Volume 2002

Conference collection

Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management

Proceedings of the 5th International Conference on Biological Science

ICBS

Faculty of Biology Universitas Gadjah Mada

Yogyakarta, Indonesia
15–16 September 2017

Editors
Tuty Arisuryanti, Maryani, Zuliyati Rohmah, Lisna Hidayati and Ganies Riza Aristya

AIP | Conference Proceedings

proceedings.aip.org

Scientific & Editorial (S&E) Board: Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management

Cite as: AIP Conference Proceedings **2002**, 010002 (2018); https://doi.org/10.1063/1.5050096
Published Online: 15 August 2018

Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management
AIP Conf. Proc. 2002, 010002-1–010002-2; https://doi.org/10.1063/1.5050096
Published by AIP Publishing. 978-0-7354-1718-2/$30.00

37. Miftahul Ilmi, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
38. Muhammad Fauzi Arif, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
39. Mukhlish Jamal Musa Holle, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
40. Mulyati, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
41. Nailil Husna, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
42. Niken Satuti Nur Handayani, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
43. Nova Eka Margiyanti, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
44. Novia Risa, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
45. Parvez Alam, School of Engineering, The University of Edinburgh, UK
46. Penny Wurm, School of Environment, Charles Darwin University, AUS
47. Purnomo, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
48. Qisti Fauziyah, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
49. Rahadian Yudo Hartantyo, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
50. Ratih Aryasari, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
51. RC. Hidayat Soesilohadi, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
52. Retno Peni Sancayaningsih, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
53. Luke Daniels, Department of Biology, The College of Idaho, USA
54. Rifa Nurhayati, Research Unit for Natural Product Technology, Indonesian Institute of Sciences, Yogyakarta, IDN
55. Rina Sri Kasiamdari, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
56. Rury Eprilurahman, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
57. Sari Darmasiwi, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
58. Sena Adi Subrata, Faculty of Forestry, Universitas Gadjah Mada, Yogyakarta, IDN
59. Sitarina Widyarini, Faculty of Veterinary Medicine, Universitas Gadjah Mada, Yogyakarta, IDN
60. Siti Fatimah Binti Sabran, Department of Technology and Natural Resources, Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia, Johor, MYS
61. Slamet Widiyanto, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
62. Soenarwan Hery Poerwanto, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
63. Suharyanto, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
64. Sukarti Moeljopawiro, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
65. Sukirno, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
66. Susilo Hadi, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
67. Suwarno Hadisusanto, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
68. Tri Joko Raharjo, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Yogyakarta, IDN
69. Tri Rini Nuringtyas, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
70. Trijoko, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
71. Tuty Arisuryanti, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
72. Utin Elsya Puspita, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
73. Warsito Tantowijoyo, Eliminate Dengue Project, Universitas Gadjah Mada, Yogyakarta, IDN
74. Woro Anindito Sri Tunjung, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
75. Yekti Asih Purwestri, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN
76. Zuliyati Rohmah, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, IDN

Preface: Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management

Cite as: AIP Conference Proceedings **2002**, 010001 (2018); https://doi.org/10.1063/1.5050095
Published Online: 15 August 2018

PREFACE: Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management

The International Conference on Biological Science (ICBS) 2017 is hosted by Faculty of Biology Universitas Gadjah Mada (Yogyakarta, Indonesia) and jointly organized by Universiti Tun Hussein Onn Malaysia (UTHM). ICBS 2017 is supported by Indonesian Biology Consortium/Konsorsium Biologi Indonesia (KOBI) and Herpetological Society of Indonesia. As continuation to the tradition of international scientific dialogues on biodiversity for betterment of human life and sustainable development through our biennial ICBS since 2009, this 5th ICBS carries “Inventing prosperous future through biological research and tropical biodiversity management” as its theme. This theme is reflected in the diverse range of papers that have been presented. There are more than 170 presenters from countries Japan, Germany, Netherland, Australia, The United Kingdom, The Philippine, Malaysia, and Indonesia. This demonstrates the popularity of the ICBS for sharing ideas and findings with a truly international community.

Among the presented papers, we have selected 72 (seventy two) papers to be published in AIP Conference Proceeding, which is indexed in a number of databases, including Scopus (Elsevier), The Conference Proceedings Citation Index (part of Web of Science), Inspec, Chemical Abstracts Service (CAS), and Astrophysics Data System (ADS). We believe that these selected papers have reflected the eight topics of ICBS 2017 which are: evolution and systematics, ecology and biocoservation, structural and functional biology, biomedical and natural bioactive products, bioinformatics and computational biology, molecular biology and biotechnology, bionanotechnology and biomaterial, as well as system & synthetic biology and bioengineering.

We have invited 66 (sixty-six) experts and researchers from corresponding biological fields to referee the manuscripts. ICBS 2017 relies on the goodwill and the involvement of those expert and researchers in the corresponding fields to referee the papers that have been submitted. A complex process on the papers handling, from reviewing abstracts to the selecting manuscripts which would be published in this AIP proceeding, could not be done without kind support of those people. The honourable reviewers came from eight different countries which bring abroad set of perspective to the research area. Our sincere gratitude extended to all of reviewers for their time and effort in reviewing the manuscripts including giving advices and guidance to the authors for their paper improvement.

Finally, I want to acknowledge to ICBS 2017 Scientific and Editorial Board whose dedication and labors bringing this book into its finest state. The ICBS 2017 proceeding is credited to join efforts of a large group of people and everyone should be proud of the outcome.

Tuty Arisuryanti, Ph.D.
Chief Organizing Committee

Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management
AIP Conf. Proc. 2002, 010001-1–010001-1; https://doi.org/10.1063/1.5050095
Published by AIP Publishing. 978-0-7354-1718-2/$30.00

Table of Contents

‹ PREV | NEXT ›

INVENTING PROSPEROUS FUTURE THROUGH BIOLOGICAL RESEARCH AND TROPICAL BIODIVERSITY MANAGEMENT: Proceedings of the 5th International Conference on Biological Science

Conference date: 15-16 September 2017
Location: Yogyakarta, Indonesia
ISBN: 978-0-7354-1718-2
Editors: Tuty Arisuryanti, Maryani, Zuliyati Rohmah, Lisna Hidayati and Ganies Riza Aristya
Volume number: 2002
Published: Aug 15, 2018

Free . August 2018

Butterfly (Lepidoptera: Rhophalocera) diversity in Bukit Soga, the green lung of Batu Pahat, Malaysia

Aqilah Awg Abdul Rahman, Maryati Mohamed and Alona Cuevas Linatoc

AIP Conference Proceedings **2002**, 020005 (2018); https://doi.org/10.1063/1.5050101

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Edible and medicinal plants sold at selected local markets in Batu Pahat, Johor, Malaysia

Asma Adiba Sulaini and Siti Fatimah Sabran

AIP Conference Proceedings **2002**, 020006 (2018); https://doi.org/10.1063/1.5050102

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Length-weight relationship, sex ratio and condition factors of mud crab (*Scylla paramamosain* Estampador, 1949) from Brantas Estuary, East Java, Indonesia

Asriningsih Suryandari, Anita Putri Maharsari, Bambang Irawan and Agoes Soegianto

AIP Conference Proceedings **2002**, 020007 (2018); https://doi.org/10.1063/1.5050103

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The diurnal bird community in the vicinity of Adisutjipto International Airport Yogyakarta

Bambang Agus Suripto and Noorman Hendri

AIP Conference Proceedings **2002**, 020008 (2018); https://doi.org/10.1063/1.5050104

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The growth and histology structure of Indonesian eel (*Anguilla bicolor bicolor* McClelland, 1844) fed with microalgae

Christin Yohana Ratucoreh and Bambang Retnoaji

AIP Conference Proceedings **2002**, 020009 (2018); https://doi.org/10.1063/1.5050105

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The effectivity of rice husk ash in enhancing drought tolerance on different rice cultivars

Diah Rachmawati, Maryani, Ulfatul Masruroh and Ni Luh Gde Mona Monika

AIP Conference Proceedings **2002**, 020010 (2018); https://doi.org/10.1063/1.5050106

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity of N_2-fixing cyanobacteria in organic rice field during the cycle of rice crops

Dian Hendrayanti, Istatik Khoiriyah, Nurrahmi Fadilah and Andi Salamah

AIP Conference Proceedings **2002**, 020011 (2018); https://doi.org/10.1063/1.5050107

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Snakes and lizards (Reptilia: Squamata) of Gadjah Wong River area, Province of Daerah Istimewa Yogyakarta

Donan Satria Yudha, Rury Eprilurahman, Edwina Prastiwi Sri Rizky, Wiwit Feri Wijiastuti and Muhammad Anis Nasrullah

AIP Conference Proceedings **2002**, 020014 (2018); https://doi.org/10.1063/1.5050110

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Ciprofloxacin effect on the *Fgf10* gene expression in chicken embryo (*Gallus gallus domesticus*) limb development

Dwi Listyorini, Nursasi Handayani, Qoni'atul Munawaroh, Dwi Meinita Sari, Elhah Nailul Khasna, Mareida Ariyadhiny and I. Kade Karisma Gita Ardana

AIP Conference Proceedings **2002**, 020015 (2018); https://doi.org/10.1063/1.5050111

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Indole-3-acetic acid producing bacteria and its application on the growth of rice

Dwi Ningsih Susilowati, Eni Ida Riyanti, Mamik Setyowati and Karden Mulya

AIP Conference Proceedings **2002**, 020016 (2018); https://doi.org/10.1063/1.5050112

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Toxicity test of mangrove epibiont sponges in Tampora Situbondo using brine shrimp lethality test (BSLT)

Edwin Setiawan, Awik Pudji Diah Nurhayati, Nicole J. de Voogd, Amelia Trisnanda Dewi, Alkautsar Alivy, Lanny Kartikasari and Iwenda Subagio

AIP Conference Proceedings **2002**, 020017 (2018); https://doi.org/10.1063/1.5050113

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Structure and composition of tree species in sub-montane forests of Mount Endut, Banten

Edy Nasriadi Sambas

AIP Conference Proceedings **2002**, 020018 (2018); https://doi.org/10.1063/1.5050114

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Polymorphism of *Pun1* gene for pungency in *Capsicum frutescens* 'Cakra Hijau' Indonesian local pepper

Elhah Nailul Khasna, Shelly Zairina, Ria Reinnata Juliandari, Bagus Paramajati, Mohammad Habibi, Andi Madihah, Septi Kurniama Sari and Dwi Listyorini

AIP Conference Proceedings **2002**, 020019 (2018); https://doi.org/10.1063/1.5050115

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Feeding position preferences of Javan slow loris (*Nycticebus javanicus* E. Geoffroy, 1812) at Talun Cipaganti Village, Garut, West Java

Endah Septi Fauzi, Luthfiralda Sjahfirdi, Marie Sigaud, K. Anne-Isola Nekaris, Nurul Laksmi Winarni and Jatna Supriatna

AIP Conference Proceedings **2002**, 020020 (2018); https://doi.org/10.1063/1.5050116

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Antioxidant role of taurine and oyster mushroom on kidneys of male mice induced by paraquat herbicide

Endang Linirin Widiastuti, Endang Nurcahyani and Bayu Putra Danan Jaya

AIP Conference Proceedings **2002**, 020021 (2018); https://doi.org/10.1063/1.5050117

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Orchid biotechnology for Indonesian orchids conservation and industry

Endang Semiarti

AIP Conference Proceedings **2002**, 020022 (2018); https://doi.org/10.1063/1.5050118

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Potency of growth promoting bacteria on mycelial growth of edible mushroom *Pleurotus ostreatus* and its identification based on *16S* rDNA analysis

Evan Febriansyah, Iwan Saskiawan, Wibowo Mangunwardoyo, Tri Ratna Sulistiyani and Eva Watamtin Widhiya

AIP Conference Proceedings **2002**, 020023 (2018); https://doi.org/10.1063/1.5050119

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Ethnobotanical survey on plants used as traditional salad food (*ulam*) in Kampung Taun Gusi, Kota Belud Sabah, Malaysia

Fadzilah Awang-Kanak, Mohd Fadzelly Abu Bakar and Maryati Mohamed

AIP Conference Proceedings **2002**, 020024 (2018); https://doi.org/10.1063/1.5050120

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity and phenetic relationship of black potato (*Coleus tuberosus* Benth.) in Yogyakarta based on morphological and leaf anatomical characters

Fahriza Khairinisa, Purnomo and Maryani

AIP Conference Proceedings **2002**, 020025 (2018); https://doi.org/10.1063/1.5050121

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Expression of gene encoded homogentisate geranylgeranyl transferase involved in tocotrienol biosynthesis in Indonesian local rice (*Oryza sativa* Linnaeus)

Farida Aryani Dian, Anis Rochani, Elhah Nailul Khasna, Dwi Listyorini and Dahlia

AIP Conference Proceedings **2002**, 020026 (2018); https://doi.org/10.1063/1.5050122

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Sex reversal of juvenile freshwater crayfish (*Cherax quadricarinatus*) influenced by steroid extract of sea cucumber and 17α-methyltestosterone hormone at different temperatures

Gregorius Nugroho Susanto, Supono and Fadhli Dzil Ikrom

AIP Conference Proceedings **2002**, 020027 (2018); https://doi.org/10.1063/1.5050123

Free . August 2018

Phenotype variation of guppy fish (*Poecilia reticulate* W. Peters, 1859) population from different quality of aquatic environments in Surabaya, Indonesia

Hasan Adro'i, Sucipto Hariyanto, Mahrus Ali and Bambang Irawan

AIP Conference Proceedings **2002**, 020028 (2018); https://doi.org/10.1063/1.5050124

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Identification of biofilm-forming bacteria from steel panels exposed in sea waters of Jakarta Bay and Madura Strait

Heddy Julistiono, Yusrina Hidayati, Neni Yuslaini, Achirul Nditasari, Achmad Dinoto, Sundjono, Lutviasari Nuraini, Gadang Priyotomo and Hadi Gunawan

AIP Conference Proceedings **2002**, 020029 (2018); https://doi.org/10.1063/1.5050125

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity of bryophyte at junior and senior high schools environment in Yogyakarta city for supporting the implementation of curriculum 2013 in applicative biology learning

Heri Sujadmiko and Pantalea Edelweiss Vitara

AIP Conference Proceedings **2002**, 020030 (2018); https://doi.org/10.1063/1.5050126

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The influence of mackerel fish (*Rastrelliger* sp.) consumption towards the number of pyramidal cell in cerebral cortex of congenital hypothyroid rats (*Rattus norvegicus*)

Idiani Darmawati, Aulia Rahmah and Zulkhah Noor

AIP Conference Proceedings **2002**, 020031 (2018); https://doi.org/10.1063/1.5050127

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity of decapod crustaceans on intertidal zone of Sombu Beach, Wangi-Wangi Island, Wakatobi, Southeast Sulawesi

Imroatul Habibah, Brigitta Juniari Saraswati, Thomi Asyari, Nur Rachman, Puspo Restu Sayekti, Burhan Amirudien, Sevina Rahmi, Afifah and Rury Eprilurahman

AIP Conference Proceedings **2002**, 020032 (2018); https://doi.org/10.1063/1.5050128

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The effect of perimeter trap crop system using insectary plant for enhancing arthropod natural enemies at tobacco plantations (*Nicotiana tabacum* Linnaeus)

Indah Trisnawati and Wildan Cahyo Wuriyanto

AIP Conference Proceedings **2002**, 020033 (2018); https://doi.org/10.1063/1.5050129

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Mold community diversity differences in Wonorejo Surabaya habitats

Intan Ayu Pratiwi and Bambang Irawan

AIP Conference Proceedings **2002**, 020034 (2018); https://doi.org/10.1063/1.5050130

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Distribution study of migratory bird in Surabaya east coast as introduction to predict species adaptation through global warming impact

Iska Desmawati, Indah Trisnawati D. T. and Muhammad Nasrulloh

AIP Conference Proceedings **2002**, 020035 (2018); https://doi.org/10.1063/1.5050131

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Research with diversified people

Keiko T. Natsuaki

AIP Conference Proceedings **2002**, 020036 (2018); https://doi.org/10.1063/1.5050132

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The potency of gadung (*Dioscorea hispida* Dennst.) tuber as a functional food: Toxicity, phytochemical content and starch characters

Laurentius Hartanto Nugroho and Anna Estyaniyana

AIP Conference Proceedings **2002**, 020037 (2018); https://doi.org/10.1063/1.5050133

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Identification and phylogenetic study of bioluminescent bacteria from squid (*Loligo duvaucelii*) based on *16S rRNA* gene

Melati Putri Pertiwi, Patricia Karin Himawan Praseptin, Ika Diana Werdani, Dwi Listyorini and Sitoresmi Prabaningtyas

AIP Conference Proceedings **2002**, 020038 (2018); https://doi.org/10.1063/1.5050134

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Characterization of cycloartenol synthase *KcCAS* promoter region from mangrove plant (*Kandelia obovata* Sheue, H. Y. Liu & J. Yong)

Mohammad Basyuni, Ridha Wati, Shigeyuki Baba and Hirosuke Oku

AIP Conference Proceedings **2002**, 020040 (2018); https://doi.org/10.1063/1.5050136

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Isolation and phylogenetic analysis of new predicted polyprenol reductase from mangrove plant (*Kandelia obovata* Sheue, H. Y. Liu & J. Yong)

Mohammad Basyuni, Shigeyuki Baba, Ridha Wati, Sumardi, Nurdin Sulistiyono, Hirosuke Oku and Hiroshi Sagami

AIP Conference Proceedings **2002**, 020041 (2018); https://doi.org/10.1063/1.5050137

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Screening and identification of lignolytic bacteria from the forest at eastern slope of Lawu Mountain

Muh. Nahrowi B., Ari Susilowati and Ratna Setyaningsih

AIP Conference Proceedings **2002**, 020042 (2018); https://doi.org/10.1063/1.5050138

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Estimating the species richness of anuran fauna at Taman Negara Johor Endau Rompin using non-parametric estimators

Muhammad Taufik Awang, Maryati Mohamed, Lili Tokiman and Amirrudin Ahmad

AIP Conference Proceedings **2002**, 020043 (2018); https://doi.org/10.1063/1.5050139

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Antimicrobial activity from leaf, flower, stem, and root of *Clitoria ternatea* – A review

Nadzirah Jamil and Furzani Pa'ee

AIP Conference Proceedings **2002**, 020044 (2018); https://doi.org/10.1063/1.5050140

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Biodegradability of four wood species treated by gamma-irradiation and its applicability to the termite management

Niken Subekti, Priyantini Widiyaningrum, Fidia Fibriana and Agus Indarjo

AIP Conference Proceedings **2002**, 020045 (2018); https://doi.org/10.1063/1.5050141

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Antihyperlipidemic and anti-obesity effects of the methanolic extract of *parijoto* (*Medinilla speciosa*)

Noor Nailis Sa'adah, Awik Puji Dyah Nurhayati and Kristanti Indah Purwani

AIP Conference Proceedings **2002**, 020046 (2018); https://doi.org/10.1063/1.5050142

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Spatial distribution of butterfly (Lepidoptera: Papilionoidea) along altitudinal gradients at Gunung Ledang National Park, Johor, Malaysia

Norradihah Ismail, Maryati Mohamed, Phon Chooi Khim and Lili Tokiman

AIP Conference Proceedings **2002**, 020047 (2018); https://doi.org/10.1063/1.5050143

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Ethnomedicinal knowledge of plants used for healthcare by the Javanese-Malay community in Parit Jelutong, Batu Pahat, Johor, Malaysia

Nur Amalina Ismail, Siti Fatimah Sabran, Maryati Mohamed and Mohd Fadzelly Abu Bakar

AIP Conference Proceedings **2002**, 020048 (2018); https://doi.org/10.1063/1.5050144

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity and phenetic analysis of *tomboreso* (*Dioscorea pentaphylla* L.) in Yogyakarta based on morphological and leaf anatomical characters

Purnomo, Malikah and Maryani

AIP Conference Proceedings **2002**, 020049 (2018); https://doi.org/10.1063/1.5050145

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Iron chelating activity of *Caesalpinia sappan* L. extract on iron status in iron overload rats (*Rattus norvegicus* L.)

Ratu Safitri, Ani Melani Maskoen, Mas Rizky Anggun Adipurna Syamsunarno, Mohammad Ghozali and Ramdan Panigoro

AIP Conference Proceedings **2002**, 020050 (2018); https://doi.org/10.1063/1.5050146

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Bioinformatics analysis of the expressed sequence tags from *Rhizophora stylosa* Griff. genomic library

Ridha Wati, Mohammad Basyuni, Shigeyuki Baba and Hirosuke Oku

AIP Conference Proceedings **2002**, 020051 (2018); https://doi.org/10.1063/1.5050147

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Detection of polymorphisms on strawberry (*Fragaria* spp.) based on cleavage amplified polymorphic sequence

Rina Kasiamdari, Ganies Riza Aristya, Achmad Syahrian and Wakhidah Kurniawati

AIP Conference Proceedings **2002**, 020052 (2018); https://doi.org/10.1063/1.5050148

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Natural polyploidy in amaranths (*Amaranthus* spp.)

Rita Andini, Muhammad Ikhsan Sulaiman and Ryo Ohsawa

AIP Conference Proceedings **2002**, 020053 (2018); https://doi.org/10.1063/1.5050149

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Potential of vascular plants as phytotourism products in Endau Rompin Johor National Park, Malaysia

Salasiah Mohamad, Maryati Mohamed and Muhammad Shafiq Hamdin

AIP Conference Proceedings **2002**, 020054 (2018); https://doi.org/10.1063/1.5050150

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Ciprofloxacin down-regulates *Wnt5a* gene expression in chick embryo leg bud

Silmy Aulia Rufiatin Nisa, Elhah Nailul Khasna, Dwi Listyorini and Nursasi Handayani

AIP Conference Proceedings **2002**, 020055 (2018); https://doi.org/10.1063/1.5050151

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The effect of supplemented probiotic on the laying performance and egg quality of Japanese quail (*Coturnix-coturnix japonica* Temminck and Schlegel, 1849)

Slamet Widiyanto and Wahyu Indrawan

AIP Conference Proceedings **2002**, 020056 (2018); https://doi.org/10.1063/1.5050152

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Effect of coloring pH and mordant on fungal dyes quality using woolen yarn

Suciatmih and Yuliar

AIP Conference Proceedings **2002**, 020057 (2018); https://doi.org/10.1063/1.5050153

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Breeding ecology of the rice field rat (*Rattus argentiventer* Rob & Kloss, 1916) in irrigated rice ecosystem in Indonesia

Sudarmaji and Nur 'Aini Herawati

AIP Conference Proceedings **2002**, 020058 (2018); https://doi.org/10.1063/1.5050154

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Selection of potential probiotic lactic acid bacteria isolated from palm sap (*Borassus flabellifer* Linn.) origin Kupang, East Nusa Tenggara

Sulistiani

AIP Conference Proceedings **2002**, 020059 (2018); https://doi.org/10.1063/1.5050155

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Application biopreservatives produced by lactic acid bacteria (LAB) for preservation boiled-salted (*pindang*) tuna (*Euthynnus affinis* Cantor, 1849)

Sulistiani and Rini Handayani

AIP Conference Proceedings **2002**, 020060 (2018); https://doi.org/10.1063/1.5050156

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Pathological alteration of digestive tissues in blue mussel (*Mytillus galloprovincialis*) larvae induced by *Alexandrium fundyense* lysates

Supono, Christopher Bolch and Graeme Knowles

AIP Conference Proceedings **2002**, 020061 (2018); https://doi.org/10.1063/1.5050157

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Effect of sequential extraction on total phenolic content (TPC) and antioxidant activities (AA) of *Luffa acutangula* Linnaeus dried pulps

Supriatno and Lelifajri

AIP Conference Proceedings **2002**, 020062 (2018); https://doi.org/10.1063/1.5050158

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Study of the characteristic of neritidae: Shell and operculum

Susintowati, Suwarno Hadisusanto, Nyoman Puniawati, Erny Poedjirahajoe and Niken Satuti Nur Handayani

AIP Conference Proceedings **2002**, 020063 (2018); https://doi.org/10.1063/1.5050159

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Screening and identifying of cellulolytic bacteria from Alas Purwo National Park

Syahriar Nur Maulana Malik Ibrahim, Sibyandhita Erhaa Amalia, Bunga Agatha, Mustikayanti Yuni Lestari, Antonius Dwi Saputra, Nur Laily Fachira Ikmala, Fazareyna Hyuwan Argi Ryanto, Puspita Ayu Dewi, Mochamad Khoirul Anam, Farah Aisyah Nafidiastri, Nastiti Trikurniadewi, Ditta Putri Kumalasari, Erta Tri, more...

AIP Conference Proceedings **2002**, 020064 (2018); https://doi.org/10.1063/1.5050160

SHOW ABSTRACT PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The contents of glucose and lactic acid in tube paste flour additional amylolytic *Lactobacillus bulgaricus* FNCC 004P and *Streptococcus thermophillus* FNCC 1.9.03

Tatik Khusniati, Firda Fatimah Al Ansya and Erlinda Gangga

AIP Conference Proceedings **2002**, 020065 (2018); https://doi.org/10.1063/1.5050161

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Diversity of crabs in the intertidal zone at Sundak Beach, Gunungkidul, Indonesia

Titis Sukmaningrum, Basith Kuncoro Adji, Eka Mulia Pratiwi, Bening Larasati, Puspa Restu Sayekti, Ikhsan Maulana and Rury Eprilurahman

AIP Conference Proceedings **2002**, 020066 (2018); https://doi.org/10.1063/1.5050162

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

The antioxidant and cytotoxic activities of the chloroform extract of agarwood (*Gyrinops versteegii* (Gilg.) Domke) leaves on HeLa cell lines

Tri Rini Nuringtyas, Rini Isromarina, Yovi Septia, Lisna Hidayati, Nastiti Wijayanti and Sukarti Moeljopawiro

AIP Conference Proceedings **2002**, 020067 (2018); https://doi.org/10.1063/1.5050163

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Genetic identification of two mudskipper species (Pisces: Gobiidae) from Bogowonto Lagoon (Yogyakarta, Indonesia) using *COI* mitochondrial gene as a DNA barcoding marker

Tuty Arisuryanti, Rika Lathif Hasan and Johan Putra Koentjana

AIP Conference Proceedings **2002**, 020068 (2018); https://doi.org/10.1063/1.5050164

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Karyomorphological study on two local garlic cultivars (*Allium sativum* L.) from central Java, Indonesia

Tuty Arisuryanti, Zulfa Kurniawati and Johan Putra Koentjana

AIP Conference Proceedings **2002**, 020069 (2018); https://doi.org/10.1063/1.5050165

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Histologic observation, identification, and secondary metabolites analysis of endophytic fungi isolated from a medicinal plant, *hedychium acuminatum* Roscoe

Utami Sri Hastuti, Putri Moortiyani Al Asna, and Dwi Rahmawati

AIP Conference Proceedings **2002**, 020070 (2018); https://doi.org/10.1063/1.5050166

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Length-Weight relationship, sex ratio and condition factor of blue swimming crab (*Portunus pelagicus* Linnaeus, 1758) from Java Sea Indonesia

Vella Rohmayani, Muhammad Reza Pahlevi, Bambang Irawan and Agoes Soegianto

AIP Conference Proceedings **2002**, 020071 (2018); https://doi.org/10.1063/1.5050167

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Free . August 2018

Influence of bacterial consortium for copper biosorption and accumulation

Wahyu Irawati, Nommensen Pangihutan Ompusunggu and Triwibowo Yuwono

AIP Conference Proceedings **2002**, 020072 (2018); https://doi.org/10.1063/1.5050168

SHOW ABSTRACT | PDF ADD TO FAVORITES SHARE EXPORT CITATION

Phenotype variation of guppy fish (Poecilia reticulate W. Peters, 1859) population from different quality of aquatic environments in Surabaya, Indonesia

Hasan Adro'i, Sucipto Hariyanto, Mahrus Ali, and Bambang Irawan

Phenotype Variation of Guppy Fish (*Poecilia reticulate* W. Peters, 1859) Population from Different Quality of Aquatic Environments in Surabaya, Indonesia

Hasan Adro'i, Sucipto Hariyanto[a)], Mahrus Ali, and Bambang Irawan

Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Surabaya, Indonesia.

[a)]Corresponding author: sucipto-h@fst.unair.ac.id

Abstract. Guppy fish (*Poecilia reticulata*) is commonly found in various regions and widespread distribution throughout the world, several aquatic environments in Surabaya have been known belong to the category of water quality class III or class IV. Abiotic factors that present in the environment may influence the polymorphism in a guppy fish population. When the population faces different environmental condition, it will cause the phenotypic variation in order to adapt to the conditions in the local environment. This study aims to observe the phenotypic variation of guppy fish population living in several aquatic environments with different quality levels in Surabaya. Fish samples were taken from six different locations that have been known for their water quality based on measurement of physical and chemical parameters. The total of 120 fish samples was obtained from six locations and used for phenotypic character analysis, such as body size and body color pattern. The results of this study consist of data on phenotype structure and phenogram tree. The population kinship based on phenogram tree consists of the first group that coming from a population of the class IV location, while the second group is coming from a population of the class III location. The phenotypic character of guppy fish that have different values between sites is body length, body area, the relative area of structural color, and relative area of carotenoid color.

Keywords: aquatic environments, guppy fish, phenogram, phenotypic character

INTRODUCTION

Guppy (*Poecilia reticulata*) is a freshwater fish native species from Trinidad and northeastern region of South America [1]. The male guppy is a popular commercial fish because it has many strains and more varies in color and fin shape that makes it has been widely traded [2]. Guppy fish has been used to control the vector of *Aedes aegypti* disease [3] and is effectively used as a biological control agent against malaria mosquito larvae in Kenya [4]. This guppy species exhibits phenotype character of sexual dimorphism, the male fish has a wider tail fin, a more variable body color pattern, and relatively has a smaller body size than the female fish [5]. The male guppy has a size between 25 mm to 35 mm and has conspicuous color polymorphism patterns consisting of combinations of black, white, red-orange, yellow, green, iridescent spots, lines, and speckles. Males have a gonopodium; a slender, modified anal fin used as an intromittent organ, whereas the anal fin of females is rounded. Females are uniform silver grey and are larger and deeper bodies than males (40 mm to 60 mm). Juvenile fish resemble females and are independent from birth [6].

In Indonesia, guppy fish was first introduced as a biological control agent and has grown in wild environment through natural reproduction [7]. In Surabaya, the guppy fish which are abundant, can be found in most of the freshwater habitat in the city. The increase in human population has negative impacts on the environment, one of which is aquatic environment pollution due to both domestic and industrial waste generated by various human activities. That various kind of waste has a major influence on water quality changes in Surabaya [8]. Based on The Local Regulation of Surabaya No. 2 in 2004 about water quality management and water pollution control, the aquatic environments in Surabaya has been determined based on different quality levels which is consist of four different classes according to some physical, chemical, and microbiological parameters. This regulation has also

Inventing Prosperous Future through Biological Research and Tropical Biodiversity Management
AIP Conf. Proc. 2002, 020028-1–020028-10; https://doi.org/10.1063/1.5050124
Published by AIP Publishing. 978-0-7354-1718-2/$30.00

determined each class of several aquatic environments in Surabaya, which all consist of water quality class III, and class IV [9], and this condition was observed every year [8].

Guppy fish to be found in various regions and it has widespread distribution throughout the world. Some populations to be found inhabit in environments with varying conditions [10]. Various factors affect this fish species have a widespread distribution such as very high reproduction rate [11], have an ability to tolerate the contaminations in the environment [12], and have phenotypic plasticity [13]. When this fish has adapted in the new environments that have very different conditions from the origin environments, then this fish could present the divergence of several phenotypic characters in male fish from their original fish population [14].

This fish has a capability to adapt even in contaminated water conditions [15], but only a handful of study about the phenotypic character variation of guppy fish that exists in the introduced location. In Indonesia, the guppy fish that are living in the wild environments is rarely studied. Rahayu *et al*. [16] conducted the previous study about guppy fish in the wild habitat. Their study investigated the associations between trace metals in sediment, water, and guppy from urban streams of Semarang, Indonesia. Some abiotic factors that present in the environment such as turbidity or nutrient availability may influence the color polymorphism in introduced population of guppy fish [17]. Polymorphism occurs when two or more different phenotypic character present in one population of the same species [18]. When the population faces different environmental condition, it will cause the phenotypic variation due to adaptation in the new local environment [19].

This study aims to observe the phenotypic variation of guppy fish populations inhabit several aquatic environments with different quality levels in Surabaya. Furthermore, this study is to gain the new information and knowledge about the morphological relationship among guppy fish populations inhabit in several aquatic environments in Surabaya based on phenotypic characters and it could be as a useful data and developed for the future study.

MATERIALS AND METHODS

Study Area and Fish Sampling

Guppy fish have collected from Jan to Feb 2017 at six different sites of aquatic environmental streams in Surabaya, East Java, Indonesia (Table 1). The three sites were Kaldami (KD), Kenjeran (KE), and Kebonagung (KA), all have the water quality class III. Whereas the three other sites were Pegirian (PE), Wonorejo (WO), and Darmo (DA), all have the water quality class IV (Table 1 and Fig. 1). These sites selected because they both have different water quality levels (class III and IV) in Surabaya and present the population of guppy fish based on observer's exploratory sampling.

TABLE 1. Location of the sampling sites.

Sampling Site (Stream Name)	Site Code	Coordinates		Water Quality Class
Kalidami	KD	7°16'36.1"S	112°45'44.9"E	III
Kenjeran	KE	7°15'10.1"S	112°47'42.2"E	III
Kebonagung	KA	7°19'53.4"S	112°46'35.7"E	III
Pegirian	PE	7°14'16.7"S	112°44'40.7"E	IV
Wonorejo	WO	7°18'44.1"S	112°46'50.3"E	IV
Darmo	DA	7°17'24.0"S	112°44'32.0"E	IV

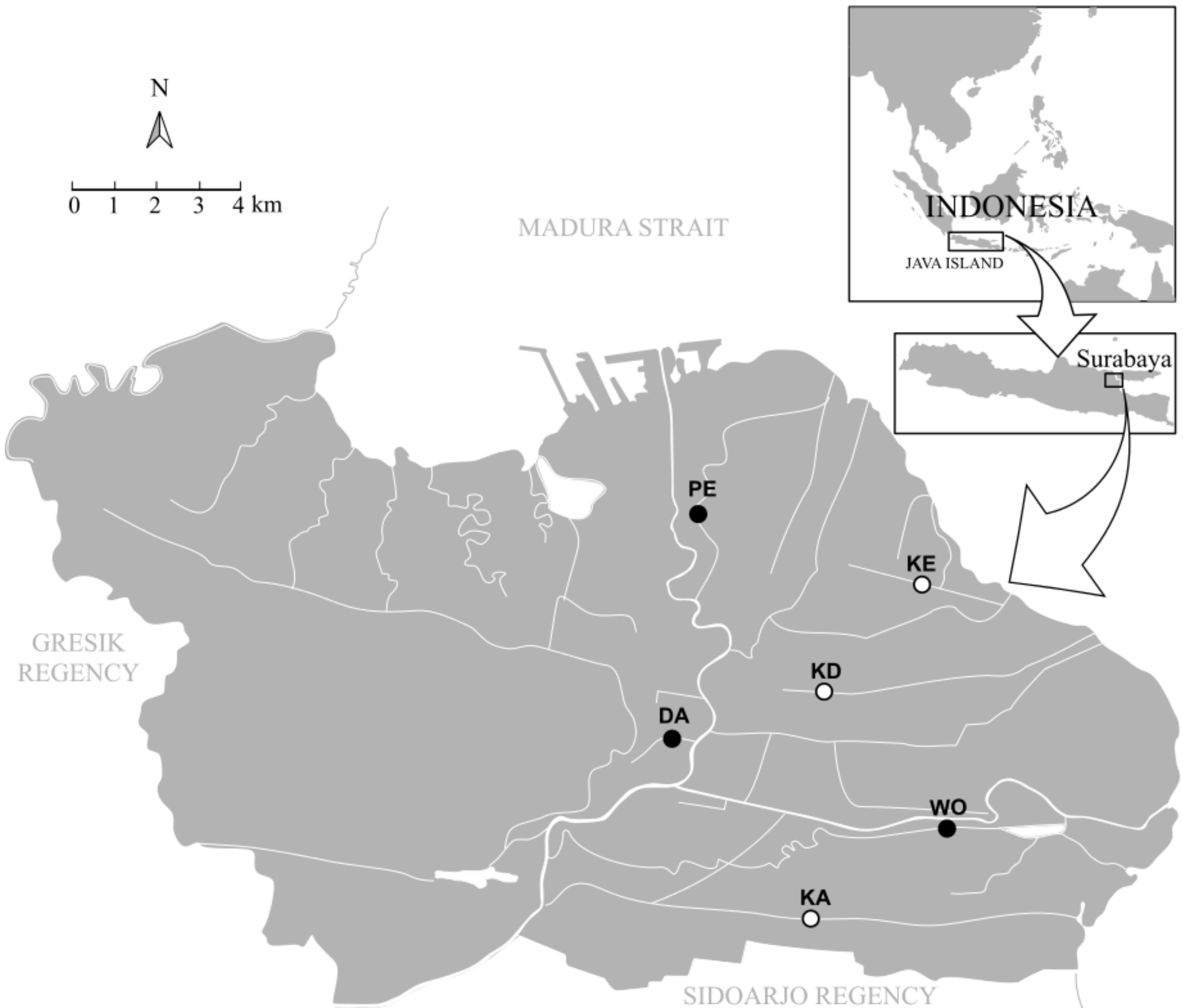

FIGURE 1. The sampling site locations of guppy fish in Surabaya. The white circles are the water quality class III, while the black circles are the water quality class IV locations. The white color patterns on the map are the water bodies

Before the fish samples were collected, we analyzed the physicochemical parameters of aquatic environment quality using the water quality measurement instruments. The parameters that samples measured directly on the site were temperature, pH, dissolved oxygen (DO), salinity, and water flow velocity. As for, the parameters that were measured after the water samples collected and analyzed in the laboratory were biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS). The parameters of aquatic environment quality were measured once in a month from Jan 2017 until Mar 2017 in each sampling site. Some parameters, such as temperature, TSS, pH, BOD, COD, and DO were measured based on the range value criteria arranged by The Local Regulation of Surabaya No. 2 in 2004, which has four different classes of water quality categories (Table 2). Class I is the water intended for use for drinking and other purposes that require the same water quality as those uses; class II, water intended for use in facilities of water recreation, cultivation of freshwater and brackish fish, livestock, irrigation, and other purposes that require the same water quality as those uses; class III, water intended for use in the cultivation of freshwater and brackish fish, livestock, irrigation, and other purposes that require the same water quality as those uses; and class IV, water intended for irrigation and other purposes that require the same water quality as those uses [9].

TABLE 2. The range values of water quality class categories arranged by The Local Regulation of Surabaya No. 2 in 2004 [9].

Parameter	Unit	Water Quality Class			
		I	II	III	IV
Physical					
Temperature	°C	Deviation 3	Deviation 3	Deviation 3	Deviation 3
TSS	$mg \cdot L^{-1}$	50	50	400	400
Inorganic Chemical					
pH	-	6 to 9	6 to 9	6 to 9	5 to 9
BOD	$mg \cdot L^{-1}$	2	3	6	12
COD	$mg \cdot L^{-1}$	10	25	50	100
DO	$mg \cdot L^{-1}$	6	4	3	0

Description: The above value is the maximum value, except for pH and DO. As for pH is a range value that should not be less or more of the listed value. The value of DO is the minimum value. The temperature deviation is in the natural condition.

Phenotypic Characters Analysis

Using a hand-net, a number of 20 males to 30 males of guppy fish were collected in each site. Fish were transport immediately to the Laboratory of Biosystematics, Faculty of Science and Technology, Universitas Airlangga Surabaya. Then they were anesthetized with a dose of eugenol ($C_{10}H_{12}O_2$). The fish then were processed following the methods of [20]. Lateral images of the left side of each fish photographed using a digital camera placed at a standard distance with the aid of a tripod. Each sample was placed on a white background with millimetric scale, and color standards (Red, Orange, Yellow, Blue, Green, White and Black). The phenotypic characters of male guppy fish such as, body length (standard length), body area (excluding the fins and tail), tail length, and the area and the number of each color spot (excluding the fins and tail) (Fig. 2) were measured using software Image J (version 1.50e). All fish sample images were analyzed by a similar person.

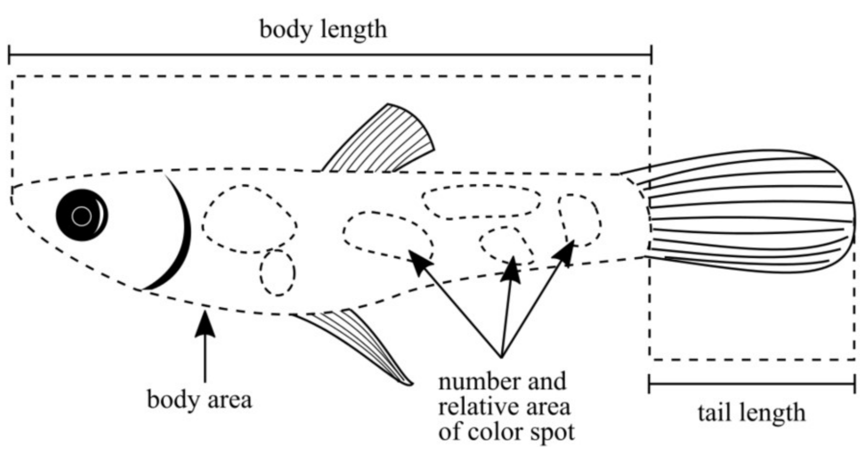

FIGURE 2. The phenotypic characters of male guppy fish which measured in this study

To reduce the number of variables for analysis, the color patterns were grouped into biologically relevant categories. These groups have different physiological bases, structural bases, functional interpretations, and selective relevance [21–26]. Carotenoid colors consisted of the sum of orange and yellow spots, although note that pigments other than carotenoids also contribute to these spots [23]. Structural colors are colors that are iridescent and have higher levels of reflection and consisted of the sum of blue, violet, and silver spots [22]. Melanic colors consisted of the sum of black and fuzzy black spots.

Data Analysis

Software SPSS version 20 was used to build a phenogram tree based on all phenotypic character value using Ward Linkage method. The statistical analysis from the phenotypic characters of guppy fish such as, body size and color pattern of each sample was analyzed using Principal Component Analysis (PCA) to find the factors that formed among different guppy fish populations. The one-way Analysis of Variance (ANOVA) was performed to know which of each character has a different value among different populations from each site following the post-hoc test using the Bonferroni test. This test was for the data which have homogenous variance whereas the Gomes-Howell test was used for the non-homogenous data with a significant value 0.05 ($\alpha = 0.05$).

RESULTS AND DISCUSSION

A number of 20 male guppy fish samples which the body length between 12.0280 mm and 17.8470 mm and the tail length between 3.0280 mm and 5.8270 mm were measured and used for the further analysis with the other phenotypic characters (Table 3).

TABLE 3. Phenotypic character data of guppy fish from each site in Surabaya.
The data represent mean ± standard deviation (SD) and samples sizes (N) estimated across sites.

Site	N	Body Length (mm)	Body Area (mm^2)	Relative Area of (mm^2)	
				Carotenoid Color	Structural Color
KD	20	13.6612 ± 0.9141	41.8963 ± 5.1870	0.0357 ± 0.0198	0.1040 ± 0.0143
KE	20	13.8019 ± 1.0294	37.6103 ± 6.3479	0.0668 ± 0.0192	0.0978 ± 0.0185
KA	20	13.9310 ± 0.8280	37.8840 ± 2.1361	0.0311 ± 0.0140	0.0860 ± 0.0246
PE	20	16.2201 ± 0.7765	49.9349 ± 1.2514	0.0909 ± 0.0219	0.1641 ± 0.0146
WO	20	16.5912 ± 0.6090	49.9516 ± 1.0159	0.0959 ± 0.0232	0.1455 ± 0.0253
DA	20	16.7658 ± 0.6658	49.9500 ± 1.2678	0.0834 ± 0.0166	0.1526 ± 0.0300

Aquatic Environment Quality

Overall, most of the measurement values have met the criteria of the freshwater quality class category in Surabaya based on Table 1 and Table 2. From both tables, the location of KD, KE, and KA belonged to the water quality Class III, while the location of PE, WO, and DA belonged to the water quality Class IV (Table 4). Guppy is a fish that has excellent adaptability in broad environmental conditions and they are easy to adapt even in the high-contaminated water conditions [15, 27]. Therefore, in this study, the guppy fish easily found in the aquatic environment, which has either class III or class IV water quality in Surabaya.

TABLE 4. Phenotypic character data of guppy fish from each site in Surabaya. The data represent mean ± standard deviation (SD) and samples sizes (N) estimated across sites.

Site	Month	pH	DO ($mg \cdot L^{-1}$)	BOD ($mg \cdot L^{-1}$)	COD ($mg \cdot L^{-1}$)	Turbidity (NTU)	Water Velocity (mph)	Salinity (‰)	Temperature (°C)	TSS ($mg \cdot L^{-1}$)
	Jan	7.90	5.67	5.21	11.21	9.50	8.00	0.00	29.17	173.00
KD	Feb	7.50	3.83	5.67	12.65	9.54	1.67	0.00	29.00	170.00
	Mar	7.47	5.47	6.65	11.92	10.21	0.33	0.00	29.00	270.33
Accuracy (%)		**100**	**100**	**66.7**	**100**		**-**	**-**	**100**	**100**
	Jan	7.60	5.73	5.73	9.43	10.34	0.00	0.00	28.83	148.33
KE	Feb	7.47	5.13	7.64	8.76	10.32	0.00	0.00	29.17	258.00
	Mar	7.50	5.73	5.50	9.65	10.30	0.00	0.00	29.00	267.00
Accuracy (%)		**100**	**100**	**66.7**	**100**		**-**	**-**	**100**	**100**
	Jan	7.43	3.43	6.65	11.34	10.23	0.04	0.00	28.57	198.67
KA	Feb	7.43	3.97	4.76	11.65	9.58	10.00	0.00	28.67	178.67
	Mar	7.50	5.10	8.76	11.65	10.25	9.00	0.00	29.00	102.67

Continued on next page

Table 4. Continued

Site	Month	pH	DO (mg · L^{-1})	BOD (mg · L^{-1})	COD (mg · L^{-1})	Turbidity (NTU)	Water Velocity (mph)	Salinity (‰)	Temperature (°C)	TSS (mg · L^{-1})
Accuracy (%)		**100**	**100**	**33.2**	**100**	**-**	**-**	**-**	**100**	**100**
	Jan	7.57	2.60	10.54	15.74	14.93	2.33	1.33	29.00	341.00
PE	Feb	7.63	2.13	10.54	16.76	18.43	0.10	1.00	29.00	305.00
	Mar	7.53	2.07	8.67	15.20	15.44	0.00	0.00	29.00	351.00
Accuracy (%)		**100**	**100**	**100**	**100**	**-**	**-**	**-**	**100**	**100**
	Jan	7.40	2.73	11.25	18.70	15.46	0.00	0.00	29.67	332.00
WO	Feb	7.43	2.80	6.87	17.65	17.96	0.15	0.00	29.33	342.67
	Mar	7.50	2.50	8.23	18.64	17.65	0.00	0.00	29.50	346.67
Accuracy (%)		**100**	**100**	**100**	**100**	**-**	**-**	**-**	**100**	**100**
	Jan	7.53	2.20	10.22	20.31	16.50	0.00	0.00	29.00	341.33
DA	Feb	7.50	2.03	8.65	15.66	16.54	0.09	0.00	29.40	371.00
	Mar	7.50	2.20	10.66	16.47	17.01	0.00	0.00	29.17	311.33
Accuracy (%)		**100**	**100**	**100**	**100**	**-**	**-**	**-**	**100**	**100**

Phenotypic Characters

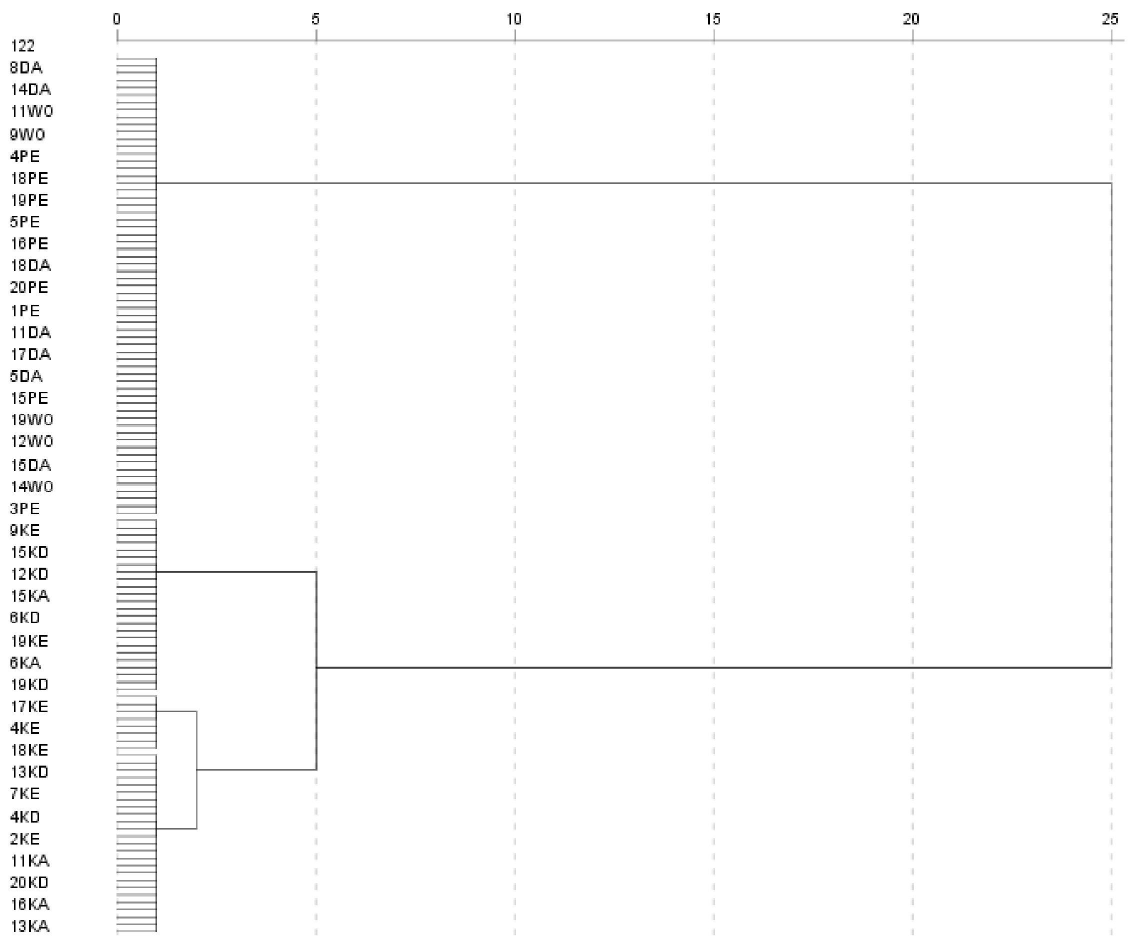

FIGURE 3. The phenogram tree of guppy fish samples from different sampling site in Surabaya streams

Based on the phenogram tree that has established there are two main branches with a value of difference is 25. The first branch is filled with the samples originating from the location with the water quality class IV (PE WO, and DA) which have a very close similarity (value of difference is 0). The second branch is filled with all the samples originating from water quality class III location (KD KE and KA) with the more varied value.

The PCA test reveals that there are only four phenotypic characters have influence (meet the statistical value), among different sites, they are body length, body area, the relative area of structural color, and relative area of carotenoid color. However, the characters of tail length, the relative area of melanic color, and spot number of each color do not correlate with location differences. The two main factors have been formed is factor 1 consists of body area, body length, and relative area of structural color. Therefore it named with "body size and structural color factor," while factor 2 consist of relative area of carotenoid color named the "carotenoid color size factor" (Fig. 4).

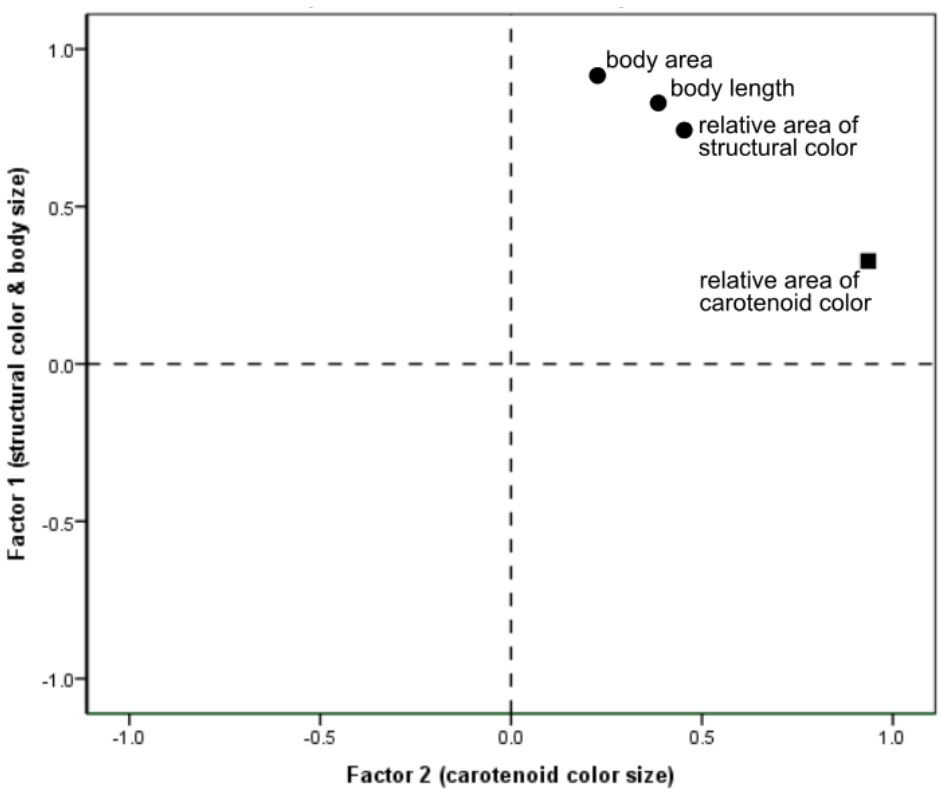

FIGURE 4. Factors that formed through PCA analysis

The PCA test reveals that there are only four phenotypic characters (they are body length, body area, relative area of structural color, and relative area of carotenoid color), have influence among different sites. However, the characters of tail length, relative area of melanic color, and spot number of each color do not correlate with location differences. The two main factors have been formed is factor 1 consists of body area, body length, and relative area of structural color. Therefore, it named with "body size and structural color factor," while factor 2 consist of relative area of carotenoid color named the "carotenoid color size factor" (Fig. 4).

TABLE 5. The results of the one way ANOVA ($\alpha = 0.05$) of four phenotypic characters.

Character	**Df**	**F**	***P***
Body length	2.294	68.151	< 0.001
Body area	2.294	59.068	< 0.001
Relative area of carotenoid color	2.294	41.977	< 0.001
Relative area of structural color	2.294	44.636	< 0.001

The result of the one-way ANOVA test of the four phenotypic characters reveals a significance value less than 0.001 ($p < 0.05$) among the four sampling sites in this study (Table 5). This shows that there are differences in value from this four characters among the sampling sites used in this study

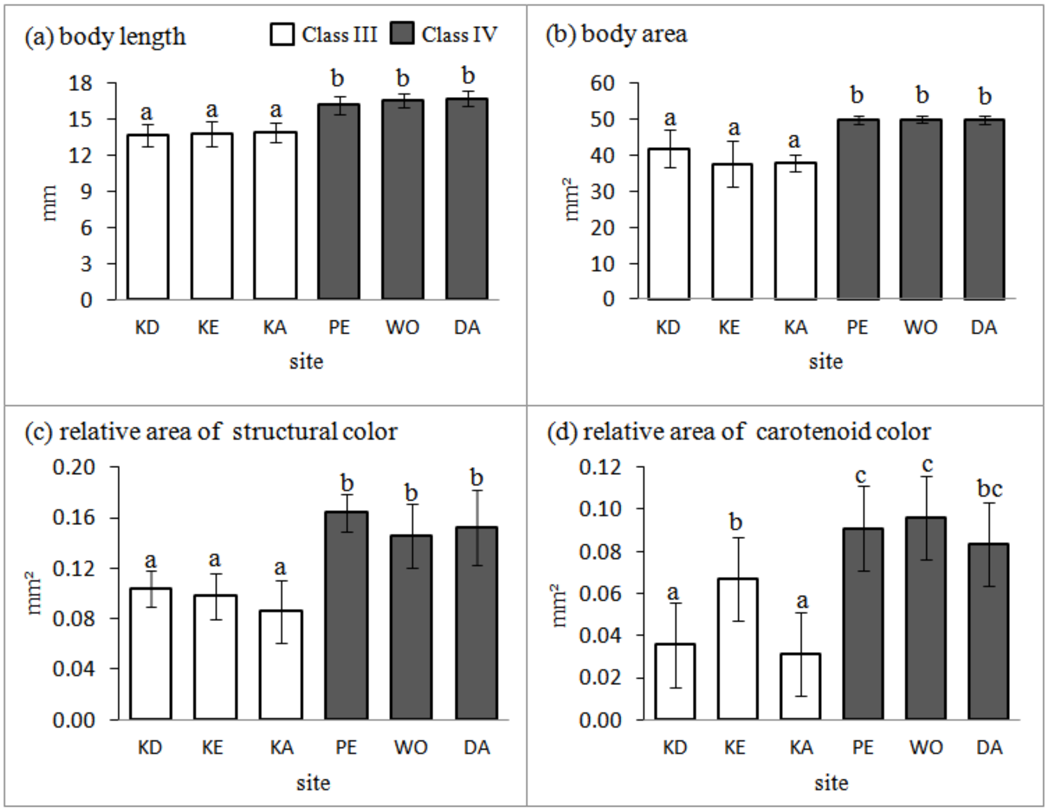

FIGURE 5. Comparison of the size of phenotypic character among male guppy fish population in each location with different water quality classes

Several studies about the guppy showed male fish has a polymorphism of phenotypic character resulting from its adaptation either in aquatic environments with different abiotic factor conditions [17, 20, 28] or in aquatic environments with different biotic factors condition, such as the presence of predatory or parasitic organisms [1, 14, 29].

The three character of body length, body area, and relative area of structural color have significant mean value differences between locations with different water quality classes but not significant in one same water quality class (Fig. 5a, Fig. 5b, and Fig. 5c). The results of a study by [13] showed that guppy fish populations, which in the higher predation regime environment, have a smaller body size in terms of both body length and area. Whereas guppies which found in the lower predation regime environment they present the larger body size. The aquatic environments, which belong to the water quality class III, have some parameters to support the life of more diverse organisms including the predatory species for guppy fish (Table 2 and Table 4) [9].

The results of this study showed that guppy fish which inhabit in the site with the water quality class III have a smaller body size than those living in the other site with the water quality class IV (Fig. 1a and Fig. 1b). The aquatic environments, which have high nutrient content could accelerate the growth of guppy fish. Therefore, the guppy fish living in this site has the larger body size [17]. The higher organic materials in class IV sites which are indicated by high levels of BOD values (Table 4) could be used as a source of nutrients for guppy fish growth.

In [17] reported that the presence of color polymorphism in male guppy fish is possible because of the presence of abiotic environmental factors such as turbidity or availability of nutrients. Several other studies have suggested that some environmental factors, which may affect the structural color patterns, were water turbidity levels and the levels of predatory organism [30]. The guppy fish which original from the class IV sites (PE, WO, and DA) that have higher water turbidity levels (Table 4) present the higher value of relative area of structural color than the guppy fish from the class III sites (KD, KE, and KA) which have lower water turbidity levels (Fig. 5c). The male guppy which lived in the darker aquatic environments (have higher turbidity levels) possess higher levels of structural color resulting from the evolutionary processes to attract the female vision in darker conditions [30]. The male guppy, which inhabits in a lower predation regime in Trinidad, present a higher level of structural color, but the fish which inhabit in the higher predation regime, present a lower structural color [31]. Therefore, the guppy fish from the class III sites less display the structural color character in order to avoid the detection from more predator organisms.

The KD and KA sites, which belong to the water quality class III, have a significant difference in mean value of relative area of carotenoid color from the PE, WO, and DA sites, which belong to the water quality class IV. However, the KE site, which also belongs to the water quality class III, has no difference in mean value from the three locations (PE WO and DA) which is the water quality class IV category (Fig. 5d). This is in accordance with the study conducted by [14] that carotenoid color characters have no differences between sites because the carotenoid color tends to be maintained compared to the structural color in order to attract the female fish preference in the mating process in every different type of environmental conditions.

CONCLUSION

The morphological relationship of guppy fish population in some aquatic environments in Surabaya based on phenotypic characters consists of two main groups. The first group is a guppy population originating from the location with the water quality class IV, whereas the second group is the guppy population originating from the location with the water quality class III. The phenotypic characters of male guppy fish that have different values between aquatic environment sites in Surabaya are body length, body area, relative area of structural color, and relative area of carotenoid color. The three characters that have different values based from differences of the water quality of aquatic environments (class III and class IV) are the body length, body area, and the relative area of structural color. As for the relative area of carotenoid color has no different values between the two different aquatic environments in water quality both class III and class IV.

ACKNOWLEDGMENTS

Authors are thankful to Mr. Setyanto as a laboratory assistant at Laboratory of Biosystematics, and Mr. Suwarni as a laboratory assistant in Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Surabaya who is helping to operate the turbidity meter instrument to measure the water turbidity levels.

REFERENCES

1. C. K. Egset, G. H. Bolstad, G. Rosenqvist, J. A. Endler, and C. Pélabon, J. Evol. Biol. **24**(12), 2631-2638 (2011).
2. N. Colihueque and C. Araneda, Front. Genet. **251**(5), 1–8 (2014).
3. C. M. Seng, T. Setha, J. Nealon, D. Socheat, N. Chantha, and M. B. Nathan, J. Vector Ecol. **33**(1), 139–144 (2008).
4. E. J. Kweka, G. Zhou, T. M. Gilbreath III, Y. Afrane, M. Nyindo, A. K. Githeko, *et al*., Parasit. Vectors **4**, 128 (2011).
5. E. Sharma, A. Kunstner, B. A. Fraser, G. Zipprich, V. A. Kottler, S. R. Henz, *et al*., BMC Genomics **15**(1), 1–20 (2014).
6. CABI. *Poecilia reticulata* (guppy) [Online] from http://www.cabi.org/isc/datasheet/68208 (2017), [Accessed on July 23, 2017].
7. N. Hubert, Kadarusman, A. Wibowo, F. Busson, D. Caruso, S. Sulandari, *et al*., DNA Barcodes **3**, 144–169 (2015).
8. BLH Kota Surabaya, *Buku data SLHD Kota Surabaya* [Data book of SLHD Surabaya City], (BLH Surabaya, Surabaya, 2013). p. 44. [Bahasa Indonesia].
9. Jaringan Dokumentasi dan Informasi Hukum (JDIH), *Peraturan daerah tentang pengelolaan kualitas air dan pengendalian pencemaran air* [Local regulation of water quality management and water pollution control] [Online] from https://jdih.surabaya.go.id/pdfdoc/perda_36.pdf (2016), [Accessed on November 29, 2016]. [Bahasa Indonesia].

10. A. E. Deacon, I. W. Ramnarine and A. E. Magurran, PLoS One **6**(9), e24416 (2011). DOI: 10.1371/journal.pone.0024416.
11. L. M. Gomiero and F. M. S. Braga, Braz. J. Biol. **67**(2), 283–292 (2007).
12. F. C. Rocha, L. Casatti and D. C. Pereira, Acta. Limnol. Bras. **21**(1), 123–134 (2009).
13. J. Torres-Dowdall, C. A. Handelsman, D. N. Reznick, and C. K. Ghalambor, Evolution **66**(11), 3432–3443 (2012).
14. A. K. Lindholm, M. L. Head, R. C. Brooks, L. A. Rollins, F. C. Ingleby, and S. R. Zajitschek, J. Evol. Biol. **27**(2), 437–448 (2014).
15. F. G. Araujo, M. G. Peixoto, B. C. T. Pinto, and T. P. Teixeira, Braz. J. Biol. **69**(1), 41-48 (2009).
16. D. A. Rahayu, D. Listyorini, and Ibrohim, JTROLIS **3**(1), 91-95 (2013).
17. A. K. Schwartz and A. P. Hendry, Funct. Ecol. **24**(2), 354–364 (2010).
18. A. Roulin, Biol. Rev. Camb. Philos. Soc. **79**(4), 815-848 (2004).
19. T. J. Kawecki and D. Ebert, Ecol. Lett. **7**(12), 1225–1241 (2004).
20. N. P. Millar, D. N. Reznick, M. T. Kinnison, and A. P. Hendry, Oikos **113**(1), 1–12 (2006).
21. A. Kodric-Brown and P. F. Nicoletto, Behav. Ecol. Sociobiol. **50**(4), 346–351 (2001).
22. R. Brooks and J. A. Endler, Evolution **55**(5), 1002–1015 (2001).
23. G. F. Grether, M. E. Cummings, and J. Hudon, Evolution **59**(1), 175–188 (2005).
24. K. J. McGraw, E. A. Mackillop, J. Dale, and M. E. Hauber, J. Exp. Biol. **205**, 3747–3755 (2002).
25. M. W. Blows, R. Brooks, and P. G. Kraft, Evolution **57**(7), 1622–1630 (2003).
26. S. C. Griffith, T. H. Parker and V. A. Olson, Animal Behav. **71**(4), 749–763 (2006).
27. C. Martinez, C. Chavarria, D. M. T. Sharpe, and L. F. De León, PLoSONE **11**(2), e0148040 (2016). DOI:10.1371/journal.pone.0148040
28. K. A. Hughes, F. H. Rodd, and D. N. Reznick, J. Evol. Biol. **18**(1), 35–45 (2005).
29. K. M. Gotanda and A. P. Hendry, Biol. J. Linnean. Soc. **112**(1), 108–122 (2014).
30. S. Gamble, A. K. Lindholm, J. A. Endler, and R. C. Brooks, Ecol. Lett. **6**(5), 463–472 (2003).
31. F. Breden and G. Stoner, Nature **329**, 831–833 (1987).