

# Glaucus Study II: locality data, GenBank and museum voucher numbers, with molecular synapomorphies from a global sample set (Neuston Phylogeny project)

**Website:** <https://www.bco-dmo.org/dataset/505436>

**Version:** 2014-02-21

## Project

» [Community Phylogeny and Global Phylogeography of the Neuston](#) (Neuston Phylogeny)

Contributors	Affiliation	Role
<a href="#">O'Foighil, Diarmaid</a>	University of Michigan	Principal Investigator
<a href="#">Copley, Nancy</a>	Woods Hole Oceanographic Institution (WHOI)	BCO-DMO Data Manager

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## Dataset Description

These samples are part of a study that suggests the premise that continents like Europe and the Americas cause barriers to gene flow for the nudibranchs found in the uppermost layer (neuston) of the ocean. The nudibranch *Glaucus atlanticus*, found in all oceans, was studied to assess the genetic differentiation of multiple specimens from a global sampling effort.

This dataset contains molecular diagnostic traits (synapomorphies) for *Glaucus atlanticus* and *Glaucus marginatus* morphospecies in mitochondrial 16S rRNA and COI obtained with CAOS-analyzer. Both the position in the alignments and the base letter are included. Only diagnostics with values of 1.00 are included (pure diagnostics). Note that Churchill et al. (2013) were unsuccessful in obtaining mt COI genotypes for *Glaucus bennettiae* sp. nov. [Appendix I, from....????]

## Methods & Sampling

*Glaucus atlanticus* specimens were collected between 2006 and 2012 either from the beach or in the open ocean from neuston tows. The specimens were then preserved in 95% ethanol and identified. Where possible, 15 - 20 individuals were chosen from each ocean gyre for genetic analysis. Genomic DNA was extracted and mitochondrial cytochrome oxidase I (COI) was amplified using the universal primers LCO1490 and HCO2198 using the general PCR protocol. Details of the extraction, amplification and analyses can be found in the methods section of the Churchill (2014).

## Data Processing Description

See [reference?] for methodology.

## Relevant References:

Celia K. C. Churchill, Ángel Valdés and Diarmaid Ó Foighil (2014) Afro-Eurasia and the Americas present barriers to gene flow for the cosmopolitan neustonic nudibranch *Glaucus atlanticus*. Marine Biology DOI 10.1007/s00227-014-2389-7.

Celia K. C. Churchill, Alvin Alejandrino, A'ngel Valde's and Diarmaid O' Foighil (2013) Parallel changes in genital morphology delineate cryptic diversification of planktonic nudibranchs. Proc R Soc B:280: 20131224. <http://dx.doi.org/10.1098/rspb.2013.1224>.

Celia K. C. Churchill, Ellen E. Strong and Diarmaid O' Foighil (2011) Hitchhiking juveniles in the rare neustonic gastropod *Recluzia* cf. *jehennei* (Janthinidae). Journal of Molluscan Studies (2011) 0: 1-4.  
doi:10.1093/mollus/eyr020

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## Data Files

File
<b>Glaucus_bases.csv</b> (Comma Separated Values (.csv), 9.27 KB) MD5:599c30a2554653803f48170d45e4beb4 Primary data file for dataset ID 505436

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## Parameters

Parameter	Description	Units
species	species of nudibranch <i>Glaucus</i>	unitless
marker	genetic component analysed	unitless
position	position of sequence alignments	unitless
base	genetic base letter: A=adenine; T=thymine; C=cytosine; G=guanine	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	Automated Sequencer
<b>Generic Instrument Name</b>	Automated DNA Sequencer
<b>Dataset-specific Description</b>	ABI 3730xl (Applied Biosystems, Inc.)
<b>Generic Instrument Description</b>	General term for a laboratory instrument used for deciphering the order of bases in a strand of DNA. Sanger sequencers detect fluorescence from different dyes that are used to identify the A, C, G, and T extension reactions. Contemporary or Pyrosequencer methods are based on detecting the activity of DNA polymerase (a DNA synthesizing enzyme) with another chemoluminescent enzyme. Essentially, the method allows sequencing of a single strand of DNA by synthesizing the complementary strand along it, one base pair at a time, and detecting which base was actually added at each step.

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## Deployments

### OFoighil\_2014

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/505320">https://www.bco-dmo.org/deployment/505320</a>
<b>Platform</b>	OFoighil_2014
<b>Description</b>	Mollusc genetic analyses from globally collected samples.

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## Project Information

### Community Phylogeny and Global Phylogeography of the Neuston (Neuston Phylogeny)

**Coverage:** 5 subtropical gyre systems: North Atlantic, South Atlantic, North Pacific, South Pacific, Indian Ocean.

Abstract:

This project aims to construct the first marine community phylogeny. It is inspired by the integrative perspective that lies at the core of the modern concept of biodiversity. Empirical realization of this integration requires that study systems be simple enough to be tractable, yet (ideally) contain compelling ecological and evolutionary phenomena. The target marine community, the neuston, embodies these characteristics to an exceptional degree. It consists of a relatively small number of interacting species that drift at the water/atmosphere interface of the planet's subtropical gyres (40% of oceanic surface area) and play an important role in open-ocean epipelagic food webs. The ecological base of the neuston community is an endosymbiosis involving chondrophore cnidarian hosts (Porpitidae) and their dinoflagellate photosymbionts. Chondrophores are preyed upon by a variety of predators, chief among them two lineages of highly specialized gastropods (Janthinidae and Glaucinae). This prominent open ocean community has been poorly studied, apart from its resident insect genus Halobates. The investigator aims to complete a combined phylogeny/phylogeography of neuston taxa across three trophic levels (photosymbionts, chondrophore hosts, predatory gastropods) and all 5 subtropical gyre systems. The two main goals of the community phylogeny section are to determine the evolutionary origins of the photosymbiosis, and to establish the benthic sister lineages of both gastropod lineages in order to identify the synapomorphic changes associated with ancestral ecological transitions from benthos to neuston. The primary aims of the phylogeographic section are to

establish the spatial scale of speciation for the target neustonic taxa, and to test three hypotheses of within-species genetic structuring: global panmixis; ocean basin panmixis; within gyre panmixis. The investigator has developed a multi-faceted sampling strategy that involves ichthyoplankton research colleagues in multiple gyres systems, the bi-coastal, ocean-going ships and students of the Woods Hole Semester at Sea program, national and international museum collections, and an informal network of colleagues worldwide that will sample spontaneous neuston stranding event. He has also established collaborative relationships with colleagues expert in cnidarian, nudibranch, caenogastropod and epitoniid diversity, who will work closely with him on their respective groups within the neuston and, for gastropods, also within benthic sister lineages. To-date, preliminary samples from 3 of the 5 gyres have yielded results that not only demonstrate the feasibility of the primary project goals, but also provide exciting initial insights into the generality of the photosymbiotic association, the putative benthic sister lineages of neustonic gastropods, the likely presence of cryptic species complexes, and the divergent patterns of among-gyre and among-basin genetic structuring exhibited by sister taxa.

This project has an unusually extensive student outreach component in the form of the >100 Sea Education Association (SEA) undergraduates and high school students that will participate in multiple upcoming SSV Seamans & SSV Cramer cruises and who will collect neuston taxa. The investigator will provide detailed electronic feedback to the SEA courses, in the field, so that students will be able to connect the organisms they collect with the biogeographic and evolutionary hypotheses being testing, and to determine for themselves which hypotheses the available data reject, or corroborate. One graduate and three undergraduate UM students will receive in-depth training during this project. The graduate student, Celia Churchill, has participated in offshore neuston sampling, generated much of the preliminary data, and recently presented at her first scientific meeting. She will work/train with the P.I., and also with 4 expert collaborators, directly in their laboratories for 2 of them. One UM undergraduate student has already worked directly on this project and the investigator will recruit at least two more. Substantial international outreach and collaborative activities are planned across research specialties, especially involving ichthyoplankton colleagues working in different gyre systems, as well as international museum colleagues. This study promises to significantly enhance background knowledge of the vast subtropical gyre surface ecosystem, now heavily impacted, even in mid-ocean, by the incremental accumulation of non-biodegradable, plastic flotsam. This is a major new marine conservation issue that is just now entering public discourse, e.g., see recent descriptions of the North Pacific's Giant Garbage Patch in the popular press.

## **PUBLICATIONS PRODUCED AS A RESULT OF THIS RESEARCH**

Ó Foighil, D; Lee, T; Slapcinsky, J. "Prehistoric anthropogenic introduction of partulid tree snails in Papua New Guinean archipelagos," JOURNAL OF BIOGEOGRAPHY, v.38, 2011, p. 1625. View record at Web of Science

Churchill, CKC; Ó Foighil, D; Strong, EE; Gittenberger, A. "Females floated first in bubble-rafting snails," CURRENT BIOLOGY, v.21, 2011, p. R802. View record at Web of Science

Churchill, CKC; Strong, EE; Ó Foighil, D. "Hitchhiking Juveniles in the Rare Neustonic Gastropod *Recluzia* Cf. *Jehennei* (Janthinidae)," Journal Of Molluscan Studies, v.77, 2011, p. 441. View record at Web of Science

Ó Foighil, D; Li, JC; Lee, T; Johnson, P; Evans, R; Burch, JB. "Conservation Genetics of a Critically Endangered Limpet Genus and Rediscovery of an Extinct Species," PLOS ONE, v.6, 2011. View record at Web of Science

## **Focal Publications**

Churchill, C.K., Valdés, Á. Ó Foighil, D. 2014. Afro-Eurasia and the Americas present barriers to gene flow for the cosmopolitan neustonic nudibranch *Glaucus atlanticus*. Marine Biology, In Press.

Churchill, C.K., Valdés, Á. Ó Foighil, D. 2014. Molecular and morphological systematics of neustonic nudibranchs (Mollusca, Gastropoda, Glaucidae, *Glaucus*) with descriptions of three new cryptic species. In Press, Invertebrate Systematics.

Churchill, C.K., Alejandrino, A., Valdés, Á. Ó Foighil, D. 2013. Parallel changes in genital morphology delineate cryptic diversification of planktonic nudibranchs. Proceedings of the Royal Society B. 280:20131224. <http://dx.doi.org/10.1098/rspb.2013.1224>

Exemplar media coverage: [www.earthtimes.org/nature/glaucus-twin/2394/](http://www.earthtimes.org/nature/glaucus-twin/2394/)

Churchill, C.K. and Ó Foighil, D. 2013. Bubble rafting snails. McGraw-Hill Yearbook of Science and Technology 2013, pp. 56-58.

Churchill, C.K., Ó Foighil, D., Strong, E.E. and Gittenberger, A. 2011. Females floated first in bubble-rafting

snails. *Current Biology*. [21: R802-R803](#). Featured on the [journal cover](#), in [Science](#) and in multiple online media outlets, e.g., [http://www.msnbc.msn.com/id/44849146/ns/technology\\_and\\_science-science/#.UPMcqY5\\_dsR](http://www.msnbc.msn.com/id/44849146/ns/technology_and_science-science/#.UPMcqY5_dsR)

Churchill C.K., Strong, E.E. and Ó Foighil, D. 2011. Hitchhiking juveniles in the rare neustonic gastropod *Recluzia* cf. *jehennei* (Janthinidae). *Journal of Molluscan Studies*. [77:441-444](#).

### Non-Focal publications

Li, J., Ó Foighil, D. & Park, J.K. 2013. Triton's trident: cryptic Neogene divergences in a marine clam (*Lasaea australis*) correspond to Australia's three temperate biogeographic provinces. *Molecular Ecology* 22:1933-1946.

<http://onlinelibrary.wiley.com/doi/10.1111/mec.12220/full>

Exemplar media: <http://phys.org/news/2013-03-cryptic-clams-biologists-species-plain.html>

Scott, P.V., Ó Foighil, D. & Li, J. 2013. Where's Waldo? A new commensal species, *Waldo arthuri* (Mollusca: Bivalvia: Galeommatidae), from the Northeastern Pacific Ocean. *Zookeys*, 316:67-80.  
[www.pensoft.net/journals/zookeys/article/4256](http://www.pensoft.net/journals/zookeys/article/4256)

Exemplar media coverage: <http://www.sciencedaily.com/releases/2013/07/130716120022.htm>

<http://www.foxnews.com/science/2013/07/20/heres-waldo-strange-new-alien-like-clam-species-found/>

Miura, O., Köhler, F., Lee, T., Li, J. & Ó Foighil, D. 2013. Rare, divergent Korean *Semisulcospira* spp. mitochondrial haplotypes have Japanese sister lineages. *Journal of Molluscan Studies*, 79:86-89.  
<http://mollus.oxfordjournals.org/content/79/1/86.full.pdf+html>

Li, J., Ó Foighil, D. & Middelfart, P. 2012. The evolutionary ecology of biotic association in a megadiverse bivalve superfamily: sponsorship required for permanent residency in sediment. *PLoS ONE*, [7\(8\): e42121](#). Featured in multiple online media outlets, e.g., <http://www.sciencedaily.com/releases/2012/08/120809090308.htm>

Li, J. and Ó Foighil, D. 2012. Host-specific morphologies but no host races in the commensal bivalve *Neaeromya rugifera*. *Invertebrate Biology*, [131:197-203](#).

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### Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0850625</a>

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