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# ECOLOGY, ENVIRONMENT AND CONSERVATION

## VOL. 26 (3) : 2020

### CONTENTS

- 957–962 Short-term experimenton effects of sulfuric acid on atranorin concentration and upper surface structure in *Pyxine cocolos* (Sw.) Nyl.  
—*Chitsupang Kheawsalab, Wanaruk Saipunkaew, Somporn Chantara, Pitchaya Mungkornasawakul and Nattakarn Sransupphasirigul*
- 963–968 Effect of skip irrigation and nano potassium treatments on maize yield  
—*Ali H. Jasim, Sura R. Husain and Hanaa H, Mohammed*
- 969–973 Computation model of electrostatic spraying in Agriculture Industry  
—*Murtadha Al-Mamury, Balachandran, Wamadeva, Al-Raweshidy, Hamed and Manivannan, Nadarajah*
- 974–979 Study of the dynamics of natural stands of *Pinus halepensis* in the Beni Oudjana forest (Khenchela, Algeria)  
—*Insaf Hani, Malika Rached-Kanouni, Hichem Khamar and Menasri Ammar*
- 980–986 Assessment of vulnerability of climate change on crop and livestock production, adaption in Vietnam  
—*Pham Thi To Oanh and Tran Ngoc Thin*
- 987–994 The determination of radon gas concenentration distributed North of Baghdad Governorate: spatial analysis by applying remote Sensing (RS) and geographic information system (GIS) techniques  
—*Fouad K. Mashee Al Ramahi, Muaid Jassim Rasheed and Mazin Shakir Jasim*
- 995–999 Single modified fractionation technique of lead in sediments of Shatt Al-Hilla-Iraq  
—*Hazim Aziz AL-Robai and Russel Jabbar Al-Jbouri*
- 1000–1004 Contribution to the study of the adaptation of *Casuarina equisetifolia* to heat stress using biochemical markers  
—*Malika Rached-Kanouni, Zahia Kadi, Hichem Khammar, Rima Bouzobra and Fadhila Belghit*
- 1005–1011 Effect of Nano fertilizer and Gibberellic acid application in vegetative and floral growth of *Gazania rigens* L.  
—*Raghad Adnan AL-Qadi, Mateen Yilmaz I. AL-Bayati, Ala, aHussien AL-Bakkar and Ali Mohammad Ahmed*
- 1012–1017 Developing collective awareness in providing local-based preservation of coastal area  
—*Fenty Puluwulawa and Amanda Adelina Harun*
- 1018–1026 Effect of spraying organic fertilizer, untrigrin and alkaren algae extract on vegetative floral and chemical growth of two types of tulip plants  
—*Alaa Hashim Younis Altaee and Kefaia Ghazi saeed*
- 1027–1035 Community perception and participation in mangrove ecotourism development in Lembar area west Lombok regency  
—*Sukuryadi, Nuddin Harahab, Mimit Primyastanto and Bambang Semedi*
- 1036–1042 The resistance of tomato plants from seed treated with a magnetic field of 0.2 m T against *Fusarium* sp.  
—*Rochmah Agustrina, Endang Nurcahyani, Bambang Irawan, Eko Pramono, Ika Listiani, EkoNastiti and Sutopo Hadi*
- 1043–1048 The assessment of the efficiency of environmental activities in Moscow  
—*Konstantin Zakharov*
- 1049–1054 Characteristics of growing sites *Anisoptera thurifera* in South Manokwari West Papua  
—*Rima H.S. Siburian, Anna Tampang, Agustunus Murdjoko and Doni Djitmau*



- 1055–1058 First record of threatened Asian Catfish, *Clarias batrachus* (Linnaeus, 1758) (Siluriformes, Clariidae) from Kangean Island, Indonesia  
—*Aditya Mirzapahlevi Saptadjaja, Veryl Hasan, Muhammad Arief, Wahyu Isoni and Rozi*
- 1059–1067 Study the effect of Carvacrol, Eugenol and Thymol on *Fusariums* sp responsible for *Loliumperenne* fusariosis  
—*Hamza Saghrouchni, Azeddin El Barnossi, Hanane Chefchaou, Aouatef Mzabi, Mariam Tanghort, Adnane Remmaland and Chami Fouzia*
- 1068–1077 Flood risk management of Urban Territories  
—*Elena Sierikova, Elena Strelnikova, Leonid Pishnia and Elena Pozdnyakova*
- 1078–1084 Understanding identity of a tourist region through Travelsketch event  
—*Augustinus Madyana Putra, Gagoek Hardiman and Agung Budi Sardjono*
- 1085–1089 Environmental management: A study on the precautionary principle in siak regency of Indonesia towards sustainable development  
—*Sri Maulidiah, Monalisa, Zaini Ali, Sharifah Zarina Syed Zakaria, Nuriah Abd. Majid, Kadir Arifin, Zuliskandar Ramli, Emrizal and Muhammad Rizal Razman*
- 1090–1097 Value chain analysis of Bee Jay mangrove ecotourism in Probolinggo  
—*Candra Adi Intyas, Mochammad Fattah and Tiwi Nurjannati Utami*
- 1098–1099 Effect of the Bacteria *Bacillus thuringiensis* var kurstaky on second larval instar of Angoumois moth *Sitotroga cerealella*  
—*Ahmed M. Tarek*
- 1100–1109 The implementation of conservation village model program in mount Rinjani National Park (A Regulation Perspective)  
—*Andi Chairil Ichsan, Irwan Mahakam Lesmono Aji, Hairil Anwar, Tenri Waru and Indra Gumay Febryano*
- 1110–1114 Prospects for the use of fallow lands in the TVER region for sowing long-stalked flax  
—*Alexey Alekseevich Akimov, Natalya Nikolaevna Ivanyutina, Alexander Sergeevich Vasiliev, Ilya Alexandrovich Drozdov and Yuri Teodorovich Farinyuk*
- 1115–1118 **Presence of the invasive nile Tilapia *Oreochromis niloticus* Linnaeus, 1758 (Perciformes, Cichlidae) in the Yamdena Island, Indonesia**  
—*Liga Insani, Veryl Hasan, Fitri Sil Valen, Fajar Surya Pratama, Maheno Sri Widodo, Abdul Rahem Faqih, R. Adharyan Islamy, Akhmad Taufiq Mukti and Wahyu Isoni*
- 1119–1123 Heavy metal (Mercury and Plumbum) accumulation of two fish species in Sipin and Teluk Lake, Jambi Province  
—*Siswanta Kaban, M. Edi Armanto, M. Rasyid Ridho and Poedji L. Hariani*
- 1124–1127 Realization of the biological potential of Potato varieties in the agricultural conditions of the upper Volga region  
—*Z.I. Usanova, M.N. Pavlov, N.S. Chernikova and S.E. Pryadein*
- 1128–1138 Analysis of Islamic performance index on Sharia business unit in Indonesia towards sustainable development  
—*Hamdi Agustin, Sri Indrastuti, Amris Rusli Tanjung, Syahdanur, Pipin Kurnia, Sharifah Zarina Syed Zakaria, Nuriah Abd. Majid, Kadir Arifin, Zuliskandar Ramli, Emrizal and Muhammad Rizal Razman*
- 1139–1144 Improvement of regional cooperation in overcoming the problem of water resources in the decentralization Era in East Java Province, Indonesia  
—*Lutfi Agus Salim*
- 1145–1157 Actinobacteria isolated from Algerian hot spring waters: A potential source of important enzymes  
—*Meissa Medjemadj, Juan-José Escuder-Rodríguez, Allaoueddine Boudemagh and María-Isabel González-Siso*

- 1158–1161 A review on aquatic macrophytes as bio indicators of Water Quality of Lakes  
—*Kalpita Bhatta and Hemant Kumar Patra*
- 1162–1165 Study and first report on the occurrence of six species of coccoidal cyanobacteria - *Merismopedia meyen* 1839 from Bardhaman East and Bardhaman West Districts of West Bengal, India  
—*Sudip Chatterjee*
- 1166–1169 The number of main species of bark beetles (Scolytinae) and protective measures in the mountain forests of the Zaili Alatau  
—*Nurzhan Mukhamadiyev, J. Bolat, A. Koigeldina and Gulnaz Mengdibayeva*
- 1170–1174 Macroinvertebrate diversity of effluent affected Dhansiri and Kaliani Rivers of Assam, India  
—*Janmoni Moran*
- 1175–1183 Understanding climate change in terms of rainfall fluctuations and status of agricultural productivity in Northeastern States of India  
—*Niranjan Roy, Avijit Debnath and Sunil Nautiyal*
- 1184–1188 Effect of plastic mulches and irrigation levels on yield parameters of tomato (*Solanum lycopersicum*) in Madurai District of Tamil Nadu  
—*M. Jayalalitha, M. Rajeswari, P. Saravanapandian and R. Lalitha*
- 1189–1192 The population of Bark Beetles (Scolytinae) and their entomophages on endemic spruce in the Zaili Alatau  
—*Nurzhan Mukhamadiyev, J. Bolat, A. Koigeldina and Gulnaz Mengdibayeva*
- 1193–1199 Exogeneous application of *Moringa oleifera* leaf extract and Salicylic acid on modulation of Salinity Stress effects in Pea (*Pisum sativum*) plants  
—*Vishal Sharma, Sarita and Alka*
- 1200–1203 Water potability assessment of Boranakanive Reservoir in Chikkanayakanahalli Taluk of Tumkur District, Karnataka, India  
—*R. Shruthi and S. Ramakrishna*
- 1204–1207 Integrated system of protection of soybeans from insect pests in the fields of “Ontustik Agropark” LLP  
—*A.O. Sagitov, N.S. Mukhamadiyev, N.Zh. Sultanova, A.S. Dinassilov, M.À. Uzakbayeva and G.Zh. Mengdibayeva*
- 1208–1211 Multivariate analysis for genetic diversity estimation among tomato (*Solanum lycopersicum* L.) Genotypes  
—*Ankita Debnath, Rajesh Kumar, Sita Kumari Prasad, Nisha Sharma and Jitendra Kumar Kushwah*
- 1212–1217 Effect of Arsenic contaminated ground water on the developmental phenomena of primary-school children in Assam  
—*Ananta Kumar Jena, Munmi Barman, Somnath Gupta, Jaishree Devi, Satarupa Bhattacharjee and Sabina Yeasmin Barbhuiya*
- 1218–1221 Biological activity and emission of carbon dioxide from dark chestnut soil of Western Kazakhstan  
—*Nurlan Sergaliyev, Aliya Nagiyeva and Anvar Tlepov*
- 1222–1227 Density and population growth of the Black sea cucumber, *Holothuria (Halodeima) atra* (Jaeger, 1833) in two different microhabitats of Jepara Waters, Indonesia  
—*Retno Hartati, Muhammad Zainuri, Ambariyanto Ambariyanto, Ita Riniatsih, Hadi Endrawati, Sri Redjeki, Ria AT Nuraini, Agoes Soegianto and Sekar Widyaningsih*
- 1228–1234 Floristic diversity of lacustrine ecotone of Lakes in Valsad District, Gujarat, India  
—*Ayantika Das and Jigna Desai*

- 1235–1238 The effect of spring wheat cultivation methods on some fertility indicators of Southern carbonate chernozem in Northern Kazakhstan  
—*Nadezhda Filippova, Galina Churkina, Maral Utebayev, Irina Rukavitsina and Kairat Kunanbayev*
- 1239–1243 Noise pollution and human health: A case study in Bangkok City, Thailand  
—*N. Vattanapruteep*
- 1244–1248 Surabaya strategy to Answer air pollution improvement  
—*Intan Ayu Pratiwi and Rusdiana Puspa Ayu*
- 1249–1258 Local ecological knowledge of invasive Alien species *Opuntia ficus-indica* in three local municipalities in the Eastern Cape Province, South Africa  
—*Luleka Mdweshu and Alfred Maroyi*
- 1259–1270 Plant bacterial endophytes as a potent source of plant growth promoters and other bioactive compounds: A Review  
—*K.K. Dayamrita and Nivya Mariam Paul*
- 1271–1275 Monitoring of population density of *Vibrio* sp. and health condition of hepatopancreas pacific white shrimp (*Litopenaeus vannamei*) cultivated with intensive systems in Bulukumba regency, South Sulawesi, Indonesia  
—*Mayadita Dwi Sani, Agnes Yuantin Maharani, Muhammad Inas Riandy, Raden Joko Kuncoroningrat Susilo, Putu Angga Wiradana and Agoes Soegianto*
- 1276–1281 People within Park: forest cover dynamics and management strategies in Dibru-Saikhowa National Park, India  
—*Rekib Ahmed*
- 1282–1289 Spatial relationship modeling for urban environmental factors analysis to population density change  
—*Nutchanat Buasri, Patiwat Littidej, Naruset Prasertsri and Benjamabhorn Pumhirunroj*
- 1290–1299 Adoption of united nations sustainable development goals 2030 in environmental management system by earth moving and construction equipment industries in India  
—*Dheeraj Verma, Vartika Singh, Prodyut Bhattacharya and Jagdish Kishwan*
- 1300–1304 Development of hydroxyapatite from corals obtained from contamination waters of Northern Java by precipitation method  
—*Siswanto, Siti Nurmala, Dyah Hikmawati, Aminatun and Retna Apsari*
- 1305–1308 Physico-chemical characteristics of Groundwater in Byramangala and Harobele command areas of Arkavathi sub-basin of River Cauvery, Karnataka  
—*Suma Rani S.N. and B.C. Nagaraja*
- 1309–1312 Studying the biological features of development and the technology of breeding the *Orius laevigatus* Fieb Predatory Bug  
—*Aizhan Mukashevna Chadinova, Abay Orazuly Sagitov, Karlygash Azirbekovna Alpysbayeva and Balzhan Zhasulanovna Naimanova*
- 1313–1318 Larvicidal and Pupicidal activities from *Citrus hystrix* against *Aedes aegypti* Mosquitoes  
—*Niken Subekti, Asni Puraedah, Dyah Rini Indriyanti and Agoes Soegianto*
- 1319–1323 Comparison of remediation performance of *Chaetoceros calcitrans* on heavy metals and diesel fuel exposure  
—*Diana Arfiati, Nunik Cokrowati, Dwi Candra Pratiwi, Niken Pratiwi, Qurrota A'yunin, Trisnadi W. C. Putranto and Thin Soedarti*
- 1324–1326 Effect of microbial inoculants on soil quality, growth and yield of pea plant  
—*Simmi Goel and Yasmeen Bano*
- 1327–1330 Biosurfactants production using bacterial isolate from Cangar hot spring, East Java, Indonesia  
—*Almando Geraldi, Aulia Azzahra, Lillah Asritafriha, Rizki Amaliah Zain, Us Watun Nurul Khasanah, Nastiti Trikurniadewi and Ni'matuzahroh*

- 
- 1331–1341 Wetland degradation and its impact on life and livelihood of people in the Majuli River Island, Assam  
—*Ranjan Das and Jhimli Bhattacharjee*
- 1342–1347 Greenhouse Gas (GHG) Emission Reduction Model in Surabaya  
—*Intan Ayu Pratiwi, Eka Prasetyo and Helmi Dadang Ardiansyah*
- 1348–1351 Difference of Hg (II) removal efficiency in leachate by Immobilized *Skeletonema* sp.  
—*Isna Arifatus Shalihah, Eko Prasetyo Kuncoro, Tini Surtiningsih, Nur Indradewi Oktavetri and Thin Soedarti*
- 1352–1361 Classification of air pollutants caused by e-waste and health risk evaluation  
—*Sajeev Ram, C.S. Shylaja and R. Anandan*
- 1362–1367 Application of probiotics and microalgae (*Chaetoceros calcitrans*) to stimulate non-specific Immune responses in white Shrimp (*Litopenaeus vannamei*) infected with *Vibrio harveyi*  
—*Mila Ayu Ambarsari and Woro Hastuti Satyantini*
- 1368–1371 *Pseudomonas* community in white syndrome diseases of *Echinopora lamellosa* coral at nature reserve Pulau Sempu, Indonesia  
—*Oktyas Muzaky Luthfi, Muliawati Handayani, Andik Isdianto, Muhammad Arif Asadi, Tajuddin Atho'illah and Moch Affandi*
- 1372–1382 Effect of locally made subsoiler tines on some energy requirements  
—*Ghazwan Ahmed Dahham, Othman Muayad Mohammed Taofeeq and Layth Mahmood Yahya*
- 1383–1388 Copepod growth populations (*Acartia* sp.) in outdoor mass culture tanks: Exploring natural feed potentials for sustainable aquaculture  
—*Putu Angga Wiradana, Sephia Anjani, Deny Suhernawan Yusup, Joko Wiryatno, Regina Melianawati, Sin War Naw, Aondohemba Samuel Nege and Agoes Soegianto*
- 1389–1395 Modelling risks using Quantum physics principles for health projects: Mangaung Metropolitan Municipality, South Africa  
—*Bernard Moeketsi Hlalele*
- 1396–1400 Productivity of corn hybrids in the North-eastern upper volga region, Russia  
—*Z.I. Usanova, P.I. Migulev, Yu.T. Farinyuk and M.N. Pavlov*
- 1401–1404 Realization of the biological potential of potato varieties in the agricultural conditions of the upper Volga Region  
—*Z.I. Usanova, M.N. Pavlov, N.S. Chernikova and S.E. Pryadein*
- 1405–1419 Economic and social analysis of the proposed programme of measures in order to achieve good environmental status in Turkish Seas: The Case of the EU Marine strategy framework directive  
—*Ömer Eyuboglu*
- 1420–1423 Development and evaluation of bacterial consortia for biodegradation of polycyclic aromatic hydrocarbons  
—*E.R. Faizulina, S.A. Aitkeldiyeva, L.G. Tatarkina, K. Ashimuly, A.V. Alimbetova and A.K. Sadanov*
- 1424–1431 Oil palm empty fruit bunch as the selected organic matter in developing the Swampy forest system for passive treatment of acid mine drainage  
—*Ihsan Noor, Yudi Firmanul Arifin, Bambang Joko Priatmadi and Akhmad Rizalli Saidy*

# Presence of the invasive Nile Tilapia *Oreochromis niloticus* Linnaeus, 1758 (Perciformes, Cichlidae) in the Yamdena Island, Indonesia

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## ABSTRACT

Nile Tilapia *Oreochromis niloticus* is native fish to North Africa, with introductions reported from many regions in the worldwide. In Indonesia, *O. niloticus* was reported in the several conservation islands. On 11-29 June 2019 specimens of *O. niloticus* were captured from temporary swamp and estuary in Yamdena Island, Indonesia. These records are among first of this species from a remote island in the Eastern Indonesia Archipelago. In many cases, introduced of non-native fish would cause a negative impact on the aquatic fauna by predation of larvae and eggs of native fish, so that the presence of the *O. niloticus* is a danger alert. The specimens of *O. niloticus* were characterized as follows dorsal spin rays 15, dorsal soft rays 10, pectoral fin rays 11, pelvic spin rays 1, pelvic soft rays 5, anal spin rays 8, anal soft rays 10. Other description of specific morphological characters of a specimen are provided.

**Key words:** Freshwaters, Invasive, Non-native fish

## Introduction

The adverse ecological impacts associated with non-native fish introductions on recipient fresh and brackish water ecosystems worldwide have drawn attention to the need to control and manage the movement of invasive species (Cambray, 2003; Pimentel *et al.*, 2005). Nile Tilapia *Oreochromis*

*niloticus* Linnaeus, 1758 is the most successful invasive Tilapia worldwide (Maddern *et al.* 2007; Martin *et al.*, 2010). It is now introduced to many regions for aquaculture, exotic pet and sport fishing (Canonico *et al.*, 2005). *Oreochromis niloticus* exhibits highly omnivory habits, tolerance to salinity and new habitats. This fish can be found in high altitude or estuary (Peterson *et al.*, 2005; Kulac *et al.* 2012;



Vicente and Fonseca-Alves, 2013). It can have negative impacts in fresh and brackish water communities through competition for food and other resources, and as a vector of disease causing pathogens (Cucherousset and Olden, 2011; Torchin *et al.* 2013; Tuttle *et al.*, 2017).

*Oreochromis niloticus* spread in mainland Indonesia is due to aquaculture and aquarium trade activities (Basuki and Sri, 2014). Previous records showed this species was found in several remote islands and conservation area, among others Bawean Island (Hasan and Tamam, 2019) and Kangean Island in the Java Sea (Hasan *et al.*, 2019a; Hasan *et al.*, 2019b). Yamdena, remote island and fisheries center in the Eastern of Indonesia, is a conservation area and has no record of culturing *O. niloticus*. The presence of *O. niloticus* in the Yamdena Island constitutes a new record.

## Materials and Methods

Twenty three live specimens of *O. niloticus* were obtained from a local fisherman during a fieldwork carried out on 11-29 June, 2019 in the temporary swamp and estuary, Yamdena Island. Eight of them were used as preserved specimens in 10% formalin solution (Hasan *et al.*, 2019b) and deposited at the Zoology Laboratory, Generasi Biologi Indonesia, Gresik, Indonesia. Diagnostic morphological characters of *O. niloticus* were analyzed following Trewavas (1983). Administratively, the site is located in Tanimbar Regency, Maluku Province, Indonesia. The fishing gear used by the fisherman was a cast net, fish trap and medium hook with bottom and bait used were crustaceans.

## Results

### New record

Indonesia: Maluku Province: Tanimbar Regency: temporary swamp (7°52'23.1"S; 131°13'56.6"E), V. Hasan and F.S Pratama collectors, 11 June 2019, 14 specimens of *Oreochromis niloticus* GBI0016. Indonesia: Maluku Province: Tanimbar Regency: estuary (7°50'11"S; 131°10'55"E). V. Hasan and F.S Pratama collectors, 29 June 2019, 9 specimens, photographed.

### Identification

Specific morphological characters of *O. niloticus* are as follows: Snout moderate; scales cycloid; 3 rows of

scales on cheek; gill rakers short; teeth widen; maxilla and lower jaw equal; pectoral fin pointed; dorsal, pectoral and anal fins blunt; caudal scaly. Coloration fresh specimen: upper margin of dorsal fin grey or black, the melanin sometimes slightly mixed with red, not orange or vermilion even in breeding males. Head and trunk of breeding male suffused with red; in some localities lower jaw, pelvics and anterior part of anal fin black; caudal fin covered with narrow vertical stripes; anal fin faintly barred; about 9 narrow dark bars on sides body; dark blotch at corner of operculum; dorsal spin rays 15, dorsal soft rays 10, pectoral fin rays 11, pelvic spin rays 1, pelvic soft rays 5, anal spin rays 8, anal soft rays 10 (Figure 1).



Fig. 1. *Oreochromis niloticus* fresh specimen GBI0016, from temporary swamp, Yamdena Island, Indonesia.

## Discussion

*Oreochromis niloticus* is listed among the top 100 worst alien species around the globe and have successfully established in more than 90 countries on five continents (all except Antarctica) (De Silva *et al.* 2004; Russell *et al.*, 2012). Temporary swamp conditions in Yamdena Island, namely salinity 2-7 ppt, temperature 29-30 °C, current velocity 4.5 cm/s and depth 55-81 cm, while estuary namely salinity 20-26 ppt, temperature 30-31 °C, current velocity 8.1 cm/s and depth 67-111 cm are ideal for *O. niloticus* reproduction, survival and growth and (Riede, 2004; Admassu, 1996). They are a benthopelagic species, feeding near the surface as well as near the bottom. They can survive in fresh and brackish water with low dissolved oxygen (Abdel-Tawwab *et al.*, 2015). These characteristics make *O. niloticus* a dangerous non-native species, with potential for a massive invasion (Colautti *et al.*, 2004). The size of sampled individuals, ranging from adults to young fishes, suggest that *O. niloticus* is able to adapt well in the

Yamdena Island waters, and can possibly establish a viable population there. This is further supported by observation of fish gonad. Variation of Gonad maturity in several specimens indicate that the fish are able to breed in the Yamdena Island.

The first establishment of tilapias is believed to have occurred in Indonesia Archipelago in the 1930s as a result of an aquarium release (Courtenay and Williams, 1992). Due to intensive aquaculture, *O. niloticus* occurs in all fresh and brackish waters of mainland Indonesia such as Sumatra, Java, Borneo, Celebes and Papua. Its presence on the island of Yamdena, represents a new record (Figure 2). We speculate that *O. niloticus* were released into temporary swamp and estuary in Yamdena Island by human, but the purpose is not clear. As the island does not have an aquaculture industry, further investigation is warranted to determine the source of *O. niloticus* in the Yamdena Island. In the future further introductions should be prevented to reduce the impact of invasive fish species on the conservation area on does not disturb the conservation area (Peterson 2004; McDonald 2007; Mert and Cicek 2010).



**Fig. 2.** Presence of *Oreochromis niloticus* in the Yamdena Island. Red square is the estuary and red triangle is temporary swamp.

There are many native aquatic organisms in the waters of Yamdena Island, mostly fish (Gobiidae, Latidae, Chanidae, Anguillidae and Mugilidae) and invertebrata (Palaemonidae, Portunidae, Nephropidae and Octopodidae), that can be affected by *O. niloticus*, including through predation and competition for niche, so that the presence of *O. niloticus* is a danger alert.

Regulations on the prohibition of the entry of *O. niloticus* into the Indonesian waters environment

have not been established by the Indonesian government. While Europe, Australia and America have banned *O. niloticus* from entering into natural waters (Pettersen, 2004; Pettersen, 2005; Maddern, 2007). Although the Indonesian government has not officially banned it, it is necessary to socialize the community related to the impact of the entry of foreign fish. The way to overcome foreign fish that has already entered is by catching it, making it community food or fish meal as feed. This habit can suppress *O. niloticus* populations so that the population is not massive, because actually *O. niloticus* do not have natural predators as in their original habitat, whereas in its original habitat *O. niloticus* is main food for several predators such as African Catfish *Clarias gariepinus*, Nile Perch *Lates niloticus* and Nile Crocodile *Crocodylus niloticus*.

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### References

- Abdel-Tawwab, M., Hagrass, A.E., Elbaghdady, H.A.M. and Monier, M.N. 2015. Effects of dissolved oxygen and fish size on Nile tilapia, *Oreochromis niloticus* (L.): growth performance, whole-body composition, and innate immunity. *Aquaculture International*. 23(5): 1261-1274.
- Admassu, D. 1996. The breeding season of Tilapia, *Oreochromis niloticus* in Lake Awassa (Ethiopian Rift Valley). *Hydrobiologia*. 337: 77-83.
- Basuki, F. and Sri, R. 2014. Analysis on the Survival Rate and Growth of Larasati Tilapia (*Oreochromis niloticus*) F5 seed in Saline Media. *Procedia Environmental Sciences*. 23: 142-147.
- Bagenal, T. 1968. *Methods For Assessment of Fish Reproduction In Fresh Water*. Blackwell Scientific Publication, London.
- Cambray, J.A. 2003. Impact on indigenous species biodiversity caused by the globalisation of alien recreational freshwater fisheries. *Hydrobiologia*. 500: 217-230.
- Canonico, G.C., Arthington, A., McCrary, J.K. and Thieme, M.L. 2005. The effects of introduced tilapias on native biodiversity. *Aquatic Conservation Marine and Freshwater Ecosystems*. 15: 463-483.

- Colautti, R.I., Ricciardi, A., Grigorovich, I.A. and MacIsaac, H.J. 2004. Is invasion success explained by the enemy release hypothesis? *Ecology Letters*. 7: 721-733.
- Courtenay, W.R. and Williams, J.D. 1992. Dispersal of exotic species from aquaculture sources, with emphasis on freshwater fishes. In: Rosenfield A, Mann R (Eds) *Dispersal of Living Organisms into Aquatic Ecosystems*. University of Maryland Sea Grant Program, Col-lege Park, 49–81.
- Cucherousset, J. and Olden, J.D. 2011. Ecological impacts of non-native freshwater fishes. *Fisheries*. 36(5): 215–230.
- De Silva, S., Subasinghe, R., Bartley, D. and Lowther, A. 2004. Tilapias as Alien Aquatics in Asia and The Pacific. A Review. FAO Fisheries Technical Paper, Rome.
- Hasan, V., Mukti, A.T. and Putranto, T.W.C. 2019a. Range expansion of the invasive Nile tilapia *Oreochromis niloticus* (Perciformes: Cichlidae) in Java Sea and first record for Kangean Island, Madura, East Java, Indonesia. *Eco. Env. & Cons.* 25 (July Suppl. Issue) : S187-S189.
- Hasan, V., Pratama, F., Malonga, W.A.M. and Cahyanurani, AB. 2019b. First record of the Mozambique Tilapia *Oreochromis mossambicus* Peters, 1852 (Perciformes: Cichlidae) on Kangean Island, Indonesia. *Neotropical Biology and Conservation*. 14 (2): 207–211.
- Hasan, V. and Tamam, M.B. 2019. First record of the invasive Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Perciformes, Cichlidae), on Bawean Island, Indonesia. *Check List*. 15 (1): 225-227.
- Kulac, B., Guluzur, A. and Mustafa, C. 2012. Investigations on the ATPase activities and cadmium uptake in freshwater fish *Oreochromis niloticus* following exposures to cadmium in increased salinity. *Turkish Journal of Fisheries and Aquatic Sciences*. 12 : 861-869.
- Maddern, M.G., Morgan, D.L. and Gill, H.S. 2007. Distribution, diet and potential ecological impacts of the introduced Mozambique mouthbrooder *Oreochromis mossambicus* Peters (Pisces: Cichlidae) in Western Australia. *Journal of the Royal Society of Western Australia*. 90: 203–214.
- Martin, C.W., Valentine, M.M. and Valentine, J.F. 2010. Competitive interactions between invasive Nile Tilapia and native fish: The potential for altered trophic exchange and modification of food webs. *Plos One*. 5 (12): 1–6.
- McDonald, J.L., Peterson, M.S. and Slack, W.T. 2007. Morphology, density and spatial patterning of reproductive bowers in an established alien population of Nile tilapia, *Oreochromis niloticus* Linnaeus. *Journal of Freshwater Ecology*. 22: 461-468.
- Mert, R. and Cicek, E. 2010. Range expansion of introduced tilapiaspecies (*Oreochromis niloticus*, L. 1758) in Turkey. *Journal of Animal and Veterinary Advances*. 9: 1753-1756.
- Peterson, M.S., Slack, W.T., Brown-Peterson, N.J. and McDonald, J.L. 2004. Reproduction in non-native environments: establishment of Nile tilapia, *Oreochromis niloticus* (Linnaeus) in coastal Mississippi watersheds. *Copeia*. 2004 : 842-849.
- Peterson, M.S., Slack, W.T. and Woodley, C.M. 2005. The occurrence of nonindigenous Nile Tilapia, *Oreochromis niloticus* (Linnaeus) in coastal Mississippi: ties to aquaculture and thermal effluent. *Wetlands*. 25 : 112-121.
- Pimentel, D., Zuniga, R. and Morrison, D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics*. 52 : 273-288.
- Riede, K. 2004. *Global Register of Migratory Species from Global to Regional Scales*. Final Report of the R&D-Projekt 808 05 081. Federal Agency for Nature Conservation, Bonn, Germany, 329 pp.
- Torchin, M.E., Lafferty, K.D., Dobson, A.P., McKenzie, V.J. and Kuris, A.M. 2003. Introduced species and their missing parasites. *Nature*. 421 : 628–630.
- Trewavas, E. 1983. Tilapiine Fishes of The Genera *Sarotherodon*, *Oreochromis* and *Danakilia*. British Museum (Natural History), London.
- Tuttle, L.J., Sikkel, P.C., Cure, K. and Hixon, M.A. 2017. Parasite-mediated enemy release and low biotic resistance may facilitate invasion of Atlantic coral reefs by Pacific Red Lionfish (*Pterois volitans*). *Biological Invasions*. 19: 563–575.
- Vicente, I.S.T. and Fonseca-Alves, C.E. 2013. Impact of Introduced Nile tilapia (*Oreochromis niloticus*) on non-native aquatic ecosystems. *Pakistan Journal of Biological Sciences*. 16(3): 121-12.

# EEC26

*by* Akhmad Taufiq Mukti

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2

## Presence of the invasive Nile Tilapia *Oreochromis niloticus* Linnaeus, 1758 (Perciformes, Cichlidae) in the Yamdena Island, Indonesia

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### ABSTRACT

9

Nile Tilapia *Oreochromis niloticus* is native fish to North Africa, with introductions reported from many regions in the worldwide. In Indonesia, *O. niloticus* was reported in the several conservation islands. On 11-29 Jun 2019 specimens of *O. niloticus* were captured in temporary swamp and estuary in Yamdena Island, Indonesia. These records are among first of this species from a remote island in the Eastern Indonesia Archipelago. In many cases, introduced of non-native fish would cause a negative impact on the aquatic fauna by predation of larvae and eggs of native fish, so that the presence of the *O. niloticus* is a danger alert. The specimens of *O. niloticus* were characterized as follows dorsal spin rays 15, dorsal soft rays 10, pectoral fin rays 11, pelvic spin rays 1, pelvic soft rays 5, anal spin rays 8, anal soft rays 10. Other description of specific morphological characters of a specimen are provided.

**Key words:** Freshwaters, Invasive, Non-native fish

### Introduction

11

The adverse ecological impacts associated with non-native fish introductions on recipient fresh and brackish water ecosystems worldwide have drawn attention to the need to control and manage the movement of invasive species (Cambray, 2003; Pimentel *et al.*, 2005). Nile Tilapia *Oreochromis*

*niloticus* Linnaeus, 1758 is the most successful invasive Tilapia worldwide (Maddern *et al.* 2007; Martin *et al.*, 2010). It is now introduced to many regions for aquaculture, exotic pet and sport fishing (Canonico *et al.*, 2005). *Oreochromis niloticus* exhibits highly omnivory habits, tolerance to salinity and new habitats. This fish can be found in high altitude or estuary (Peterson *et al.*, 2005; Kulac *et al.* 2012;

Vicente and Fonseca-Alves, 2013). It can have negative impacts in fresh and brackish water communities through competition for food and other resources, and as a vector of disease causing pathogens (Cucherousset and Olden, 2011; Torchin *et al.* 2013; Tuttle *et al.*, 2017).

*Oreochromis niloticus* spread in mainland Indonesia is due to aquaculture and aquarium trade activities (Basuki and Sri, 2014). Previous records showed this species was found in several remote islands and conservation area, among others Bawean Island (Hasan and Tamam, 2019) and Kangean Island in the Java Sea (Hasan *et al.*, 2019a; Hasan *et al.*, 2019b). Yamdena, remote island and fisheries center in the Eastern of Indonesia, is a conservation area and has no record of culturing *O. niloticus*. The presence of *O. niloticus* in the Yamdena Island constitutes a new record.

## Materials and Methods

Twenty three live specimens of *O. niloticus* were obtained from a local fisherman during a fieldwork carried out on 11-29 June, 2019 in the temporary swamp and estuary, Yamdena Island. Eight of them were used as preserved specimens in 10% formalin solution (Hasan *et al.*, 2019b) and deposited at the Zoology Laboratory, Generasi Biologi Indonesia, Gresik, Indonesia. Diagnostic morphological characters of *O. niloticus* were analyzed following Trewavas (1983). Administratively, the site is located in Tanimbar Regency, Maluku Province, Indonesia. The fishing gear used by the fisherman was a cast net, fish trap and medium hook with bottom and bait used were crustaceans.

## Results

### New record

Indonesia: Maluku Province: Tanimbar Regency: temporary swamp (7°52'23.1"S; 131°13'56.6"E), V. Hasan and F.S Pratama collectors, 11 June 2019, 14 specimens of *Oreochromis niloticus* GBI0016. Indonesia: Maluku Province: Tanimbar Regency: estuary (7°50'11"S; 131°10'55"E). V. Hasan and F.S Pratama collectors, 29 June 2019, 9 specimens, photographed.

### Identification

Specific morphological characters of *O. niloticus* are as follows: Snout moderate; scales cycloid; 3 rows of

scales on cheek; gill rakers short; teeth widen; maxilla and lower jaw equal; pectoral fin pointed; dorsal, pectoral and anal fins blunt; caudal scaly. Coloration fresh specimen: upper margin of dorsal fin grey or black, the melanin sometimes slightly mixed with red, not orange or vermilion even in breeding males. Head and trunk of breeding male suffused with red; in some localities lower jaw, pelvics and anterior part of anal fin black; caudal fin covered with narrow vertical stripes; anal fin faintly barred; about 9 narrow dark bars on sides body; dark blotch at corner of operculum; dorsal spin rays 15, dorsal soft rays 10, pectoral fin rays 11, pelvic spin rays 1, pelvic soft rays 5, anal spin rays 8, anal soft rays 10 (Figure 1).



Fig. 1. *Oreochromis niloticus* fresh specimen GBI0016, from temporary swamp, Yamdena Island, Indonesia.

## Discussion

*Oreochromis niloticus* is listed among the top 100 worst alien species around the globe and have successfully established in more than 90 countries on five continents (all except Antarctica) (De Silva *et al.* 2004; Russell *et al.*, 2012). Temporary swamp conditions in Yamdena Island, namely salinity 2-7 ppt, temperature 29–30 °C, current velocity 4.5 cm/s and depth 55–81 cm, while estuary namely salinity 20-26 ppt, temperature 30–31 °C, current velocity 8.1 cm/s and depth 67–111 cm are ideal for *O. niloticus* reproduction, survival and growth and (Riede, 2004; Admassu, 1996). They are a benthopelagic species, feeding near the surface as well as near the bottom. They can survive in fresh and brackish water with low dissolved oxygen (Abdel-Tawwab *et al.*, 2015). These characteristics make *O. niloticus* a dangerous non-native species, with potential for a massive invasion (Colautti *et al.*, 2004). The size of sampled individuals, ranging from adults to young fishes, suggest that *O. niloticus* is able to adapt well in the

Yamdena Island waters, and can possibly establish a viable population there. This is further supported by observation of fish gonad. Variation of Gonad maturity in several specimens indicate that the fish are able to breed in the Yamdena Island.

The first establishment of tilapias is believed to have occurred in Indonesia Archipelago in the 1930s as a result of an aquarium release (Courtenay and Williams, 1992). Due to intensive aquaculture, *O. niloticus* occurs in all fresh and brackish waters of mainland Indonesia such as Sumatra, Java, Borneo, Celebes and Papua. Its presence on the island of Yamdena, represents a new record (Figure 2). We speculate that *O. niloticus* were released into temporary swamp and estuary in Yamdena Island by human, but the purpose is not clear. As the island does not have an aquaculture industry, further investigation is warranted to determine the source of *O. niloticus* in the Yamdena Island. In the future further introductions should be prevented to reduce the impact of invasive fish species on the conservation area on does not disturb the conservation area (Peterson 2004; McDonald 2007; Mert and Cicek 2010).



Fig. 2. Presence of *Oreochromis niloticus* in the Yamdena Island. Red square is the estuary and red triangle is temporary swamp.

There are many native aquatic organisms in the waters of Yamdena Island, mostly fish (Gobiidae, Latidae, Chanidae, Anguillidae and Mugilidae) and invertebrata (Palaemonidae, Portunidae, Nephropidae and Octopodidae), that can be affected by *O. niloticus*, including through predation and competition for niche, so that the presence of *O. niloticus* is a danger alert.

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### References

- Abdel-Tawwab, M., Hagra, A.E., Elbaghdady, H.A.M. and Monier, M.N. 2015. Effects of dissolved oxygen and fish size on Nile tilapia, *Oreochromis niloticus* (L.): growth performance, whole-body composition, and innate immunity. *Aquaculture International*. 23(5): 1261-1274.
- Admassu, D. 1996. The breeding season of Tilapia, *Oreochromis niloticus* in Lake Awassa (Ethiopian Rift Valley). *Hydrobiologia*. 337: 77-83.
- Basuki, F. and Sri, R. 2014. Analysis on the Survival Rate and Growth of Larasati Tilapia (*Oreochromis niloticus*) F5 seed in Saline Media. *Procedia Environmental Sciences*. 23: 142-147.
- Bagenal, T. 1968. *Methods For Assessment of Fish Reproduction In Fresh Water*. Blackwell Scientific Publication, London.
- Cambray, J.A. 2003. Impact on indigenous species biodiversity caused by the globalisation of alien recreational freshwater fisheries. *Hydrobiologia*. 500: 217-230.
- Canonico, G.C., Arthington, A., McCrary, J.K. and Thieme, M.L. 2005. The effects of introduced tilapias on native biodiversity. *Aquatic Conservation Marine and Freshwater Ecosystems*. 15: 463-483.



- Colautti, R.I., Ricciardi, A., Grigorovich, I.A. and MacIsaac, H.J. 2004. Is invasion success explained by the enemy release hypothesis? *Ecology Letters*. 7: 721-733.
- Courtenay, W.R. and Williams, J.D. 1992. Dispersal of exotic species from aquaculture sources, with emphasis on freshwater fishes. In: Rosenfield A, Mann R (Eds) *Dispersal of Living Organisms into Aquatic Ecosystems*. University of Maryland Sea Grant Program, College Park, 49-81.
- Cucherousset, J. and Olden, J.D. 2011. Ecological impacts of non-native freshwater fishes. *Fisheries*. 36(5): 215-230.
- De Silva, S., Subasinghe, R., Bartley, D. and Lowther, A. 2004. Tilapias as Alien Aquatics in Asia and The Pacific. A Review. FAO Fisheries Technical Paper, Rome.
- Hasan, V., Mukti, A.T. and Putranto, T.W.C. 2019a. Range expansion of the invasive Nile tilapia *Oreochromis niloticus* (Perciformes: Cichlidae) in Java Sea and first record for Kangean Island, Madura, East Java, Indonesia. *Eco. Env. & Cons.* 25 (July Suppl. Issue) : S187-S189.
- Hasan, V., Pratama, F., Malonga, W.A.M. and Cahyanurani, A.B. 2019b. First record of the Mozambique Tilapia *Oreochromis mossambicus* Peters, 1852 (Perciformes: Cichlidae) on Kangean Island, Indonesia. *Neotropical Biology and Conservation*. 14 (2): 207-211.
- Hasan, V. and Tamam, M.B. 2019. First record of the invasive Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Perciformes, Cichlidae), on Bawean Island, Indonesia. *Check List*. 15 (1): 225-227.
- Kulac, B., Guluzur, A. and Mustafa, C. 2012. Investigations on the ATPase activities and cadmium uptake in freshwater fish *Oreochromis niloticus* following exposures to cadmium in increased salinity. *Turkish Journal of Fisheries and Aquatic Sciences*. 12 : 861-869.
- Maddern, M.G., Morgan, D.L. and Gill, H.S. 2007. Distribution, diet and potential ecological impacts of the introduced Mozambique mouthbrooder *Oreochromis mossambicus* Peters (Pisces: Cichlidae) in Western Australia. *Journal of the Royal Society of Western Australia*. 90: 203-214.
- Martin, C.W., Valentine, M.M. and Valentine, J.F. 2010. Competitive interactions between invasive Nile Tilapia and native fish: The potential for altered trophic exchange and modification of food webs. *Plos One*. 5 (12): 1-6.
- McDonald, J.L., Peterson, M.S. and Slack, W.T. 2007. Morphology, density and spatial patterning of reproductive bowers in an established alien population of Nile tilapia, *Oreochromis niloticus* Linnaeus. *Journal of Freshwater Ecology*. 22: 461-468.
- Mert, R. and Cicek, E. 2010. Range expansion of introduced tilapia species (*Oreochromis niloticus*, L. 1758) in Turkey. *Journal of Animal and Veterinary Advances*. 9: 1753-1756.
- Peterson, M.S., Slack, W.T., Brown-Peterson, N.J. and McDonald, J.L. 2004. Reproduction in non-native environments: establishment of Nile tilapia, *Oreochromis niloticus* (Linnaeus) in coastal Mississippi watersheds. *Copeia*. 2004 : 842-849.
- Peterson, M.S., Slack, W.T. and Woodley, C.M. 2005. The occurrence of non-indigenous Nile Tilapia, *Oreochromis niloticus* (Linnaeus) in coastal Mississippi: ties to aquaculture and thermal effluent. *Wetlands*. 25 : 112-121.
- Pimentel, D., Zuniga, R. and Morrison, D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics*. 52 : 273-288.
- Riede, K. 2004. *Global Register of Migratory Species from Global to Regional Scales*. Final Report of the R&D-Projekt 808 05 081. Federal Agency for Nature Conservation, Bonn, Germany, 329 pp.
- Torchin, M.E., Lafferty, K.D., Dobson, A.P., McKenzie, V.J. and Kuris, A.M. 2003. Introduced species and their missing parasites. *Nature*. 421 : 628-630.
- Trewavas, E. 1983. Tilapiine Fishes of The Genera *Sarotherodon*, *Oreochromis* and *Danakilia*. British Museum (Natural History), London.
- Tuttle, L.J., Sikkil, P.C., Cure, K. and Hixon, M.A. 2017. Parasite-mediated enemy release and low biotic resistance may facilitate invasion of Atlantic coral reefs by Pacific Red Lionfish (*Pterois volitans*). *Biological Invasions*. 19: 563-575.
- Vicente, I.S.T. and Fonseca-Alves, C.E. 2013. Impact of introduced Nile tilapia (*Oreochromis niloticus*) on non-native aquatic ecosystems. *Pakistan Journal of Biological Sciences*. 16(3): 121-12.