



# THE TERN TIDE

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## Ask the Expert

By Kate Mackey

*Question: Are studies underway to find out how climate change has affected plankton numbers and distribution, and therefore the food chain? Are there any discernible trends?*

*Answer: What a great question! This is a timely topic and yes, there are many scientists investigating the impacts of climate change on plankton communities around the globe, including the Mackey Lab.*

The term 'climate change' refers to a series of complex phenomena that can affect plankton in many different ways. Phytoplankton are microscopic algae that drift in the ocean. Although tiny, these microbes are a big deal! They produce about half of the oxygen on Earth's by recycling carbon dioxide via photosynthesis. They also serve as the initial food source for virtually all ocean creatures, being consumed by zooplankton, which in turn serve as food for larger animals. Thus, as the question implies, anything that disturbs the phytoplankton will very likely affect marine food chains and the ecosystem as a whole.

A central component of the human-caused climate change that our planet is currently experiencing is global warming, which is caused by emission of greenhouse gases (mainly carbon dioxide, but also methane and nitrous oxide) that people have introduced into the atmosphere since the Industrial Revolution. Due to its sheer mass and high ability to store heat, about 90% of the excess heat from global warming is stored in the ocean. This has resulted in a 0.85 °C increase in average sea surface temperature between 1880 and 2012. The heat also causes the water to expand, contributing to sea level rise.

The increase in sea surface temperatures (or SST for short) is expected to affect global phytoplankton distribution in at least two important ways: directly, through alterations to cellular metabolism/growth, and indirectly, via alterations to vertical mixing of ocean waters.

Our planet has distinct SST latitudinal zones with temperatures ranging from ~ 30 °C in tropical waters to ~

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## President's Tern

# Thank You to the Amigos Membership!

By Charles Falzon

Thank you to all our members who responded to our recent membership renewal drive. Your continued support by renewing your annual membership is so important to the Amigos de Bolsa Chica's four decades of success. We truly could not have done it without you and we cannot achieve much in the future without your support. Your membership renewal allows us to continue to face the many challenges and opportunities of the 21st century.

As we've discussed in the Tern Tide in the past, finding funding for continued maintenance of the full tidal basin is one of our most pressing priorities. Many of us remember what the Bolsa Chica was like prior to the full tidal basin, with only muted tidal areas. Returning to that is not an option – we all want to see this amazing restoration project continue to flourish and bring greater biodiversity to the Bolsa Chica for generations to come.

We are continuing to build on the success of FLOW, our citizen science program, by embarking on a new partnership with the Newport Bay Conservancy. Their interest in our plankton research ensures we can educate a new generation of young, inquisitive minds about the necessity of and connection between healthy

wetlands and healthy oceans. The miracles and joys of phytoplankton should not be underestimated.

We are also currently revising our wetland tour education materials to promote the variety of Next Generation Science Standards that are met through the Amigos' docent-led tours of the Bolsa Chica. The Amigos has offered tours of Bolsa Chica to schools since 1986, assisting educators in meeting their educational goals and needs. These necessary revisions ensure that educators of all grades can count on the Amigos de Bolsa Chica for years to come.

But none of this can be achieved without you—our members—support. Annual membership dues, along with our annual donation solicitation letter, cover much of the funding to keep the organization going: bus transportation for underserved schools, phones, printing, postage, insurance for volunteers and participants, and our two-person part-time staff, just to mention a few of the basic necessities for any organization or business. So thank you again, dear member. Your contributions large and small, are incredibly important and more appreciated than you may ever know.



## 2018 Coastal Cleanup

By Jennifer Robins

On Saturday, September 15, the Amigos de Bolsa Chica had 57 volunteers covering 3 miles along trails of the reserve and collecting 260 pounds of trash and recyclables. 1379 cigarette butts and a total of 345 plastic lids, straws, bottle caps, food containers, grocery bags, and pieces of plastic were collected. We used only buckets to collect trash – no plastic bags.

People who participated: employees of PIMCO, led by Matt Clark; Thomas Pfeifer's students from Segerstrom High School; Cub Scout Pack 1149 from Anaheim led by Jenna Davis; Amigos members Jim Robins, Thomas Pfeifer, Kim Dipasquale, Jennifer Robins; and friend of the wetlands, Marco Vivanti, who has been participating for over ten years.



Employees from PIMCO joined the Amigos for the Coastal Cleanup at the Bolsa Chica Ecological Reserve. Photo by Matt Clark.

# The Amigos Support Proposition 3

By Mateo Crow

On the statewide November ballot this fall you will be faced with Proposition 3, a water bond that funds watershed and water supply projects across the state, and we urge you to vote YES! Proposition 3 includes nearly \$4 billion in conservation funding and would provide much-needed funding to advance a plethora of both the state's natural resource objectives and our own goals for restoring and protecting the Bolsa Chica.

With a changing climate, more intense droughts, and increased demand on the state's water resources, Proposition 3 ensures that we not only care for our water as a supply issue, but invest in the health of the watersheds, ecosystems, and open spaces.

As part of this restoration funding Proposition 3 includes \$135 million to the State Coastal Conservancy for the protection and restoration of coastal watersheds, \$280 million for the protection and acquisition of waterfowl habitat, \$100 million for the Ocean Protection Council, as well as numerous other funds that could help fund our priorities. Financial support of this proportion doesn't come along every year and Proposition 3 will ensure that we have sufficient funding to achieve our biggest conservation priorities and that California continues to demonstrate the environmental leadership it is known for globally.

Supporters for Proposition 3 come from a broad array of sectors, including water districts, business, agriculture, local government, and over 95 conservation groups ranging from regional non-profits like us all the way to national groups like the Nature Conservancy and National Wildlife Federation, demonstrating the importance of healthy watersheds and clean water quality to all of us. Never before have we had a bond that provides this much funding for our state's watersheds while encouraging our water supply in a more sustainable direction.

Proposition 3 is not just desired but needed – funds from previous water bonds are almost completely allocated, and as the federal administration steps away from some its environmental funding programs, California must seize the moment to ensure we have sufficient conservation funding for the years to come.

Help us advance Amigos de Bolsa Chica's goals by spreading the word to vote YES ON 3 in November. For more information or to contact the campaign please visit their website, [www.waterbond.org](http://www.waterbond.org) and follow them on twitter @YesOnProp3, Instagram @YesOnProp3, and on Facebook.



California Water Bond 2018



*Segerstrom High School teacher Thomas Pfeifer's Environmental Studies students also participated with the Amigos in the Coastal Cleanup. Photos by Thomas Pfeifer.*



## *Ask the Expert continued from page 1*

-2 °C at the poles. In general, phytoplankton can maintain growth over a surprisingly wide range of temperatures, but every species has a unique optimum growth temperature. Some types of phytoplankton thrive in colder waters, while some like it hot! In this way, global SST is one of several environmental variables controlling the growth and distribution of diverse phytoplankton species. When SST change beyond the ideal range for the phytoplankton inhabiting a given region, the consumption and allocation of resources within their cells are affected. Proteins and other cellular molecules have to function in suboptimal conditions, and that reduces the efficiency of photosynthesis in converting carbon dioxide into organic carbon. In the long run, this reduces the amount of carbon that would otherwise be buried in the deep ocean, reinforcing global warming in what scientists call a “climate feedback”.

At the same time, increased SST prevents vertical mixing of the water column due to the difference in density between the warm surface water and cold, nutrient-rich deep water. Without adequate mixing, nutrients cannot reach the sunlit surface ocean where phytoplankton grow, and hence phytoplankton are starved for essential resources (nitrogen, phosphorus, and iron). Therefore, the integrated response of marine phytoplankton to increased SST will be a blend of both the direct temperature-induced changes to cellular biology and indirect changes of surface nutrient availability.

The importance of changes in SST to phytoplankton biology, as explained above, is unquestionable. However, the way in which these climate change-related factors have actually impacted marine plankton globally is still a topic of much interest within the scientific community. Some researchers think that the warming of SST has caused significant negative impacts to marine phytoplankton around the globe. For example, back in 2010, Boyce and collaborators published a study in the prestigious scientific journal *Nature* arguing that phytoplankton concentrations have declined in eight out of ten ocean regions at a global rate of ~1% of the global median per year. According to this estimate, the amount of phytoplankton around the globe today would be about half of what existed in the 1950's! These findings were

contested by a number of researchers, some of whom argued that phytoplankton abundance might have increased in certain regions as a response to higher SST, offsetting the losses at other sites.

This debate—a vital element of the peer review process, which maintains the integrity of the scientific method—continues, as new methods and analytical tools evolve. One of the most exciting areas of research within this field is the use of Earth System models to predict the changes in phytoplankton community structure in the next decades and centuries, as SST continues to rise globally. The Earth System approach views Earth's processes as intimately interconnected, and focuses on the ways that land, atmosphere, and ocean processes interact. Recent studies have shown that global warming and its consequent changes to ocean circulation will likely cause the geographic distribution of phytoplankton species to change. For example, in models of the North Atlantic Ocean, entire phytoplankton communities move in space in response to changing ocean conditions. It is possible that over the coming century, most but not all studied species could shift northeastward in the Atlantic, moving at a rate faster than previously estimated.

Finally, the capacity of phytoplankton to evolve and adapt to new environmental conditions will play a role in determining how they will fare as Earth's climate changes. Phytoplankton are able to reproduce both sexually, by exchanging gametes, and asexually, by cellular division in which they make identical copies of their cells. Cellular division can double the population size in a matter of hours to days, and it is this quick generation time that can facilitate rapid evolutionary adaptation by the phytoplankton. Many exciting laboratory experiments indicate that phytoplankton species have the capacity to evolve over a few years in response to single environmental factors such as changes in carbon dioxide concentration or temperature. The question now is, how will those results obtained from laboratory experiments of single factors on individual algae species translate to the much more complex real world ocean?

Our team and other scientists at the University of California in Irvine are currently studying the combined effects of higher temperatures and changing

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# FLOW Friday Special Presentations

By Jill Lemon

FLOW (Follow and Learn about the Ocean and Wetlands) has a constant need for volunteers to conduct citizen science. One part of what the Amigos citizen scientists do is collect a water sample from the ocean inlet at Bolsa Chica State Beach and at the footbridge in the Ecological Reserve each week. They send a sample to the California Department of Public Health as well as perform analysis and microscopy of the sample. Since phytoplankton are the basis of the aquatic food web and produce most of Earth's oxygen, the citizen scientists also pass along what they have learned about the ocean-wetland food web to visiting classes from middle schools, high schools and community colleges.

Citizen scientists, no matter their age, are just as inquisitive as the young people who participate in the program during the school year. Once a citizen scientist is hooked on identifying phytoplankton species, which is not unlike birding, they start to ask lots of questions. They want to know more about why a certain species is abundant, why another species is rare, why are some toxic, and how or if they work in concert to affect the planet as a whole. We are now happy to be able to have special presentations during regular FLOW meetings. Each week, after the sample from the inlet is collected and returned, an open discussion presentation is given.

These presentations, now a part of the ongoing training of citizen scientists, help both new and established volunteers have a deeper grasp of the importance of

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resource availability on phytoplankton communities using a combination of laboratory, field, and modelling approaches. Ultimately, we aim to predict how these changes will affect atmospheric carbon dioxide levels and marine food webs around the globe.

*Special thanks to my graduate students Johann Lopez and Joana Tavares for their collaboration on this article.*

Kate Mackey is an Assistant Professor of Earth System Science at the University of California, Irvine.

## FLOW Friday October Presentations:

OCT 5– Recent Case Studies of HAB's: Florida has been decimated by multiple simultaneous Harmful Algal Blooms. Can a similar situation happen in SoCal?

OCT 12 – Genus Focus: Dinophysis: This genus can be responsible for a HAB that causes Diarrhetic Shellfish Poisoning.

OCT 19– Sample Collection and Analysis: A run through of our procedures with a critical eye on methodology and insight to developing better lab techniques.

what they are doing. We'll be looking at more topics that interest our volunteers, such as phytoplankton's connection to the environment, toxins and their affects, lab procedures, and information on specific genus-types that inhabit Southern California. Training for the FLOW program is conducted at every Friday at the Bolsa Chica State Beach Visitor Center, and a schedule of dates and topics is posted on the Amigos website. Contact Jill at [flow@amigosdebolsachica.org](mailto:flow@amigosdebolsachica.org) if you are interested in volunteering with FLOW.

*FLOW Program Manager Jill Lemon demonstrates how phytoplankton is involved in cloud formation.*



# Julia Sayoko Tafel Memorial

By Shirley Dettloff

Julia Tafel was a life time member of the Amigos de Bolsa Chica and one of our earliest volunteers, along with her husband Ron Davis. Julia passed away peacefully on August 12, 2018. She is survived by her husband Ron, daughter Laura Savitz, and son Chris and grandchildren Jaime, Brandon and Megan.

Julia was born February 1, 1942 to Frank and Sachiko Hiosawa at Manzanar. After the war years, the family moved to Chicago Illinois and then returned to California (Beaumont) and eventually settling in Boyle Heights. Julia graduated with honors from Roosevelt High School and attended UCLA where she met her first husband. They married and Julia suspended her studies to raise her children. In 1972 the family moved to Seal Beach where Julia resumed her studies and received her Bachelor's degree with honors in mathematics from California State University, Long Beach along with a minor in German.

Along with the end of her first marriage Julia began her

career as an aerospace engineer working at McDonnell Douglas, Magnavox and Northrop Grumman. She met her future husband Ron while both were working at McDonnell Douglas. They married in 1996 and Julia retired from aerospace in 2002.

Julia and Ron loved to volunteer both at Manzanar National Historic site and the Bolsa Chica wetlands where we had the privilege of having Ron and Julia as our docents. Along with their volunteer activities they loved to travel. She and Ron visited 47 of the 50 states and traveled to five continents which included many trips to Germany and the rest of Europe.

Julia enjoyed reading everything from the classics to modern romance, but her true passion was her love of the arts and especially music. Whether this was singing in her church choir or sitting in the audience of an opera or the symphony, music was a pure joy. Julia will always be remembered as a life well lived. She will be missed.

## BCER Bridge Repairs, Closures This Fall

Starting Monday, September 17, repairs to the steel bridge that crosses the Outer Bolsa Bay from the north parking lot will begin. The bridge will be closed to everyone but the construction crew up through the first week in November, or later if there are weather delays. There will also be a temporary loss of six parking stalls on the end of the lot next to the interpretive panels and bridge ramp. Sanding and painting of the steel bridge is expected to take two months.

Once repairs of the steel bridge are completed in November, the bridge will be reopened to the public and the contractor will move to the south lot for repairs to the Bolsa Chica Ecological Reserve's other pedestrian bridge. The wood footbridge crossing Inner Bolsa Bay from the south parking lot is estimated to be closed to the public sometime in November and may not reopen until sometime in January, depending on the weather.. This is an estimate at this time and subject to change. As soon as the bridge is repaired, the south lot will be repainted and handicapped stalls repaired. These projects must be completed before March 15, 2019.

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**Amigos de Bolsa Chica**  
P. O. Box 1563  
Huntington Beach, CA 92647

(714) 840-1575 (Phone/Fax)  
www.amigosdebolsachica.org  
info@amigosdebolsachica.org

**Editor & Graphic Design:**  
Thomas Anderson

**President:** Charles Falzon  
**Vice President:** Daryth Morrissey  
**Secretary:** Shirley Dettloff  
**Treasurer:** Brian Westcott

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### First Saturday of the Month Tour

Free tours of the Bolsa Chica Ecological Reserve led by Amigos docents.  
9:00 a.m. to 10:30 a.m.

### Last Saturday of the Month Bird Walk

Free bird walk led by Amigos docents. 9:00 am.  
Reservations are encouraged,  
714-840-1575

**Free monthly tours are on a first come, first served basis. Carpooling is encouraged as parking at the Bolsa Chica Ecological Reserve is limited. All tours begin at the south parking lot, PCH between Warner Ave. and Seapoint St.**

# Tiger Woods International STEM Studio

By Daryth Morrissey

It's all about connections! On Saturday, July 21, the Amigos de Bolsa Chica hosted 16 International teachers who were participating in the Tiger Woods International STEM Studio. The 16 countries represented: Ghana, Cuba, Panama, Nigeria, South Africa, Lithuania, Romania, Ukraine, Philippines, Turkmenistan, and Austria. Dr. Kathy Bihr, current Executive Director of the Tiger Woods Learning Center has had a long standing relationship with two Amigos; Jerry Donahue, former President, and Daryth Morrissey, current Vice President. Jerry is a former science teacher and Daryth is a current science/marine biology teacher at Vista View Middle School where Dr. Bihr served as principal. Dr. Bihr was looking for a local “best practices in STEM” field trip opportunity for the teachers and made the call to the Amigos!

Participants started with a tour of the Bolsa Chica Ecological Reserve, which included bird identification and participated in a plankton collection. They then went across the Coast Highway to the Bolsa Chica Visitor Center to participate in the FLOW program—plankton races, water quality analysis and microscopy—as well as see the “Saving the Bolsa Chica Wetlands” film and meet Charles Falzon, current Amigos President and one of the original founding members of the Amigos de Bolsa Chica.

We hope that the experience, as well as the love and passion for the Bolsa Chica will translate into several best practices lessons they can share with their worldwide students!

*Teachers from around the world get the full Amigos experience. Clockwise from left: a wetland tour and birdwatching; plankton collection; plankton races; and water quality analysis and microscopy. Photos by Thomas Anderson.*





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www.amigosdebolsachica.org

info@amigosdebolsachica.org

(714) 840-1575

**AMIGOS DE BOLSA CHICA MEMBERSHIP APPLICATION**

I support the specific and primary purpose of Amigos de Bolsa Chica, which is to advocate the preservation, restoration and maintenance of the Bolsa Chica, to encourage the public acquisition of all the wetlands and sufficient surrounding open space to create a viable ecosystem, and to provide education about the importance of wetlands.

**ANNUAL DUES**

\$ 10 Student

\$ 25 Individual

\$ 40 Family

\$100 Sustaining

\$1000 Life Member

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_ Zip: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_

**Additional Contribution:**

\$ \_\_\_\_\_ Fund operational expenses    \$ \_\_\_\_\_ Fund education projects    \$ \_\_\_\_\_ Total enclosed

**Please check if you are interested in volunteering for:**

FLOW Citizen Science  Docent training/wetland tours  Wetlands cleanups  Fundraising  Grantwriting

All contributions to Amigos de Bolsa Chica are tax-deductible as allowed by law under IRS Code Section 501(c)3.

No goods or services were provided in consideration of this gift.

Return application to: Amigos de Bolsa Chica, P.O. Box 1563, Huntington Beach, CA 92647