H2020-MSCA-ITN
Bringing marine ecology into 21st century

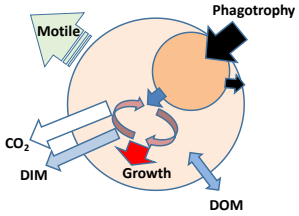
MIXOTROPH.ORG
MIXITIN

Training next generation marine ecologists in the mixotroph paradigm

Summer 2018 Newsletter: Meet the Mixotrophs!

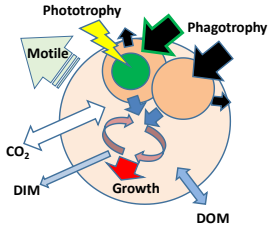
Traditionally, marine eukaryote microplankton (protists) were considered to be either "phytoplankton" or microzooplankton". In evolutionary terms, "microzooplankton" (which eat) came first, while protist "phytoplankton" (which cannot eat, but only photosynthesize) evolved last. Mixotrophs can both eat and photosynthesise, in one cell. Dismissed as of minor consequence by mainstream marine science for over a century, we now know that most "phytoplankton" and 50% of the "microzooplankton" in the upper ocean are mixotrophic.

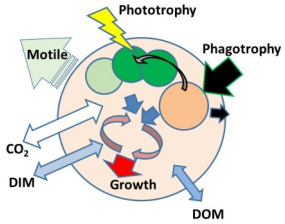
However, there are more differences between mixotroph types than there are between "phytoplankton" and "microzooplankton". **Below, we show the differences between these organisms.**



Microzooplankton are heterotrophic protists, gaining energy and nutrition primarily via eating (i.e., phagotrophy). They are motile, hunting and selecting different prey types. They release CO_2 and dissolved inorganic materials (DIM). They may use, as well as release, dissolved organic matter (DOM). They also release a portion of undigested prey (outward black arrow).

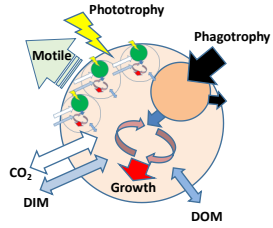
General Non-Constitutive Mixotrophs (GNCM) are basically microzooplankton that can also gain energy and limited nutrition via phototrophy using photosystems (plastids) acquired from their phototrophic prey. Using these plastids they can use (fix) CO_2 and less DIM is released. However, they cannot maintain these plastids, so they need to top-up frequently. Fortunately, they can acquire plastids from many prey species.

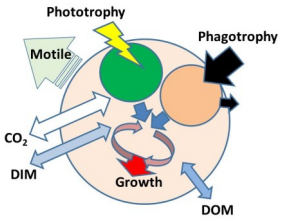




plastidic Specialised Non-Constitutive Mixotrophs (pSNCM) represent an enhancement over GNCMs, in that these organisms can maintain, and to some extent control, the plastids acquired from their phototrophic prey. They thus do not need to top-up with new plastids frequently. However, they can only perform this trick using plastids from a few prey species, so they must find the correct phototrophic prey.

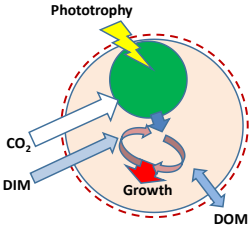
endosymbiotic Specialist Non-Constitutive Mixotrophs (eSNCM) represent an alternate to **pSNCM**s which sees the entire phototrophic prey held within the protist cell as endosymbionts. The prey grow and multiply within the host, making use of nutrients (DIM) taken up from the sea water &/or released by the host during prey digestion, plus their own phototrophy. The host gains from DOM released by the symbionts, plus they could consume their phototrophic symbionts.





Constitutive Mixotrophs (CM) represent an enhancement over pSNCM, in that these organisms possess a constitutive ability to make their own plastids to perform photosynthesis. CMs can thus mix and match phagotrophy and phototrophy, as they require, to balance their needs for energy and nutrients. This is the configuration usually considered as the archetypal plankton mixotroph.

Phytoplankton are only well represented within the protist plankton by the diatoms. Diatoms have lost the ability to feed via phagocytosis. They cannot swim (though some can alter their buoyancy). They have a rigid cell wall made of silicate, which may help protect them from grazers but also enables them to be more vacuolated than normal protists, thus needing less nutrient to support cell division for a given cell size.



Website: www.mixotroph.org Email: mixotroph@swansea.ac.uk Follow us on Twitter @mixotrophs Like us on Facebook

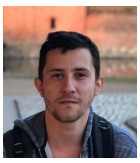
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 766327.

H2020-MSCA-ITN
Bringing marine ecology into 21st century

MIXOTROPH.ORG
MIXITIN

Training next generation marine ecologists in the mixotroph paradigm

Summer 2018 Newsletter: Meet the ESRs!



ESR1 Konstantinos Anestis My BSc is from Aristoteleio Panepistimio Thessalonikis (Greece) and MSc from Università degli studi di Napoli Federico II (Italy). I work at Alfred-Wegener-Institut (Germany), on *Functional and comparative genomics to study regulatory and metabolic processes in mixotrophs*.

ESR2 Nikola Medic My BSc is from Sveučilište Jurja Dobrile (Croatia) and MSc from Prirodoslovno matematički fakultet, Sveučilište u Zagrebu (Croatia). I am working at København Universitet (Denmark), studying *Ecophysiology of key species of constitutive mixotrophs including those contributing to harmful algal blooms (HABs)*.

ESR3 Guilherme Ferreira My BSc and MSc are from the Escola Superior de Turismo e Tecnologia do Mar, Instituto Politécnico de Leiria (Portugal). I work at Consejo Superior de Investigaciones Científicas (CSIC-ICM, Spain), on *Top down control of marine protists by mixotrophs*.

ESR4 Joost Mansour I studied at University of Amsterdam (The Netherlands) and Penn State University (USA). I work at Station de Biologique de Roscoff (France) on *Oceanic Greenhouses*, the endosymbiotic non-constitutive mixotrophic Radiolaria and Acantheria.

ESR5 Filomena Romano I studied at Università degli studi di Napoli Federico II (Italy). I now work at the Hellenic Centre for Marine Research (Crete, Greece), studying *Ciliate mixotrophy in the ultra-oligotrophic Eastern Mediterranean*.

ESR6 Andreas Norlin My BSc and MSc are from Københavns Universitet (Denmark). I now work at Swansea University (UK), studying mixotrophs that harbour intact symbionts, *Life in planktonic greenhouses; a systems dynamics approach*.

ESR7 Maira Maselli I did my BSc and MSc at Università degli studi di Napoli Federico II (Italy). I am now working at Københavns Universitet (Denmark), studying *Ecophysiology of key species of general non-constitutive mixotrophs (GNCMs)*.

ESR8 Anna Anschuetz I have a BSc from Kiel University (Germany) and my MSc from GEOMAR - Helmholtz Centre for Ocean Research Kiel (Germany). I am now working at Swansea University (UK) on *Trophodynamics of the cryptophyte-Mesodinium-Dinophysis complex*.

ESR9 Claudia Traboni I studied for my BSc and MSc degrees at Università degli studi di Napoli Federico II (Italy). I am currently working at Consejo Superior de Investigaciones Científicas (CSIC-ICM, Spain), investigating *Interactions between mixotrophs and their predators*.

ESR10 Jon Lapeyra I did my BSc at UPV/EHU & Universidad de Valparaiso (Chile) and then my MSc under the ERASMUS MUNDUS programme. I work at Unviersité Libre de Bruxelles (Belgium) on *The role of mixotrophy in ecosystem dynamics*.

ESR11 Lisa Schneider I studied in Germany at University of Hamburg and Technical University Dresden. I am now working at Deltares (Netherlands), where I am studying *Coastal water management under the mixotrophic plankton paradigm.*

Website: www.mixotroph.org Email: mixotroph@swansea.ac.uk Follow us on Twitter @mixotrophs Like us on Facebook

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 766327.

This document reflects only the author's view; the REA and the European Commission are not responsible for any use that may be made of the information it contains.