

Series 3B: Supplemental experiments on *Thalassiosira pseudonana* (CCMP1014) cultures determining the optimal aquapen actinic light pulse (A-pulse) setting: computed values including min and max fluorescence

Website: <https://www.bco-dmo.org/dataset/748978>

Data Type: experimental

Version: 1

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Project

» [Collaborative Research: Effects of multiple stressors on Marine Phytoplankton](#) (Stressors on Marine Phytoplankton)

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Abstract

Series 3B: Supplemental experiments on *Thalassiosira pseudonana* (CCMP1014) cultures determining the optimal aquapen actinic light pulse (A-pulse) setting for NPQ1 protocols of the AquaPen for assessment of non-photochemical quenching in *Thalassiosira pseudonana* CCMP 1014 cultures grown at different light environments. Computed values include min and max fluorescence in dark-adapted state, quantum yield of the Photosystem II, non-photochemical chlorophyll fluorescence quenching and the coefficient of photochemical quenching (an estimate of open PSII reaction centers during these corresponding measurements).

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Coverage

Temporal Extent: 2018-07-03 - 2018-07-06

Dataset Description

Experiments were conducted to determine the optimal actinic light pulse (A-pulse) setting for NPQ1 protocols of the AquaPen for assessment of non-photochemical quenching in *Thalassiosira pseudonana* CCMP 1014 cultures grown at different light environments.

Computed values include min and max fluorescence in dark-adapted state, quantum yield of the Photosystem

II, non-photochemical chlorophyll fluorescence quenching and the coefficient of photochemical quenching (an estimate of open PSII reaction centers during these corresponding measurements).

Methods & Sampling

Experiments were conducted in the lab at the University of California Santa Barbara to determine the optimal actinic light pulse (A-pulse) setting for NPQ1 protocols of the AquaPen for assessment of non-photochemical quenching in *Thalassiosira pseudonana* CCMP 1014 cultures grown at different light environments. TP1014 stock cultures were maintained in artificial sea water (Kester et. al 1967), enriched as with f/2 media (Guillard 1975). For the experiment, 5 ml of the TP1014 stock cultures was inoculated into 75 ml of ASW in four tubes. The tubes were incubated in a Multicultivator MC-1000 OD unit (Qubit Systems), at 25°C and light intensities of 200, 400, 600 and 800 $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$ respectively, set at a 12:12 day:night cycle for four days. All samples were bubbled with air at 60 $\text{ml}\cdot\text{min}^{-1}$ through a 0.2 μm stainless steel carbonating stones. Samples were collected from each tube after three days and analyzed used for assessment of photochemistry using the Aquapen-C AP-C 100 (Photon Systems Instruments). Three ml samples were placed in the dark at 25°C for a minimum of 30 minutes prior to measuring photochemistry. The NPQ1 protocol on the instrument was used for assessment of non-photochemical quenching in samples. The NPQ1 protocol administers 5 light pulses over 60 seconds during actinic light exposure, followed by 3 light pulses over 88 seconds during recovery in the dark. Blue light (455 nm) was used as actinic light in these experiments. Baseline measurements were made at f-pulse settings of 0.03 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, Saturating pulses were set at 2100 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, and actinic light pulses (for the NPQ1 protocol only) were set at 100, 200, 300, 400, 500, 600, 700, and 800 $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$ respectively for each sample.

Data Processing Description

BCO-DMO Processing Notes:

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
3B_Apulse_test_computed_trans.csv (Comma Separated Values (.csv), 6.26 KB) MD5:ec828ab1b1179e14f6f29baf333f26dc
Primary data file for dataset ID 748978

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Related Publications

Guillard, R. R. L. (1975). Culture of Phytoplankton for Feeding Marine Invertebrates. Culture of Marine Invertebrate Animals, 29–60. doi:[10.1007/978-1-4615-8714-9_3](https://doi.org/10.1007/978-1-4615-8714-9_3)
Methods

Kester, D. R., Duedall, I. W., Connors, D. N., & Pytkowicz, R. M. (1967). Preparation of Artificial Seawater 1. Limnology and Oceanography, 12(1), 176–179. doi:[10.4319/lo.1967.12.1.0176](https://doi.org/10.4319/lo.1967.12.1.0176)
Methods

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Parameters

Parameter	Description	Units
treatment	treatment identifier of <i>T.pseudonana</i> ; formatted as Tn_Apm where 'n' is light intensity during the culture growth in micromole photons/meter ² /second and a A-pulse setting of 'm' in micromol photons/meter ² /second	unitless
Fo	minimum fluorescence in dark-adapted state.	RFU (Relative Fluorescence Units)
Fm	the maximum fluorescence in dark-adapted state; measured during the first saturation flash after dark adaptation	RFU (Relative Fluorescence Units)
Fp	the fluorescence in the peak of fast Kautsky induction	RFU (Relative Fluorescence Units)
Fm_L1	The first measurement of the maximum fluorescence following exposure to actinic light for 7 seconds (L1 indicates the first measurement in the "light" phase)	RFU (Relative Fluorescence Units)
Fm_L2	The second measurement of the maximum fluorescence following exposure to actinic light for another 12 seconds (L2 indicates the second measurement in the "light" phase)	RFU (Relative Fluorescence Units)
Fm_L3	The third measurement of the maximum fluorescence following exposure to actinic light for another 12 seconds (L3 indicates the third measurement in the "light" phase)	RFU (Relative Fluorescence Units)
Fm_L4	The fourth measurement of the maximum fluorescence following exposure to actinic light for another 12 seconds (L4 indicates the fourth measurement in the "light" phase)	RFU (Relative Fluorescence Units)
Fm_Lss	The fifth measurement of the maximum fluorescence following exposure to actinic light for another 12 seconds (Lss indicates the fifth and final measurement in the "light" phase; represents a "steady state" or ss)	RFU (Relative Fluorescence Units)
NPQ_L1	The first measurement of the non photochemical chlorophyll fluorescence quenching following exposure to actinic light for 7 seconds (L1 indicates the first measurement in the "light" phase)	unitless
NPQ_L2	The second measurement of the non photochemical chlorophyll fluorescence quenching following exposure to actinic light for another 12 seconds (L2 indicates the second measurement in the "light" phase)	unitless
NPQ_L3	The third measurement of the non photochemical chlorophyll fluorescence quenching following exposure to actinic light for another 12 seconds (L3 indicates the third measurement in the "light" phase)	unitless

NPQ_L4	The fourth measurement of the non photochemical chlorophyll fluorescence quenching following exposure to actinic light for another 12 seconds (L4 indicates the fourth measurement in the "light" phase)	unitless
NPQ_Lss	The fifth measurement of the non photochemical chlorophyll fluorescence quenching following exposure to actinic light for another 12 seconds (Lss indicates the fifth and final measurement in the "light" phase; represents a "steady state" or ss)	unitless
NPQ_D1	The first measurement of the non photochemical chlorophyll fluorescence quenching 11 seconds into the dark or recovery phase (D1 indicates the first measurement in the "dark" phase)	unitless
NPQ_D2	The second measurement of the non photochemical chlorophyll fluorescence quenching after another 26 seconds into the dark or recovery phase (D2 indicates the second measurement in the "dark" phase)	unitless
NPQ_D3	The third and final measurement of the non photochemical chlorophyll fluorescence quenching after another 26 seconds into the dark or recovery phase (D3 indicates the third and final measurement in the "dark" phase)	unitless
Qp_L1	The first measurement of the coefficient of photochemical quenching following exposure to actinic light for 7 seconds (L1 indicates the first measurement in the "light" phase)	unitless
Qp_L2	The second measurement of the coefficient of photochemical quenching following exposure to actinic light for another 12 seconds (L2 indicates the second measurement in the "light" phase)	unitless
Qp_L3	The third measurement of the coefficient of photochemical quenching following exposure to actinic light for another 12 seconds (L3 indicates the third measurement in the "light" phase)	unitless
Qp_L4	The fourth measurement of the coefficient of photochemical quenching following exposure to actinic light for another 12 seconds (L4 indicates the fourth measurement in the "light" phase)	unitless
Qp_Lss	The fifth measurement of the coefficient of photochemical quenching following exposure to actinic light for another 12 seconds (Lss indicates the fifth and final measurement in the "light" phase; represents a "steady state" or ss)	unitless
Qp_D1	The first measurement of the coefficient of photochemical quenching 11 seconds into the dark or recovery phase (D1 indicates the first measurement in the "dark" phase)	unitless

Qp_D2	The second measurement of the coefficient of photochemical quenching after another 26 seconds into the dark or recovery phase (D2 indicates the second measurement in the "dark" phase)	unitless
Qp_D3	The third and final measurement of the coefficient of photochemical quenching after another 26 seconds into the dark or recovery phase (D3 indicates the third and final measurement in the "dark" phase)	unitless
Rfd	the chlorophyll fluorescence decrease ratio	unitless
Fm_D1	The first measurement of the maximum fluorescence 11 seconds into the dark or recovery phase (D1 indicates the first measurement in the "dark" phase)	RFU (Relative Fluorescence Units)
Fm_D2	The second measurement of the maximum fluorescence after another 26 seconds into the dark or recovery phase (D2 indicates the second measurement in the "dark" phase)	RFU (Relative Fluorescence Units)
Fm_D3	The third and final measurement of the maximum fluorescence after another 26 seconds into the dark or recovery phase (D3 indicates the third and final measurement in the "dark" phase)	RFU (Relative Fluorescence Units)
QY_max	The maximum Quantum yield. A measure of the Photosystem II efficiency. In a dark-adapted sample this is equivalent to F_v/F_m . In a light-adapted sample it is equivalent to F_v'/F_m' .	unitless
QY_L1	The first measurement of the effective quantum yield of photosystem II following exposure to actinic light for 7 seconds (L1 indicates the first measurement in the "light" phase)	unitless
QY_L2	The second measurement of the effective quantum yield of photosystem II following exposure to actinic light for another 12 seconds (L2 indicates the second measurement in the "light" phase)	unitless
QY_L3	The third measurement of the effective quantum yield of photosystem II following exposure to actinic light for another 12 seconds (L3 indicates the third measurement in the "light" phase)	unitless
QY_L4	The fourth measurement of the effective quantum yield of photosystem II following exposure to actinic light for another 12 seconds (L4 indicates the fourth measurement in the "light" phase)	unitless
QY_Lss	The fifth measurement of the effective quantum yield of photosystem II following exposure to actinic light for another 12 seconds (Lss indicates the fifth and final measurement in the "light" phase; represents a "steady state" or ss)	unitless

QY_D1	The first measurement of the effective quantum yield of photosystem II 11 seconds into the dark or recovery phase (D1 indicates the first measurement in the "dark" phase)	unitless
QY_D2	The second measurement of the effective quantum yield of photosystem II after another 26 seconds into the dark or recovery phase (D2 indicates the second measurement in the "dark" phase)	unitless
QY_D3	The third and final measurement of the effective quantum yield of photosystem II after another 26 seconds into the dark or recovery phase (D3 indicates the third and final measurement in the "dark" phase)	unitless

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Instruments

Dataset-specific Instrument Name	Multicultivator MC-1000 OD (Qubit Systems)
Generic Instrument Name	Cell Cultivator
Dataset-specific Description	Used for incubation of TP1014 cultures.
Generic Instrument Description	An instrument used for the purpose of culturing small cells such as algae or bacteria. May provide temperature and light control and bubbled gas introduction.

Dataset-specific Instrument Name	Aquapen-C AP-C 100 (Photon Systems Instruments)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Used to measure fluorescence. A hand-held cuvette version of the FluorPen fluorometer equipped with a blue and red LED emitter. Blue excitation light (455 nm) is intended for chlorophyll excitation, i.e., for measuring chlorophyll fluorescence in algal cultures. Red-orange excitation light (620 nm) is intended for excitation through phycobilins and is suitable for measuring in cyanobacteria.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

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Project Information

Collaborative Research: Effects of multiple stressors on Marine Phytoplankton (Stressors on Marine Phytoplankton)

The overarching goal of this project is to develop a framework for understanding the response of phytoplankton to multiple environmental stresses. Marine phytoplankton, which are tiny algae, produce as much oxygen as terrestrial plants and provide food, directly or indirectly, to all marine animals. Their productivity is thus important both for global elemental cycles of oxygen and carbon, as well as for the productivity of the ocean. Globally the productivity of marine phytoplankton appears to be changing, but while we have some understanding of the response of phytoplankton to shifts in one environmental parameter at a time, like temperature, there is very little knowledge of their response to simultaneous changes in several parameters. Increased atmospheric carbon dioxide concentrations result in both ocean acidification and increased surface water temperatures. The latter in turn leads to greater ocean stratification and associated changes in light exposure and nutrient availability for the plankton. Recently it has become apparent that the response of phytoplankton to simultaneous changes in these growth parameters is not additive. For example, the effect of ocean acidification may be severe at one temperature-light combination and negligible at another. The researchers of this project will carry out experiments that will provide a theoretical understanding of the relevant interactions so that the impact of climate change on marine phytoplankton can be predicted in an informed way. This project will engage high schools students through training of a teacher and the development of a teaching unit. Undergraduate and graduate students will work directly on the research. A cartoon journalist will create a cartoon story on the research results to translate the findings to a broader general public audience.

Each phytoplankton species has the capability to acclimatize to changes in temperature, light, pCO₂, and nutrient availability - at least within a finite range. However, the response of phytoplankton to multiple simultaneous stressors is frequently complex, because the effects on physiological responses are interactive. To date, no datasets exist for even a single species that could fully test the assumptions and implications of existing models of phytoplankton acclimation to multiple environmental stressors. The investigators will combine modeling analysis with laboratory experiments to investigate the combined influences of changes in pCO₂, temperature, light, and nitrate availability on phytoplankton growth using cultures of open ocean and coastal diatom strains (*Thalassiosira pseudonana*) and an open ocean cyanobacteria species (*Synechococcus* sp.). The planned experiments represent ideal case studies of the complex and interactive effects of environmental conditions on organisms, and results will provide the basis for predictive modeling of the response of phytoplankton taxa to multiple environmental stresses.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538602

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