinities, water brightness, water current, altitude and others. Thompson (1991) state that the factors of physical environment influence the phenotype as a consequence of genotype response to the different of environmental pressure. De Silva and Liyanage (2006) state that the environmental factor that affect on *Puntius* variation of morphology character is altitude either between different rivers or same river and that condition called as morphological plasticity.

Variations of morphology character made a cluster between populations. Analysis cluster is conducted to know the value of distance Euclidean between populations (Tables 2, Figure 3). There is a tendency that geographical distance has positive correlation by distance Euclidean. The bigger geographical distance, the bigger value of distance Euclidean and vice versa. The smaller value of

the distance Euclidean indicates that the variation of characters morphology between population getting smaller. Bernatchez *et al.*(1992) state that subdividing a population into cluster can be caused by life-history and dissociation process that happened because of process geologic millions year ago. According to Taki (1978), that existence of equality in one cluster can be assumed that they have common ancestors. There for, there is a possibility that subdividing between population in one species resulted from sharing common ancestor, nevertheless disjointed by geological process and history biogeography of Sumatra millions year ago.

Sumatera is an unstable land that disjointed at a period of Pleistocene, formed because of continuously interaction between physical factor, land/ground and climate (Hamilton, 1979 and Whitten *et al.*, 1987). In the beginning of Miocene, formed of Bukit Barisan mountain range divide the island into two unequal part and condition. This unsymmetrical part is also affected by activities of volcanic in mountain range; as a consequence the cycle of hydrology in Sumatra is varying. The western rivers relative short and flows to the West coast of Sumatra while the eastern rivers relative sloping, wide, length and flows to Sea of South Chinese (Figure 1) (Whitten *et al.*, 1987 and Colombijn, 2005). Geologically active regions create many geographically isolated areas and followed by various ecosystem conditions.

It is interesting to study more detail about this spesies, why the population in west Sumatra and Singkep Island has a smaller Euclidean distance than other part of Sumatra. Do Bukit Barisan mountain range and Toba eruption could be affect in morphology and genetic of others fresh water fish in the north and the south parts of Sumatra.

## CONCLUSION

There are geographic variation of morphological characters in *P. lateristriga* in Sumatra and the adjacent island. The results of analysis show that *P. lateristriga* from west Sumatra which represent the middle part of Sumatra population closely related to *P. lateristriga* from Singkep island with 0.10 Euclidean distance and hold in one cluster with Lampung population which represent the south part of Sumatra population, while the Aceh, Sekundur and Bahorok populations which represent the north part of Sumatra populations were existed in another one cluster

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## REFERENCES

- Beacham TD. 1990. A genetic analysis of meristic and morphometric variation in chum salmon (*Oncorhynchus keta*) at three different temperatures. *Canadian Journal of Zoology*. 68: 225-229
- Bernatchez. L, R. Guyomard and F. Bonhomme.1992. DNA sequence variation of the mitochondrial control region among geographically and morphologically remote European brown trout *Salmo trutta* populations. *Molecular biology*. 1: 161-173
- Cailliet, G.M, M.S. Love and A.W. Ebeling. 1986. Fishes. A Field and Laboratory Manual on Their Structure, Identification and Natural History. Waveland Press, Inc.
- Colombijn, F.2005. A Moving History of Middle Sumatra 1600-1870. *Modern Asia Studies*. 39: 1-38
- Day T. Pritchard J. and Schluter D. 1994. A comparison of two sticklebacks. *Evolution*.48:1723-1734
- De Silva, M.P.K.S.K., and N.P.P Liyanage. 2006. Intra specific morphological plasticity in three *Puntius* species in Srilanka. *Ruhuna Journal of science*.1: 82-95
- Hamilton. 1979. Tectonic of the Indonesian Region. GEOLOGICAL Survey Professional Paper. United States Government Printing Office, Washington

- Haryono. 2001. Variasi Morfologi dan Morfometri Ikan Dokun (*Puntius lateristriga*) di Sumatera. *Biota*. 6: 109-116
- Kondrashov and Kondrashov. 1999. Interaction among quantitative traits in the course of sympatric speciation. *Nature*. 40: 351-354.
- Kottelat, M. A. J. Whitten, S. N. Kartikasari and S. Wirjoatmodjo (1993). *Freshwater Fishes of Western Indonesia and Sulawesi*. Periplus Editions (HK) Ltd. and EMDI : Indonesia, Singapore
- Kruuk, L. 1999. Sticklers for Sympatry. *Tree*. 14 : 465-466
- Losos, J.B and R.E Glor. 2003. Phylogenetic Comparative Methods and the Geographic of Speciation. *Trends in Ecologi and Evolution*. 18: 220-226.
- Roberts, T.R. 2989. The Freshwater fishes of western Borneo (Kalimantan Barat, Indonesia). *Memoirs of the California Academy of Science*. 14: 1-120
- Robinson B.W. and D.S Wilson. 1996. Genetic variation and phenotypic plasticity ina trophically polymorphic population of pumpkinseed sunfish (*Lepomis gibbus*). *Evolutionary Ecology* 10:631-652
- Roesma, D.I, A. Chornelia, A.A. Putra, 2014. Variasi Morfometri Ikan *Puntius lateristriga* Valenciennes, 1842 (Pisces: Cyprinidae) Dari Beberapa Sungai di Kawasan PT. Tidar Kerinci Agung (TKA) Sumatera Barat. Unpublished.
- Rohlf, F.J. 2001. NT Syst. *Numerical Taxonomy and Multivariate Analysis System Version 2.0.2*. New York: Applied Biostatistic Inc.
- Strauss, R. E. and F. L. Bookstein. 1982. The Truss: Body Form Reconstruction in Morphometrics. *Syt. Zool*. 31: 113-135
- Taki, Y. A. Katsuyama, T. Urushido, 1978. Comparative Morphology and Interspecific Relationships of the Cyprinid Genus *Puntius*. *Jap. J. Icht*. Vol. 25. No. 1
- Thompson J.D. 1991. Phenotypic plasticity as a component of evolutionary change. *Trends in Ecology and Evolution*. 6:246-249
- Tweedie, M.W.F. 1961. Notes on Malayan Fresh Water Fishes.9. Regional differentiation in the colour pattern of *Puntius lateristriga*. *Bulletin of the Raffles Museum*. 26: 178-182
- Voris, H.K. 2000. Maps of Pleistocene sea level in southeast Asia : shorelines, River systems and Time Duration. *Journal of Biogeography*. 27: 1153-1167
- Weber, M. and .L.F. de Beaufort. 1916. *The Fishes of Indo-Australian Archipelago* (ostariophysii II: Cyprinoidea, Apodes, synbranchi). E.J. Brill leiden.Ltd
- Whitten, A.J., J. Anwar, and N. Nisyam. 1987. *The Ecology of Sumatra*. Yokyakarta : Gadjah Mada University Press





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