biology and life sciences forum

MDPI

Abstract

Analysis of the Efficiency of the Taxonomic Identification of Small Fishes Using Artificial Neural Networks: A CASE Study of the Ichthyofauna of the Carajás Mountain (Pará—Northern Brazil) †

Lays C. L. Nogueira [1], Rafael Schroeder [1,2,‡], Rodrigo Sant'Ana [1,*] and Antônio C. Beaumord [3]

[1] Laboratório de Estudos Marinhos Aplicados, Escola do Mar, Ciência e Tecnologia, Universidade do Vale do Itajaí (UNIVALI), Rua Uruguai, 458-Centro, Itajaí 88302-901, Brazil; layslemes.nogueira@gmail.com (L.C.L.N.); schroeder@edu.univali.br (R.S.)
[2] Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR), Terminal de Cruzeiros do Porto de Leixões, Avenida General Norton de Matos S/N, 4550-208 Matosinhos, Portugal
[3] Laboratório de Estudos de Impactos Ambientais, Escola do Mar, Ciência e Tecnologia, Universidade do Vale do Itajaí (UNIVALI), Rua Uruguai, 458-Centro, Itajaí 88302-901, Brazil; beaumord@univali.br
* Correspondence: rsantana@univali.br
† Presented at the IX Iberian Congress of Ichthyology, Porto, Portugal, 20–23 June 2022.
‡ Presenting author (Poster presentation).

Abstract: The development of techniques that assist in the processes of taxonomic identification is of utmost importance, considering the scarcity of specialists and literature available in remote and diverse areas. Environmental studies such as the Biodiversity Monitoring Program of the Carajás National Forest in northern Brazil (FLONA de Carajás—PA, 6°6′29″ S, 50°18′16″ W) face challenges in this regard. These challenges include the particularity of the morphological and evolutionary characteristics of the fauna, present in a very diverse area of intense anthropogenic intervention by the use of resources of economic interest. Thus, this work sought to analyze the efficiency of using Artificial Neural Networks (ANN), more specifically the "XCeption" algorithm, configured for the taxonomic identification of samples captured during this monitoring program. These samples were previously identified using traditional taxonomic identification keys. The taxa *Aequidens tetramerus*, *Astyanax abramis*, *Bryconops* spp., *Knodus* spp., and *Moenkhausia* spp. were used. After capturing the images, the content was assigned to different folders, named "Training" and "Test". This procedure seeks to quantify the model's ability to classify data characteristically different from that presented in the training base. The accuracy results obtained during the training phase of the algorithm used, executed in about 16 hours, were 98% for the Training phase and 92% for the Validation phase, with some categories presenting better prediction results, such as classes 4 (100%) and 2 (85%). The testing phase, executed in about 1 hour, obtained an accuracy value of 78.26%, with a 95% confidence interval (63.64–89.05%) and a *kappa* of 70%. The applied methodology presented high accuracy, configuring itself as an important tool for identifying fish species in extremely diverse and remote environments.

Keywords: deep learning; morphology; cichlidae; characidae; iguanodectidae; FLONA de Carajás (PA)

check for updates

Citation: Nogueira, L.C.L.; Schroeder, R.; Sant'Ana, R.; Beaumord, A.C. Analysis of the Efficiency of the Taxonomic Identification of Small Fishes Using Artificial Neural Networks: A CASE Study of the Ichthyofauna of the Carajás Mountain (Pará—Northern Brazil). *Biol. Life Sci. Forum* **2022**, *13*, 102. https://doi.org/10.3390/blsf2022013102

Academic Editor: Alberto Teodorico Correia

Published: 16 June 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Author Contributions: Conceptualization, A.C.B. and R.S. (Rodrigo Sant'Ana); methodology, R.S. (Rodrigo Sant'Ana) and L.C.L.N.; formal analysis, R.S. (Rodrigo Sant'Ana) and L.C.L.N.; investigation, A.C.B., L.C.L.N., R.S. (Rodrigo Sant'Ana) and R.S. (Rafael Schroeder); resources, A.C.B.; data curation, A.C.B.; writing—original draft preparation, L.C.L.N.; writing—review and editing, A.C.B., L.C.L.N., R.S. (Rodrigo Sant'Ana) and R.S. (Rafael Schroeder); supervision, A.C.B. and R.S. (Rodrigo Sant'Ana); project administration, A.C.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.