

AACL Bioflux

Country [Romania](#) -  [SJR Ranking of Romania](#)

Subject Area and Category [Agricultural and Biological Sciences](#)
[Aquatic Science](#)
[Ecology, Evolution, Behavior and Systematics](#)
[Environmental Science](#)
[Management, Monitoring, Policy and Law](#)
[Water Science and Technology](#)

10

H Index

Publisher [Bioflux Publishing House](#)

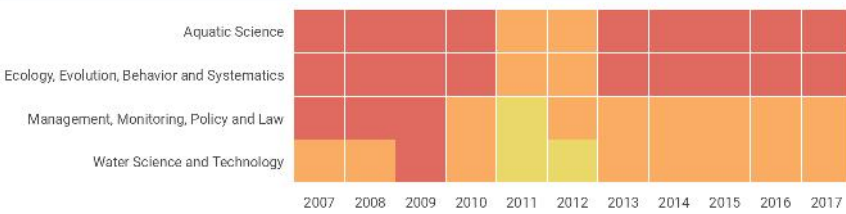
Publication type [Journals](#)

ISSN [18449166, 18448143](#)

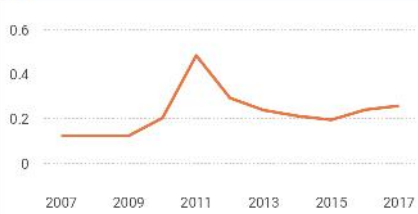
Coverage [2009-ongoing](#)

 [Join the conversation about this journal](#)

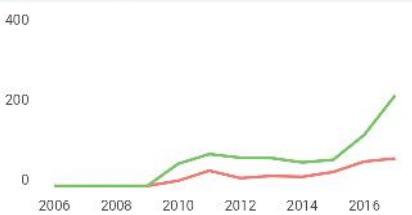
Quartiles



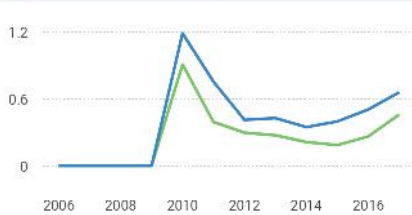
SJR



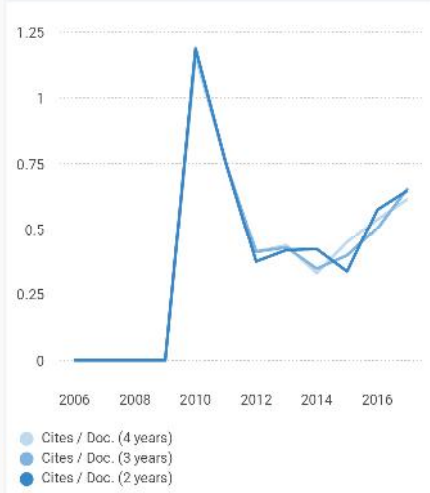
Total Cites / Self-Cites



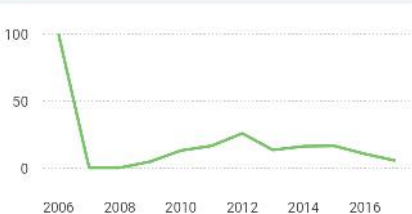
External Cites per Doc / Cites per Doc



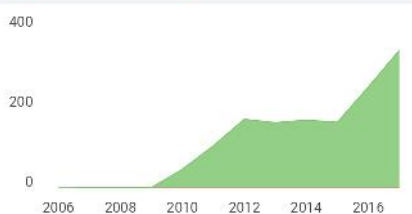
Citations per document



% International Collaboration



Citable documents / Non-citable documents



Cited documents / Uncited documents



AACL Bioflux

Q3 Management, Monitoring, Policy and Law best quartile


SJR 2017 0.26

powered by scimagojr.com


← Show this widget in your own website

Just copy the code below and paste within your html code:

```
<a href="https://www.scimagojr.com" data-bbox="430 818 538 830">
```

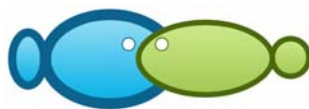
 **Abdillah Munawir** 2 months ago

Registrasi in Journal AACL Bioflux

 reply

AACL Bioflux, Volume 10(6)

December 30, 2017



Contents

Noordin N. M., Kader M. A., Morni M. M., Raes A. M. A., Daud M. S. M., Khir R. M., Kamaruzaman A. H., 2017 Application of fish bone meal from byproducts of fish processing industry in diets of juvenile striped catfish, *Pangasianodon hypophthalmus*. AAAL Bioflux 10(6):1395-1403.

Youcef B., Amira A. B., 2017 Transport of dissolved and suspended solids from three coastal rivers (North Central Algeria). AAAL Bioflux 10(6):1404-1412.

Kalalo F. P., 2017 Law enforcement and conservation at Bunaken National Park, North Sulawesi, Indonesia as perceived by the local coastal communities. AAAL Bioflux 10(6):1413-1420.

Pedroso F. L., 2017 Effects of elevated temperature on the different life stages of tropical mollusk, donkey's ear abalone (*Haliotis asinina*). AAAL Bioflux 10(6):1421-1427.

Nursidi, Mauli, Heriansah, 2017 Development of seaweed *Kappaphycus alvarezii* cultivation through vertical method in the water of small islands in South Sulawesi, Indonesia. AAAL Bioflux 10(6):1428-1435.

Wijayanto D., Nursanto D. B., Kurohman F., Nugroho R. A., 2017 Profit maximization of whiteleg shrimp (*Litopenaeus vannamei*) intensive culture in Situbondo Regency, Indonesia. AAAL Bioflux 10(6):1436-1444.

Kasim F., Nursinar S., Panigoro C., Karim Z., Lamalango A., 2017 True mangrove of North Gorontalo Regency, Indonesia, their list, status and habitat-structural complexity in easternmost coast area. AAAL Bioflux 10(6):1445-1455.

Lubis E., Pane A. B., 2017 Institutional model of fish auction refunctionalization in Indonesian fishing ports. AAAL Bioflux 10(6):1456-1465.

Nugroho E. D., Nawir D., Amin M., Lestari U., 2017 DNA barcoding of nomei fish (Synodontidae: *Harpadon* sp.) in Tarakan Island, Indonesia. AAAL Bioflux 10(6):1466-1474.

Kuvaini A., Hidayat A., Kusmana C., Basuni S., 2017 Institutional resilience of pesantren in mangrove forest management in Kangean Island, East Java Province, Indonesia. *AACL Bioflux* 10(6):1475-1482.

Adimu H. E., Boer M., Yulianda F., Damar A., 2017 The role of stakeholders in marine conservation areas in Wakatobi National Park, Indonesia. *AACL Bioflux* 10(6):1483-1491.

Sososutiksno C., Gasperz J., 2017 Economic and financial feasibility of abalone culture development in Hulaliu village, District of Maluku Tengah, Maluku Province. *AACL Bioflux* 10(6):1492-1498.

Wahidah, Yusuf M., 2017 Edible trait of giant freshwater prawn *Macrobrachium rosenbergii* of Kariango River population in Pinrang Regency, Indonesia. *AACL Bioflux* 10(6):1499-1505.

Sahami F. M., Baruadi A. S. R., Hamzah S. N., 2017 Phytoplankton abundance as a preliminary study on pearl oyster potential culture development in the North Gorontalo water, Indonesia. *AACL Bioflux* 10(6):1506-1513.

Pratasik S. B., Marsoedi, Arfiati D., Setyohadi D., 2017 Egg placement habitat selection of cuttlefish, *Sepia latimanus* (Sepiidae, Cephalopoda, Mollusca) in North Sulawesi waters, Indonesia. *AACL Bioflux* 10(6):1514-1523.

Martuti N. K. T., Setyowati D. L., Nugraha S. B., Mutiatari D. P., 2017 Carbon stock potency of mangrove ecosystem at Tapak Sub-village, Semarang, Indonesia. *AACL Bioflux* 10(6):1524-1533.

Karim M. Y., Azis H. Y., Muslimin, Tahya A. M., 2017 Physiological response: survival, growth, and nutrient content of the mud crabs (*Scylla olivacea*) which cultivated in mangrove area with different types of feed. *AACL Bioflux* 10(6):1534-1539.

Daris L., Aslinda A., Rapi N. L., 2017 Forms and strategies of conflict resolution in fishing resources utilization in the coastal area of Maros District, South Sulawesi Province. *AACL Bioflux* 10(6):1540-1545.

Taati M. M., Shabanpour B., Ojagh M., 2017 Extraction of oil from tuna fish by-product by supercritical fluid extraction (SFE) and comparison with wet reduction method. *AACL Bioflux* 10(6):1546-1553.

Baskara K. A., Hendarto R. M., Susilowati I., 2017 Economic's valuation of marine protected area (MPA) of Karimunjawa, Jepara-Indonesia. *AACL Bioflux* 10(6):1554-1568.

Pototan B. L., Capin N. C., Tinoy M. R. M., Novero A. U., 2017 Diversity of mangrove species in three municipalities of Davao del Norte, Philippines. *AACL Bioflux* 10(6):1569-1580.

Fatihah S. N., Julin H. T., Chen C. A., 2017 Survival, growth, and molting frequency of mud crab *Scylla tranquebarica* juveniles at different shelter conditions. *AACL Bioflux* 10(6):1581-1589.

Misbah I., Karim M. Y., Zainuddin, Aslamyah S., 2017 Effect of salinity on the survival of mangrove crab *Scylla tranquebarica* larvae at zoea-megalopa stages. *AACL Bioflux* 10(6):1590-1595.

Khelifi N., Boualleg C., Sahtout F., Kaouachi N., Mouaissia W., Bensouillah M., 2017 Feeding habits of *Carassius carassius* (Cyprinidae) in Beni Haroun Dam (north-east of Algeria). *AACL Bioflux* 10(6):1596-1609.

Tupan C. I., Unepetty P. A., 2017 Concentration of heavy metals lead (Pb) and cadmium (Cd) in water, sediment and seagrass *Thalassia hemprichii* in Ambon Island waters. AACL Bioflux 10(6):1610-1617.

Sofia L. A., 2017 Fishermen's perception and participation in fisheries resources conservation of Batungap swamp in Tapin Regency, South Kalimantan, Indonesia. AACL Bioflux 10(6):1618-1626.

Nainggolan C., Suwardjo D., Hutajulu J., Suharyanto, Syamsuddin S., Effendy A., Basith A., Yusrizal, Handri M., Nugraha E., Krisnafi Y., Matheis A., Irwansyah, Irwan, Khoerul, Novianto D., 2017 Analyses of pole and line fishery: catch composition and use of live bait for catching skipjack tuna *Katsuwonus pelamis* and yellowfin tuna *Thunnus albacares* in FMA 715, Indonesia. AACL Bioflux 10(6):1627-1637.

Wagey B. T., 2017 Morphometric analysis of congeneric seagrasses (*Cymodocea rotundata* and *Cymodocea serrulata*) in the coastal areas of Bunaken National Park, North Sulawesi, Indonesia. AACL Bioflux 10(6):1638-1646.

Fausayana I., Abdullah W. G., Susanti F., Sidu D., Arimbawa P., Yunus L., 2017 Factors affecting the behavior of farmers toward the risk of seaweed farming in the Bungin Permai village, southeast Sulawesi, Indonesia. AACL Bioflux 10(6):1647-1653.

Sodikin, Sitorus S. R. P., Prasetyo L. B., Kusmana C., 2017 Spatial analysis of mangrove deforestation and mangrove rehabilitation directive in Indramayu Regency, West Java, Indonesia. AACL Bioflux 10(6):1654-1662.

Anuar N. S., Omar N. S., Noordiyana M. N., Sharifah N. E., 2017 Effect of commercial probiotics on the survival and growth performance of goldfish *Carassius auratus*. AACL Bioflux 10(6):1663-1670.

Mouaïssia W., Kaouachi N., Boualleg C., Tolba M., Khelifi N., Sahtout F., Bensouilah M., 2017 Reproductive biology of Algerian barb *Luciobarbus callenis* (Valenciennes, 1842) (Cyprinidae) in Beni Haroun dam, north-east of Algeria. AACL Bioflux 10(6):1671-1682.

Syahailatua D. Y., Dangeubun J. L., Serang A. M., 2017 Artificial feed composition for growth and protein and fat retention of humpback grouper, *Cromileptes altivelis*. AACL Bioflux 10(6):1683-1691.

Mzaki F., Manchih K., Idrissi H. F., Boumaaz A., Haddouch A. B., Tazi Q., 2017 Diet of the common cuttlefish *Sepia officinalis* (Linnaeus, 1758) (Cephalopoda: Sepiidae) in the Southern Moroccan Atlantic waters, Cap Boujdour, Cap Blanc. AACL Bioflux 10(6):1692-1710.

Ghozali A. A., Kusmana C., Iswantini D., Nurhidayat N., 2017 Oil contamination in mangrove ecosystems: impacts and rehabilitations. AACL Bioflux 10(6):1711-1721.

International Standard Serial Number
Online ISSN 1844–9166; Print ISSN 1844-8143

Published by Bioflux – six issues/year (bimonthly); in cooperation with The Natural Sciences Museum Complex (Constanta, Romania)

The journal includes original papers, short communications, and reviews on Aquaculture (Biology, Technology, Economics, Marketing), Fish Genetics and Improvement, Aquarium Sciences, Fisheries, Ichthyology, Aquatic Ecology, Conservation of Aquatic Resources and Legislation (in connection with aquatic issues) from wide world.

Editor-in-Chief:

Petrescu-Mag I. Valentin: USAMV Cluj, Cluj-Napoca, University of Oradea (Romania)
Gavriloaie Ionel-Claudiu: SC Bioflux SRL, Cluj-Napoca (Romania)

Journal Secretary:

Nowak Michal: University of Agriculture in Krakow (Poland)

Editors:

Adascalitei Oana: Maritime University of Constanta (Romania)
Arockiaraj A. Jesu: SRM University, Chennai (India)
Appelbaum Samuel: Ben-Gurion University of the Negev (Israel)
Bavaru Adrian: Ovidius University, Constanta (Romania)
Botha Miklos: Bioflux SRL, Cluj-Napoca (Romania)
Breden Felix: Simon Fraser University (Canada)
Brezeanu Gheorghe: Romanian Academy of Science, Bucharest (Romania)
Bud Ioan: USAMV Cluj (Romania)
Burny Philippe: Universite de Liege (Belgium)
Caipang Cristopher M.A.: Temasek Polytechnic (Singapore)
Codreanu Mario: USAMV Bucuresti, Bucharest (Romania)
Coroian Cristian: USAMV Cluj, Cluj-Napoca (Romania)
Creanga Steofil: USAMV Iasi, Iasi (Romania)
Cristea Victor: Dunarea de Jos University of Galati (Romania)
Dimaggio Matthew A.: University of Florida (USA)
Dutu Mircea: The Ecological University of Bucharest (Romania)
Firica Cristian Manuel: Spiru Haret University Bucharest, Craiova (Romania)
Georgescu Bogdan: USAMV Cluj, Cluj-Napoca (Romania)
Grozea Adrian: USAMVB Timisoara (Romania)
Malinas Cristian: USAMV Cluj, Cluj-Napoca (Romania)
Mehrad Bahar: Gorgan University of Agricultural Sciences and Nat. Res. (Iran)
Miclaus Viorel: USAMV Cluj, Cluj-Napoca (Romania)
Molnar Kalman: Hungarian Academy of Sciences, Budapest (Hungary)
Muchlisin Zainal Abidin: Universiti Sains (Malaysia), Syiah Kuala University (Indonesia)
Murariu Dumitru: Institute of Biology - Romanian Academy of Science, Bucharest (Romania)
Olivotto Ike: Universita Politecnica delle Marche, Ancona (Italy)
Oroian Firuta Camelia: USAMV Cluj, Cluj-Napoca (Romania)
Papadopol Nicolae: Natural Sciences Museum Complex, Constanta (Romania)
Parvulescu Lucian: West University of Timisoara (Romania)
Pasarin Benone: USAMV Iasi, Iasi (Romania)
Petrescu-Mag Ruxandra Malina: Babes-Bolyai University, Cluj-Napoca (Romania)
Petrovici Milca: West University of Timisoara (Romania)
Pratasik Silvester Benny: Sam Ratulangi University, Manado (Indonesia)
Proorocu Marian: USAMV Cluj, Cluj-Napoca (Romania)
Rhyne Andrew: Roger Williams University; New England Aquarium, Boston (USA)
Sima Nicusor Flaviu: USAMV Cluj, Cluj-Napoca (Romania)
Tlusty Michael F.: New England Aquarium, Boston (USA)
Vesa Stefan Cristian: Iuliu Hatieganu UMF, Cluj-Napoca (Romania)
Yusli Wardiatno: Bogor Agricultural University (Indonesia)

Editorial councillor:

Velter Victor: UEFISCDI, Bucharest (Romania)

Scientific Reviewers:

Abdullah Khalid: Agricultural Research Institute Ratta Kulachi (Pakistan)
Adewolu Morenike A.: Lagos State University, Ojo (Nigeria)
Aftabuddin Sheikh: University of Chittagong (Bangladesh)
Al-Qutob Mutaz: Al-Quds University (Palestinian Authority)
Alves-Vianna Rafael: Federal University of Vicosa (Brazil)
Antone Veronica: Natural Sciences Museum Complex, Constanta (Romania)
Balint Claudia: USAMV Cluj, Cluj-Napoca (Romania)
Banatean-Dunea Ioan: USAB Timisoara, Timisoara (Romania)

Berkesy Corina: ICPE Bistrita (Romania)
 Boaru Anca: USAMV Cluj, Cluj-Napoca (Romania)
 Brunio Erwin O.: Tokyo University of Marine Science & Technology (Japan)
 Calado Ricardo J. G.: University of Aveiro, Aveiro (Portugal)
 Celik Meryem Yesim: University of Sinop (Turkey)
 Cighi Vasile: USAMV Cluj, Cluj-Napoca (Romania)
 Chiorean Adriana: Natural Sciences Museum Complex, Constanta (Romania)
 Cocan Daniel: USAMV Cluj, Cluj-Napoca (Romania)
 Constantinescu Radu: USAMV Cluj, Cluj-Napoca (Romania)
 Costa Daniel Ribeiro: Federal Rural University of Amazon, Belem (Brazil)
 Cosier Viorica: USAMV Cluj, Cluj-Napoca (Romania)
 Covaciu-Marcov Severus D.: University of Oradea (Romania)
 Curlisca Angelica: Natural Sciences Museum Complex, Constanta (Romania)
 Das Simon Kumar: University Kebangsaan Malaysia (Malaysia)
 Dediu Lorena: Dunarea de Jos University of Galati (Romania)
 Docan Angela: Dunarea de Jos University of Galati (Romania)
 Gavrilovic Ana: University of Dubrovnik, Dubrovnik (Croatia)
 Ghira Ioan: Babes-Bolyai University, Cluj-Napoca (Romania)
 Gorgan Lucian Dragos: UAIC Iasi, Iasi (Romania)
 Gradinaru Andrei: USAMV Iasi, Iasi (Romania)
 Hermosilla Joepette J.: Tokyo Univ. of Marine Sci.& Tech., Minato, Tokyo (Japan)
 Hoha Gabriel: USAMV Iasi, Iasi (Romania)
 Ho Thi Minh Hop: Independent researcher (Vietnam)
 Jakab Endre: Babes-Bolyai University, Cluj-Napoca (Romania)
 Kabir Milad: Gorgan University of Agricultural Sciences and Nat. Res. (Iran)
 Kader Md Abdul: University Malaysia Terengganu, Kuala Terengganu (Malaysia)
 Kamali Sanzighi Mehrdad, Islamic of Azad University (Iran)
 Karayucel Ismihan: University of Sinop, Sinop (Turkey)
 Kosco Jan: Presov University, Presov (Slovakia)
 Malos Cristian: Babes-Bolyai University, Cluj-Napoca (Romania)
 Manko Peter: Presov University, Presov (Slovakia)
 Mat Jaafar Tun Nurul Aimi: Universiti Malaysia Terengganu, Terengganu (Malaysia)
 Mihaiescu Tania: USAMV Cluj, Cluj-Napoca (Romania)
 Mihalca Andrei: USAMV Cluj, Cluj-Napoca (Romania)
 Monwar Mohammad M.: University of Chittagong (Bangladesh)
 Munteanu Florin: Natural Sciences Museum Complex, Constanta (Romania)
 Murray Joanna: CEFAS, Lowestoft (England)
 Musuka Confred G.: The Copperbelt University, Kitwe (Zambia)
 Ndimele Prince Emeka: Lagos State University, Ojo, Lagos (Nigeria)
 Nita Victor: Nat. Inst. Marine Research & Dev. Gr. Antipa, Constanta (Romania)
 Norma-Rashid Y.: University of Malaya, Kuala Lumpur (Malaysia)
 Okpala Charles O. R.: Educare Skills & Training Network, Middlesex (UK)
 Oprea Lucian: Dunarea de Jos University, Galati (Romania)
 Oroian Teofil: USAMV Cluj, Cluj-Napoca (Romania)
 Ozunu Alexandru: Babes-Bolyai University, Cluj-Napoca (Romania)
 Palm Harry: University of Rostock, Rostock (Germany)
 Parsaeimehr Ali: National Academy of Science, Yerevan (Republic of Armenia)
 Peteiro Cesar: Spanish Institute of Oceanography (IEO), Santander (Spain)
 Petrescu Dacinia Crina: Babes-Bolyai University, Cluj-Napoca (Romania)
 Popescu Irinel Eugen: UAIC Iasi, Iasi (Romania)
 Rahman Mohammed Mahabubur: Kochi University, Kochi (Japan)
 Rahmati-holasoo Hooman: University of Tehran, Tehran (Iran)
 Rosioru Corina: UBB Cluj-Napoca (Romania)
 Rus Vasile: USAMV Cluj, Cluj-Napoca (Romania)
 Sakkaravarthi Karuppiyah: Annamalai University, Tamil Nadu (India)
 Sas Istvan: University of Oradea, Oradea (Romania)
 Taati M. Mehdi: Gorgan University of Agricultural Sciences and Nat. Res. (Iran)
 Talu Stefan: Technical University of Cluj (Romania)
 Turcu Mihaela Claudia: University of Turku, Turku (Finland)
 Udoh James P.: University of Uyo, Uyo (Nigeria)
 Ustaoglu Tiril Serap: University of Sinop, Sinop (Turkey)
 Vaitheeswaran T.: Tamil Nadu Fisheries University, Chennai, Tamil Nadu (India)
 Vintila Tuliana: "Dunarea de Jos" University Galati (Romania)
 Yildirim Onder: Mugla Sitki Kocman University (Turkey)
 Zamfirescu Stefan: UAIC Iasi, Iasi (Romania).

Contact Publisher

SC Bioflux SRL, 54 Ceahlău Street, Cluj-Napoca, 400488, Romania, European Union.
 Ioan Valentin Petrescu-Mag, e-mail: zoobiomag2004@yahoo.com

Note that there is also an electronic version of the journal. You may download the fulltext version of AACL Bioflux – Volume 10/2017 from <http://www.bioflux.com.ro/aacl/> -open access.

All articles included in AACL Bioflux are peer reviewed (double blind peer-review is used). Each published article was seen before by two reviewers; the two peer-reviews are made independently.

AACL Bioflux has a publishing agreement, or is indexed, abstracted or fulltext reproduced by/in the following scholar/scientific databases, search engines, libraries, publishers:

ISI Web of Science – via CABI and Zoological Record
Zoological Record (direct submission/coverage)
Scopus - Elsevier; Sciverse
Scimago - Journal Rank
CAB International - CAB Abstracts
ProQuest
China Educational Publications Import & Export Corporation - SOCOLAR
Ulrich's Periodicals Directory
EBSCO – EBSCOhost Online Research Databases
CAB Direct (as part of CABI)
Wolters Kluwer - Ovid LinkSolver
CNCSIS Romania (Rank: B+)
Polish Ministry of Science and Higher Education – 2.00 pts/article
The National Science Digital Library - NSDL
The University of Hong Kong Libraries – HKUL Database
Deutsche Nationalbibliothek - ZDB Database
State Library of Ohio - OhioLINK Database
Smithsonian Institution Libraries
Biblioteka Główna Uniwersytetu Medycznego w Poznaniu
Google Scholar, Academic
Google (search engine)
Athabasca University - ICAAP Database
University of Southampton - ROAR
Georgetown University Library - NewJour
Università degli Studi di Modena e Reggio Emilia – SBA, Risorse Elettroniche
Simon Fraser University - PKP
University of Tsukuba - Tulips Database
Teikyo Scientific University- NTU Database
LIS Links: Link Library of Open Access English Language Journals
Fayetteville State University - Charles W. Chesnutt Library
Vrije Universiteit Brussel - VUB e-journal list
Russian CJDB
Universität Giessen - Digitale Bibliothek
Pace University Library
Tel Aviv University, Gitter-Smolarz Library of Life Sciences and Medicine
MALMAD – Israel Center for Digital Information Services
California State University – Monterey Bay Library
Réseau des Bibliothèques de l'Université Joseph Fourier et de l'Institut National Polytechnique de Grenoble
University of Saskatchewan – University Library (Electronic Journals)
YanXue Resource – YXRES
Feng Chia University – Electronic Library
Main Library of the University of Agriculture in Krakow
SUMMON Database
uOttawa Library
Università di Roma Tor Vergata - Digital Library
UTC Lupton Library
University of Notre Dame - Hesburgh Libraries
Guilford College - Hege Library
Eastern Michigan University Library - Periodicals locator
Universiteitsbibliotheek Gent - Tijdschriften
Chung Yuan Christian University Library
ArgosBiotech
Ecole Polytechnique Federale de Lausanne - Library
Rowan University – Library Services
James Cook University Library – Australia
Ministerstwo Nauki i Szkolnictwa Wyższego Warszawa
Kun Shan University Library
CCG-IBT Biblioteca
Reference Zone – Nigeria
Dayang Journal System
Riley-Hickingbotham Library
Politechnika Wroclawska
Universite Paris Diderot – Revues Electroniques
ERSA – Chinese Library.



Our collaborators



SciVerse Scopus is the world's largest abstract and citation database of peer-reviewed literature and quality web sources. Contains 41 million records, 70% with abstracts; Nearly 18,000 titles from 5,000 publishers worldwide; 70% of content is pulled from international sources; Includes over 3 million conference papers; Provides 100% Medline coverage; Offers sophisticated tools to track, analyze and visualize research.

Socolar

The free scholastic search engine is established by China Educational Publications Import and Export Corporation (CEPIEC). Under the leadership of China Ministry of Education, CEPIEC is the only company dealing with publication ex-im business in the education field. CEPIEC has been serving colleges and universities, research institutions and public libraries in China for more than 20 years, providing them with excellent academic resources from all over the world. Contact: No 41 Zhong Guan Cun Street, Haidian District, Beijing, P.R.China 100080. Tel: +86 (0)10 6251 4068; e-mail: li_yanxia@cepiec.com.cn Fax: +86 (0)10 6251 4068 www.cepiec.com.cn



CABI is a not-for-profit international organization that improves people's lives by providing information and applying scientific expertise to solve problems in agriculture and the environment. Their mission and direction is influenced by their member countries who help guide the activities they undertake. These include scientific publishing, development projects and research, and microbial services. 2010 marked 100 years of CABI. Since its beginnings as an entomological committee in 1910, it then developed into a Commonwealth organization before becoming a truly international service in agricultural information, pest identification and biological control in the mid 1980s.

EBSCOhost® databases are the most-used, premium online information resources for tens of thousands of institutions worldwide, representing millions of end-users.

Address: 10 Estes Street
Ipswich, MA 01938 USA
Phone: (978) 356-6500
Toll Free: (800) 653-2726 (USA & Canada)
Fax: (978) 356-6565
E-mail: information@ebSCOhost.com



Zoological Record (part of Biosis)

ION contains the organism names related data gathered from the scientific literature for Thomson Reuters' *Zoological Record*® database. Viruses, bacteria and plant names will be added from other Thomson Reuters databases such as *BIOSIS Previews*® and *Biological Abstracts*®



THOMSON REUTERS

Index to Organism Names (ION)



ELSEVIER PRODUCTS

Elsevier B.V., Bibliographic Databases, Radarweg 29, 1043 NX Amsterdam, The Netherlands.





Phytoplankton abundance as a preliminary study on pearl oyster potential culture development in the North Gorontalo water, Indonesia

Femy M. Sahami, Alfi S. R. Baruadi, Sri N. Hamzah

Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Gorontalo State University, Jl. Jenderal Sudirman No. 6, Gorontalo City, Gorontalo Province, Indonesia. Corresponding author: F. M. Sahami, femysahami@yahoo.co.id

Abstract. Kwandang water, Northern Gorontalo is considered as a very potential area for marine aquaculture especially the pearl oyster cultivation. However, a study of this prospective has not been published. The realization of the pearl oyster farming is affected by several factors. One of the factors that influence the success of oyster farming is the selection of proper location, which has suitable water quality for marine biota and good water productiveness as well in term of the abundance of phytoplankton. This study aims to analyze the abundance of phytoplankton as one of the biological parameters for the development of pearl oyster culture in the North Gorontalo area. The research method used is explorative by survey. The measurement of physical and chemical parameters is conducted in situ, while the biological parameter (phytoplankton) analysis is carried out in the laboratory. The results show that the North Gorontalo water qualifies as a good site for pearl oyster culture based on the abundance of phytoplankton.

Key Words: marine biota, cultivation, proper location, water quality, Kwandang water.

Introduction. Pearl oysters are one of the potential organisms that can be developed as part of the cultivation industry. The term "pearl oysters" has traditionally been applied to bivalves of the *Pinctada* and *Pteria* genera, included in the family Pteridae and most species of Pteridae are tropical and subtropical, but the distribution of some species extends to higher latitudes (Wada & Têmkin 2008).

Pearls have been considered as treasured, symbols of wealth, power, and prestige, as well as an object of devotion and respect (Strack 2008). Currently, the cultivation of pearl oyster is one of the prospect businesses in Indonesia, especially its potential that has not been developed optimally. Potential land for the development of pearl shellfish cultivation and abalone in Indonesia amounted to 62,040 Ha (Hamzah 2007).

In Indonesia, pearl oysters are one of the important commodities with economic potential value of 120 million US\$ (Dahuri 2000). In addition, the territorial waters of eastern Indonesia such as Papua, Arafuru and Sulawesi Islands, have a great potential for pearl oysters. Gorontalo is one of the areas in eastern Indonesia that has a wide coastal area so it has a great potential for the development of pearl oyster.

Development of cultivation that currently exists in the North Gorontalo waters is the cultivation of fish in floating cage and seaweed, while the cultivation of pearl oyster has not been glanced. In establishing a pearl cultivation business, the cultivation location plays an important role for successful pearl oyster production. Good cultivation sites should meet technical requirements such as water quality, water productiveness, fry and host resources, supporting facilities, security, markets and transportation (Fathurrahman et al 2015).

Pearl oysters belong to the group of herbivores that do not require additional food because they feed phytoplankton that naturally occur (Matthiessen 2001; Powell et al 2002; Powell 2004; Fernandez et al 2006). As the phytoplankton is the main food, its

biochemical composition plays a key role in nutrition quality and its function for bivalve (Faturrahman et al 2015).

This study aims to analyze the abundance of phytoplankton as a biological parameter for the development of pearl cultivation in North Gorontalo waters. This research is expected to provide basic information in the early efforts of developing the research area into a pearl oyster cultivation region in the future, especially by promoting the development of community-based pearl oyster cultivation.

Material and Method

Description of the study sites. The sampling was carried out from May to July 2017 in the waters of North Gorontalo Regency with the sampling points taken in 4 stations (Figure 1). Station 1 was located in the administrative area of Dunu Village ($00^{\circ}56'52.2''\text{N}$ and $122^{\circ}38'28.4''\text{E}$), station 2 was located in the administrative area of Tolango Village ($00^{\circ}52'50.2''\text{N}$ and $122^{\circ}45'30.7''\text{E}$), station 3 was located in the administrative area of Garapia Village ($00^{\circ}53'19.9''\text{N}$ and $122^{\circ}44'13.2''\text{E}$), and station 4 was located in the administrative area of Monano Village ($00^{\circ}53'40.2''\text{N}$ and $122^{\circ}41'48.2''\text{E}$).

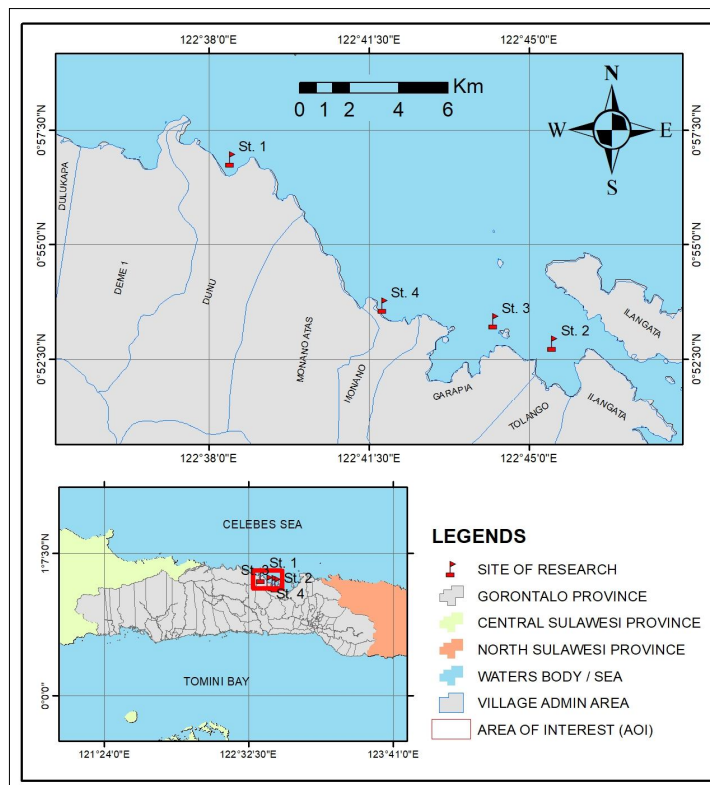


Figure 1. Map of study location.

Phytoplankton sampling. The main data collected in this research is phytoplankton data as biological parameter and physico-chemical data of water as supporting data. Phytoplankton samples were taken using plankton net (size $25\ \mu\text{m}$) vertically from 5-7 meters in depth and horizontally in surface. The filtered water sample is preserved by adding 1% Lugol solution. The physico-chemical data such as temperature, salinity, pH, and dissolved oxygen were obtained using WTW Oxi 3210 Set 1 and Schott Instruments handylab pH/LF 12 Set, correspondingly by directly measurement at the sampling sites.

Data analysis. The abundance of phytoplankton was observed using a sweeping method above the Sedgwick Rafter glass object with individual units per milliliter (ind mL^{-1}). The abundance of phytoplankton type was calculated based on equations according to APHA (2012), as follows:

$$N = \frac{oi}{op} \times \frac{Vr}{Vo} \times \frac{1}{Vr} \times \frac{n}{p}$$

Where:

- N : phytoplankton abundance (ind mL⁻¹);
 Oi : cover-glass area (mm²);
 Op : view area (mm²);
 Vr : filtered water volume (mL);
 Vo : observed water volume (mL);
 n : number of phytoplankton in the entire view area;
 p : number of view areas.

Results

Phytoplankton abundance. The results of identification and calculation of phytoplankton abundance found in the study sites are presented in Table 1.

Table 1
Abundance of phytoplankton species in the study sites

No	Phylum	Species	Station 1	Station 2	Station 3	Station 4
1	Chlorophyta	<i>Cosmarium</i> sp.	476.25	317.50	562.24	694.53
2		<i>Hyalotheca mucosa</i>	0	1058.33	0	0
3		<i>Chlorella</i> sp.	793.75	2381.24	926.04	0
4		<i>Golenkinia</i> sp.	330.73	231.51	0	198.44
5		<i>Pediastrum simplex</i>	2116.65	529.16	3208.05	3174.98
			3717.38	4517.74	4696.33	4067.95
1	Chrysophyta	<i>Achnanthes brevipes</i>	727.60	1587.49	661.45	0
2		<i>Amphora</i> sp.	396.87	330.73	694.53	0
3		<i>Cymbella</i> sp.	198.44	66.15	330.73	132.29
4		<i>Chaetoceros affinis</i>	2116.65	4497.89	1058.33	1587.49
5		<i>Chaetoceros messanensis</i>	396.87	0	1852.07	1190.62
6		<i>Coscinodiscus</i> sp.	132.29	165.36	0	198.44
7		<i>Hemiaulus membranaceus</i>	264.58	396.87	0	1058.33
8		<i>Rhizosolenia castracanei</i>	264.58	1389.05	463.02	396.87
9		<i>Rhizosolenia imbricata</i>	264.58	2778.11	297.65	0
10		<i>Rhizosolenia pungens</i>	198.44	330.73	350.57	198.44
11		<i>Surirella</i> sp.	244.74	562.24	926.04	0
12		<i>Synedra gailonii</i>	297.65	879.73	727.60	99.22
13		<i>Synedra montana</i>	0	1342.75	793.75	132.29
14		<i>Synedra ulna</i>	793.75	661.45	416.72	661.45
15		<i>Nitzschia</i> sp.	628.38	482.86	19.84	992.18
			6925.42	15471.41	8592.30	6647.62
1	Chyanophyta	<i>Anabaena</i> sp.	6482.25	0	3571.85	8995.78
2		<i>Oscillatoria</i> sp.	5688.51	9524.94	8863.49	2381.24
			12170.76	9524.94	12435.34	11377.02
	Total abundance (cell L ⁻¹)		22813.56	29514.09	25723.97	22092.59

Table 1 shows that the phytoplankton found in the study sites comprised 3 phyla namely Chlorophyta, Chrysophyta and Cyanophyta, consisting of 22 species of varying number of individuals. The highest number of species exist in the stations 1 and 2 (20 species) and followed by station 3 (18 species). While, the lowest number found in the Station 4 which has 16 species. Each phylum has a varying number of species. It can be seen from the data that Chrysophyta has the highest number of species (15 species) and followed by Chlorophyta with 5 species and Cyanophyta with 2 species. The results of the total abundance of species per phylum show that at station 2, the abundance of Chrysophyta

is the highest but overall Chyanophyta tends to have higher total abundance than others (Table 1). More details of the composition of each species are presented in Figure 2.

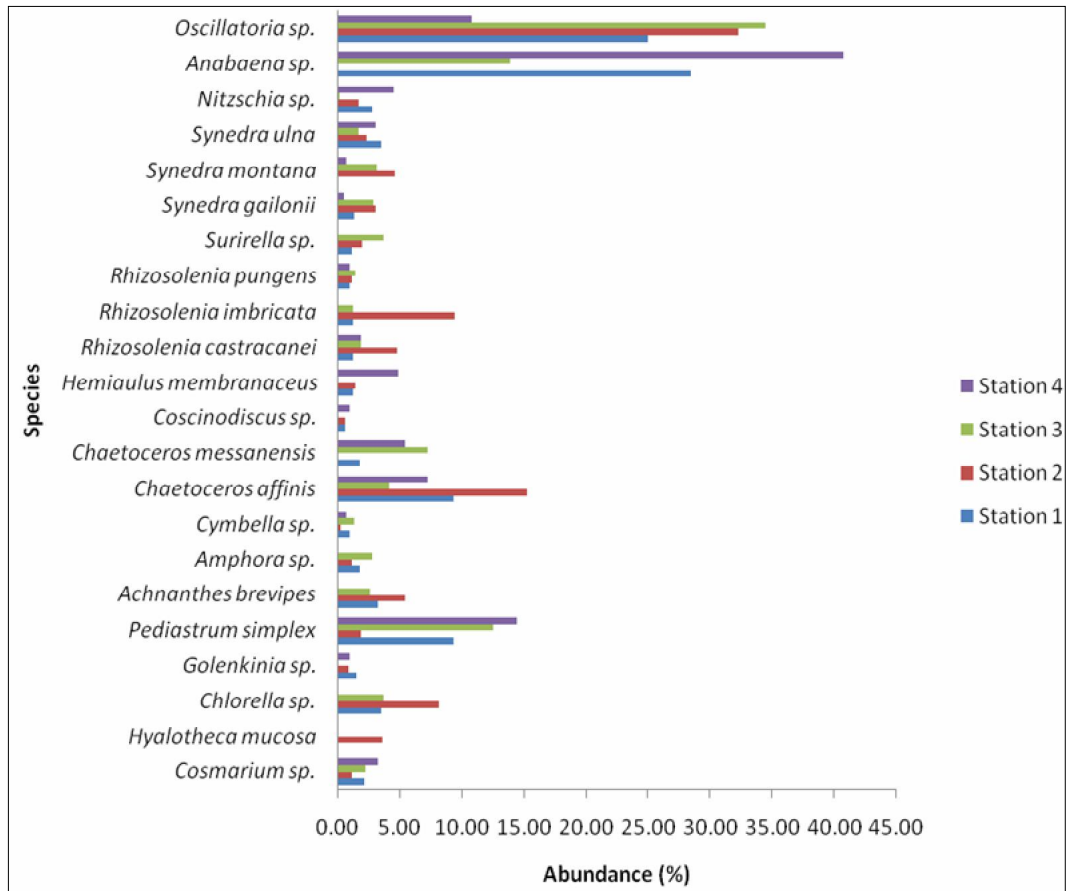


Figure 2. Abundance of phytoplankton in north Gorontalo waters.

Figure 2 shows that the abundance of species *Oscillatoria sp.* and *Anabaena sp.* is much higher than other species. It can be seen from Table 1 that station 2 has the highest total abundance compared to other stations.

Water quality. The existence of phytoplankton is certainly influenced by environmental factors. The measurement results of several environmental parameters are presented in Table 2.

Table 2

Results of physico-chemical parameters measurements at the study sites

No.	Parameter	Quality standards**	Station 1	Station 2	Station 3	Station 4
1	TDS (mg L ⁻¹)	-	88.6	88.1	87.55	87.8
2	TSS (mg L ⁻¹)	20	176	287	323	181
3	BOD ₅ (mg L ⁻¹)	20	24	27,5	30,5	57.5
4	COD (mg L ⁻¹)	-	> 1500	> 1500	> 1500	> 1500
5	Conductivity (mS cm ⁻¹)	-	50.8	50.4	50.5	55.6
6	Current velocity (m s ⁻¹)	-	0.085	0,165	0,1	0,09
7	DO (ppm)	>5	4.16	4.46	4.71	4.73
8	Temperature (°C)	28-30	29.6	29.5	29.8	30.1
9	Salinity (‰)	33-34	33.3	32.9	33.1	33.4
10	pH	7-8.5	6.89	6.92	6.99	7.34
11	Nitrate (mg L ⁻¹)	0.008	UD*	UD*	UD*	UD*
12	Phosphate (mg L ⁻¹)	0.015	0.0088	0.0071	0.0021	0.0118
13	Transparency (m)	>5	16	6	7	5
14	Depth (m)	-	16	6	7	5
15	Substrate condition	-	gritty-sand	sandy-corals	sand	sandy-corals
16	Weather condition	-	sunny	sunny	sunny	sunny
17	Chlorophyll- <i>a</i> (mg m ⁻³)	-	0.7872	1.0152	0.9844	0.9504

*UD: undetected; ** The Decision of the Minister of Environment No. 51 of 2004 on water quality standards of sea waters.

Table 2 shows that water quality measurements on each stations support the growth of aquatic organisms, except for nitrate which is undetectable

Biology index. The calculation of the biological index value was carried out for seeing the level of environmental stability. The results of the biological index calculations which include the index of diversity, the dominance index and the uniformity index are presented in Table 3.

Table 3

Results of phytoplankton biology index score in the research sites

No.	Biological index	Station 1	Station 2	Station 3	Station 4
1	Diversity index (H')	1.8924	2.2691	2.2098	1.8422
2	Dominance index (D)	0.2464	0.1578	0.1715	0.2336
3	Similarity index (S)	0.6908	0.7853	0.7888	0.7422

Based on the Table 3 it can be seen that station 2 has the highest diversity value with the lowest dominance index value.

Discussion. Development of pearl oyster cultivation requires waters that have a good productivity level. Like most other bivalve, pearl oysters are filter or suspension feeders throughout the free-living stages of their lifecycle. They filter fine suspended particles, seston, from the water around them (Lucas 2008b; Dunphy et al 2006). Phytoplankton plays a key role for pearl farming (Faturrahman et al 2015).

Phytoplankton has a very important role in the life cycle in the water. Phytoplankton can be used as a study material to determine the quality and productivity of an aquatic ecosystem that is required to support the exploitation of coastal and marine resources. Five major phytoplankton groups that live in waters are Cyanophyta (blue algae), Chlorophyta (green algae), Chrysophyta (yellow algae), Pyrrophyta and Euglenophyta (Widyastuti et al 2001; Asriana & Yuliana 2012).

The phytoplankton found consisted of 3 phylum namely Chlorophyta, Chrysophyta and Cyanophyta. Moreover, the number of phytoplankton types which are found in this research are mainly from Chrysophyta phylum. Chrysophyta consists of Xantophyceae,

Chrysophyceae and Bacillariophyceae (diatomae) classes (Widyastuti et al 2001). Brahmana (2001) explains that Chrysophyta algae are slightly heterogeneous, containing chlorophyll-*a* and chlorophyll-*c*, beta carotene and xanthophyll fucoxanthin. It is further explained that the most important group of Chrysophyta is diatoms which are energy recyclers in natural waters and are often declared the main primary producers in the ocean. Nybakken (1992) stated that composition of phytoplankton in the sea is dominated by Bacillariophyceae.

The abundance of phytoplankton was quite varied (Figure 2) with relatively large numbers of 22 species. Microalgae differ in their nutritional value for bivalve larvae and a mixture of several species is commonly used to provide a better balance of nutrients for larvae development (Southgate 2008). Two slightly dominant species are *Oscillatoria* sp. and *Anabaena* sp., which both are from Chyanophyta group. This result is rather different from previous research results that phytoplankton are found to be dominated by the type of Bacillariophyceae group (diatoms), among others in West Halmahera Jailolo waters, in marine waters of Riau, in the waters of Gilimanuk Bay TNBB, and in Berau (Thoha 2007; Aryawati & Thoha 2011; Ariana et al 2014; Yuliana 2015). Similar results have been reported by Radiarta (2013) that the phytoplankton found in the Alas Strait of Sumbawa regency of NTB is dominated by 5 types, with the abundance of *Oscillatoria* sp. from Chyanophyceae class being higher than *Chaetoceros* sp., *Thalassionema* sp., *Melosira* sp., and *Skeletonema* sp. from Bacillariophyceae class with an abundance of 446, 203, 55, 32, and 25 ind L⁻¹ respectively.

Pearl oyster in natural environment shows the simultaneous effect of a wide array of environmental factors. Food is the major environmental factor (Lucas 2008a). Development rates of pearl oyster are particularly influenced by food availability (Saucedo & Southgate 2008). Pearl oyster feeds on suspended particulate matter (SPM), consisting mainly of bacteria, microalgae, suspended organic matter, and inorganic particles. Quantity of food is also a major factor in the physiological condition, metabolic function, growth, and survival of the pearl oyster. Optimum densities of microalgae are in the 10-100 x 10³ cell mL⁻¹ range (Lucas 2008a). In this study, in the North Gorontalo waters, the results showed that the total abundance of phytoplankton in the study sites was still in optimum condition with the values ranging from 22093-29514 cells L⁻¹. The phytoplankton abundance in the North Gorontalo waters is adequately high and its productivity rate categorized as moderate. Jamilah (2015) stated that waters in which the number of phytoplankton abundance ranges between 1000 and 40000 ind L⁻¹ are classified as moderate category. The density and composition of phytoplankton are some of the important factors that determine the farming location (Fathurrahman et al 2015).

The development of pearl oyster cultivation in addition to being influenced by biological factors (food availability), is also influenced by the physical and chemical conditions of the waters. According to Lucas (2008a), as in all Poikilotherms, the ambient temperature profoundly influences the pearl oyster through its effects on metabolic rate (MR) and related processes, such as respiration and feeding rates. The measured temperature at the time of the study ranged from 29.5 to 30.1°C (Table 2). This temperature range is still optimum for the growth of marine biota. The surface water temperature in the tropics is between 20-30°C (Nybakken 1992).

Current velocity is an important parameter related to phytoplankton distribution. Lucas (2008a) mentioned that water current is very important in bringing food and oxygen to pearl oyster and carrying away their wastes; however, strong currents may be deleterious by increasing suspended inorganic matter, interfering with filtering and preingestive processes. In this study, velocity of 0.085-0.165 m s⁻¹ (Table 2) is categorized as low. Radiarta (2013) also reported that measured current velocity during a research in the Alas Straits was 0-0.27 m s⁻¹. In our study, the nitrate was undetectable and phosphate content was low (Table 2). This is in line with the results reported by Yuliana (2015) that at Idamdehe station, nitrate was undetectable and phosphate was 0.004 mg L⁻¹. This concentration is at a very low state and can be a limiting factor. Although the nutrient content is low, the abundance of phytoplankton at the study sites is still in good condition. This may be caused by other environmental parameters which are still in optimum condition. According to Yuliana (2015), no

detection of nitrate and low phosphate content suspected due to the fact that both nutrients have been exploited by phytoplankton for growing purpose.

The condition of Kwandang, North Gorontalo water can be said is still good, which can be seen from the calculation of biological indexes values (Table 3). These results can be used to test the level of environmental stability. Based on diversity index value, the North Gorontalo water was in medium diversity criteria. This is supported by Odum (1996) who stated that 1 to 3 of diversity index value indicates that waters can be categorized as medium diversity and in moderate community-stability. The results of evenness analysis indicate that environmental conditions in the study sites are in balance. Gustiarisane (2011) in Liwutang et al (2013) mentioned that if the equilibrium is greater than 0.5 and almost 1, the similarity of the organism is balanced and there is no competition for both place and food. The results of the index analysis of dominance also show a low value which means that no species dominates.

According to Subagja et al (2001), in term of water pollution, indirect monitoring is carried out through several major environmental parameter tests such as COD, BOD, suspended particles. Moreover, they also explained that based on oxygen content, a particular water body has not been stated contaminated if its COD is higher than the BOD value. Based on the results in Table 2 it can be said that the water at the study sites has not been contaminated.

Conclusions. The results show that the North Gorontalo water qualifies as a good site for pearl oyster culture based on the abundance of phytoplankton. The abundance of phytoplankton was quite varied with relatively large number of 22 species. Chyanophyta was the phylum of phytoplankton with the highest abundance. The total abundance of phytoplankton in the study sites was still in optimum condition with the values ranging from 22093-29514 cells L⁻¹ and its productivity rate categorized as moderate.

Acknowledgements. Our thanks to the Rector of UNG who has facilitated the funding in this project, and to the Dean of the Faculty of Fisheries and Marine Sciences who has provided an opportunity for the team to conduct this research.

References

- APHA, 2012 Standard methods for the examination of water and waste water. 22th edition, American Public Health Association, Washington DC, 1496 pp.
- Ariana D., Samiaji J., Nasution S., 2014 [Types and abundance composition of phytoplankton of Riau marine waters]. Jurnal Online Mahasiswa 1(1):1-15. [in Indonesian]
- Aryawati R., Thoha H., 2011 [Relation of chlorophyll-a content and abundance of phytoplankton in Berau waters of East Kalimantan]. Maspari Journal 2:89-94. [in Indonesian]
- Asriana, Yuliana, 2012 [Waters productivity]. Bumi Aksara, Jakarta, 278 pp. [in Indonesian]
- Brahmana P., 2001 [Marine ecology]. Universitas Terbuka, Jakarta, 943 pp. [in Indonesian]
- Dahuri R., 2000 [Utilization of marine resources for people's welfare]. Jakarta: Lembaga Informasi dan Studi Pembangunan Indonesia (LISPI), 146 pp. [in Indonesian]
- Dunphy B., Hall J., Jeffs A., Wells R., 2006 Selective particle feeding by the Chilean oyster, *Ostrea chilensis*, implication for nursery culture and broodstock conditioning. Aquaculture 261(2):594-602.
- Fathurrahman, Aunurohim, Fahmi V., 2015 Phytoplankton composition and its relation to pearl oyster aquaculture (*Pinctada maxima*) in Sekotong, West Nusa Tenggara. Jurnal Ilmu dan Teknologi Kelautan Tropis 7(1):33-38.
- Fernandez E., Salmon H., Southgate P., 2006 The nutritional value of seven species of tropical microalgae for black-lip pearl oyster (*Pinctada margaritifera*, L) larvae. Aquaculture 257:491-503.

- Hamzah M., 2007 [Seasonal variations of several oceanographic parameters and its relation to threshold range life of pearl shells (*Pinctada maxima*) from several locations in Central Indonesia]. Proceeding of National Seminar, Semarang: Research Center for Aquaculture Marine and Fisheries Research Agency Ministry of Marine Affairs and Fisheries Working in conjunction with the Department of Marine Sciences Faculty of Fisheries and Marine Sciences, Diponegoro University, pp. 142-157. [in Indonesian]
- Jamilah, 2015 [Hydro-oceanographic analysis for the cultivation of pearl oysters in Bau-bau waters]. Jurnal Biotek 3(2):92-105. [in Indonesian]
- Liwutang Y. E., Manginsela F. B., Tamanampo J. F. W. S., 2013 [Phytoplankton density and diversity in the waters around the reclamation area in Manado Beach]. Jurnal Ilmiah Platax 1(3):109-117. [in Indonesian]
- Lucas J. S., 2008a Feeding and metabolism. In: The pearl oyster. Elsevier, pp. 103-130.
- Lucas J. S., 2008b Environmental influences. In: The pearl oyster. Elsevier, pp. 187-229.
- Matthiessen G., 2001 Oyster culture. Blackwell Science Ltd., 125 pp.
- Nybakken J., 1992 [Marine biology: an ecological approach]. Gramedia, Jakarta, 459 pp. [in Indonesian]
- Odum E. P., 1996 [Fundamental ecology]. 3rd edition, Gadjah Mada University Press, Yogyakarta, 697 pp. [in Indonesian]
- Powell E. E., 2004 Influence of short term variations in food on survival of *Crassostrea gigas* larvae: a modelling study. Marine Science Journal 62:117-152.
- Powell E., Bochenek E., Klinck J., Hofmann E., 2002 Influence in food quality on the growth and development of *Crassostrea gigas* larvae: a modelling approach. Aquaculture 201:89-117.
- Radiarta I. N., 2013 [Relationship between phytoplankton distribution and water quality in Alas Strait, Sumbawa Regency, West Nusa Tenggara]. Bumi Lestari 13(2):234-243. [in Indonesian]
- Saucedo P. E., Southgate P. C., 2008 Reproduction, development and growth. In: The pearl oyster. Elsevier, pp. 131-186.
- Southgate P. C., 2008 Pearl oyster culture. In: The pearl oyster. Elsevier, pp. 231-272.
- Strack E., 2008 Introduction. In: The pearl oyster. Elsevier, pp. 1-35.
- Subagja Y., Utomo S., Khalif S., 2001 [Ecology]. Universitas Terbuka, Jakarta, 943 pp. [in Indonesian]
- Thoha H., 2007 [Plankton abundance in the bay waters ecosystem Gilimanuk, West Bali National Park]. Makara Sains 11(1):44-48. [in Indonesian]
- Wada K. T., Temkin I., 2008 Taxonomy and phylogeny. In: The pearl oyster. Elsevier, pp. 37-75.
- Widyastuti E., Sinaga T., Siregar A., 2001 [Hidrobiology]. Universitas Terbuka, Jakarta, 944 pp. [in Indonesian]
- Yuliana, 2015 [Distribution and community structure of phytoplankton in west Halmahera Jailolo waters]. Akuatika 6(1):41-48. [in Indonesian]

Received: 22 September 2017. Accepted: 29 October 2017. Published online: 30 November 2017.

Authors:

Femy Mahmud Sahami, Department of Aquatic Resources Management, Gorontalo State University, Jl. Jendral Sudirman, No. 6, 96128 Gorontalo City, Indonesia, e-mail: femysahami@yahoo.co.id

Alfi Sahri Remi Baruadi, Department of Aquatic Resources Management, Gorontalo State University, Jl. Jendral Sudirman, No. 6, 96128 Gorontalo City, Indonesia, e-mail: alfisahri.ung@gmail.com

Sri Nuryatin Hamzah, Department of Aquatic Resources Management, Gorontalo State University, Jl. Jendral Sudirman, No. 6, 96128 Gorontalo City, Indonesia, e-mail: ieen_ers@yahoo.com

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Sahami F. M., Baruadi A. S. R., Hamzah S. N., 2017 Phytoplankton abundance as a preliminary study on pearl oyster potential culture development in the North Gorontalo water, Indonesia. AACL Bioflux 10(6):1506-1513.