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ORIGINAL PAPER

New tool to elucidate the diet of the ormer *Haliotis tuberculata* (L.): Digital shell color analysis

V. Marchais[1] · A. Jolivet[1,2] · S. Hervé[3] · S. Roussel[1] · B. R. Schöne[4] · J. Grall[5] · L. Chauvaud[1,6] · J. Clavier[1]

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Abstract Food sources of the European abalone *Haliotis tuberculata* throughout its life cycle are still to be clarified in nature. A novel non-destructive method of digital shell color analysis to reveal the diets of European abalone (ormer) was developed in this study. The method was calibrated using ormers reared under experimental conditions in North Western Brittany in 2012 and fed a controlled monospecific diet to define the shell hues associated with various macroalgae (i.e., Rhodophyta, Chlorophyta, and Phaeophyta). General food preferences were established by comparing the shell hue of wild adult ormers and experimental adult ormers. Shell hue corresponds to the color tint in the HSL color space measured on digital pictures of the shell. Experimentally, shell hue values differed according to treatment, with the most yellow-green hue (72°) for ormers fed *Saccharina* sp. and the coral hue (25°) for ormers fed *Palmaria palmata*. High variation in shell color of wild ormers was observed according to the sampling site and/or ontogeny. The diet of wild ormers may be related to the abundance of different drifting algae in their respective habitats. Thus, this non-destructive and easy-to-use technique appears to be a promising tool for determining the diet of *Haliotis* species and, perhaps, other herbivorous mollusks.

Keywords Numerical color · Shell hue · HSL color space · Abalone · Food sources · Experiment

Introduction

The diets of herbivorous marine animals are not easily determined, because observations of feeding in nature are very difficult. Gut content analyses are subject to severe biases due to differential rates of digestion and loss of identifiable characteristics of algae in guts (Day and Cook 1995) and reveal only the last meal. Stable isotope analysis requires the knowledge of isotopic fractionation between sources and the consumer which vary between species, with the quantity of food or the growth rate (Vander Zanden and Rasmussen

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✉ V. Marchais
vmarchais@gmail.com

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR), UMR 6539 UBO, CNRS, IRD, IFREMER, Institut Universitaire Européen de la Mer (IUEM), rue Dumont d'Urville, 29280 Plouzané, France

[2] TBM Environnement/ Somme, Technopole Brest Iroise, 115 rue Claude Chappe, 29280 Plouzané, France

[3] Institut Universitaire Européen de la Mer (IUEM), University of Brest, UMS 3113, rue Dumont d'Urville, 29280 Plouzané, France

[4] Institute of Geosciences, University of Mainz, Johann-Joachim-Becherweg 21, 55128 Mainz, Germany

[5] Observatoire des Sciences de l'Univers, UMS 3113, Institut Universitaire Européen de la Mer (IUEM), rue Dumont d'Urville, 29280 Plouzané, France

[6] BeBEST Laboratoire International Associé, rue Dumont d'Urville, 29280 Plouzané, France

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