Sea Grant California

Sea Grant News

SEPTEMBER 2008

Coastal Science Serving California

NEW INVASIVE ON DOCKS!

Christina S. Johnson

A nonnative botryllid species, matching the genotype of a sea squirt in Australia, has infested San Diego Bay. Its species name is unknown and will require genotyping to determine. Sea Grant biologist Sarah Cohen holds the new invasive.

SAN DIEGO – The scientist lies flat on her belly and peers over the edge of the public fishing pier on Shelter Island in San Diego Bay, looking at the veritable garden of fouling organisms along its side.

"It really is striking that *it* is on this pier," says San Francisco State University professor Sarah Cohen. "Come and have a look. It is really quite beautiful."

"It" looks like a soggy lichen or a swatch of frog skin and has a scientific name about as pretty: botryllid tunicate.

But not to Cohen, a marine biologist at SFSU's Romberg Tiburon Center.

"Tunicates are glorious," Cohen croons. "They may look like a bag of water, but we share a lot of evolutionary history with them," she explains, her hair still wet from the last sampling. Tunicates, though gelatinous water bags as adults, are born with a primitive notochord and classified in the phylum Chordata, same as us.

California Sea Grant is funding Cohen and Gregory Ruiz at the Smithsonian Environmental Research Center in Edgewater, Md., to study the botryllid, known commonly as a sea squirt, not because of its remarkable placement on the evolutionary tree, but because the species at the pier is a new aquatic invasive, from Sydney, Australia, no less.

It is hoped that the early injection of funds to map its statewide distribution and genetic diversity will prevent a costly control effort later. According to Cornell University ecologist David Pimentel, the United States currently spends about $9 billion annually to manage exotic aquatic pests such as the zebra mussel, European green crab and shipworm. Besides their economic toll, exotics, along with things like habitat destruction and pollution, are contributing to about 40 percent of all aquatic species extinctions, he says.

Nobody yet knows whether the Australian sea squirt will be added to the list of worst offenders. This is part of the goal of the Sea Grant project.

Tunicate invasions on Prince Edward Island in Canada, however, suggest shellfish farmers have the most to lose from a full-blown sea squirt population explosion.

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Christina S. Johnson

A close-up of the Australian sea squirt.

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These invasive tunicates are prolific reproducers, Ruiz says. "When they grow on bivalves and nets, their volume and weight can be so great that it makes harvesting expensive and laborious. Growers lose a lot of product in the process, too." The invasive tunicates, filter feeders, also compete with bivalves for food.

Should the Australian sea squirt prove to be constrained by temperature to the relatively warm waters of San Diego, there is still the question of how it got here in the first place. "We want to nail the pathway," Cohen says, "and then take steps to close the pathway to future invaders."

Gail Ashton, a Smithsonian postdoctoral researcher at SFSU, calls the sea squirt "an indicator."

"Something is bringing it over, and it is probably not ballast water because the tunicate has such a short larval stage," she says.

Given that its larvae likely would perish in transit across the Pacific, Ashton says the sea squirt may have been brought over in sea chests — cavities on a ship's hull that protect intake pipes for engine cooling, ballast and firefighting.

Because these cavities are inaccessible to cleaning and protected from the scouring action of a ship's slipstream, sea chests can become hideouts for the adult life stages of marine species. Once in a foreign port, their larvae may establish a new, self-perpetuating colony. Currently, the sea chest idea is just a hunch, but it is plausible.

Fouling organisms being sampled for the project.

As Sea Grant Marine Advisor Leigh Taylor Johnson explains, the general assumption on marine species introductions is that large commercial ships carry species across oceans and that recreational boats then distribute these species up and down the coast.

A goal of the Sea Grant project is to test this theory by documenting the degree of genetic diversity of specimens collected from all infestation sites. Knowing where the tunicate has spread is also vital to monitor where it is going.

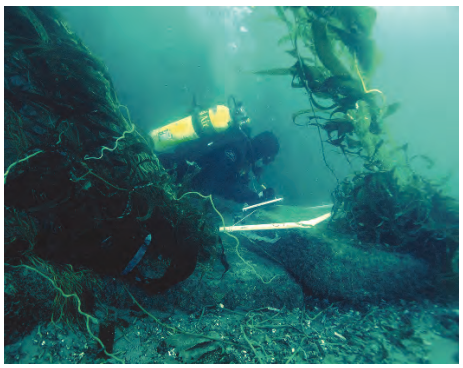
A lot of genetic diversity would suggest multiple inoculations from large ships, Cohen says. If the sea squirt's invasion were basically a monoculture, as is the *Caulerpa taxifolia* invasion in the Mediterranean Sea, it would suggest spreading via fouling growth on the hulls of small boats.

Worrisomely, the Australian sea squirt has been identified for the first time in Mission Bay, a recreational waterway a few miles north of San Diego Bay. A year ago, there were only two known infestations along the entire West Coast, both in San Diego Bay. "It's all over the place in the harbor now," Cohen says. "But, we don't know whether this means it is spreading really fast or whether we are sampling more."

Cohen's primary concern is that people will ignore the sea squirt. "It took the zebra mussel disaster in the Great Lakes to get people to pay attention to aquatic invasive species as a serious problem," she says. "For 60 or 80 years, people warned that ships had the potential to bring in exotic species and that they could be a serious problem. Nobody did anything about it and then it happened. That, to me, is a really compelling reason to pay attention now."

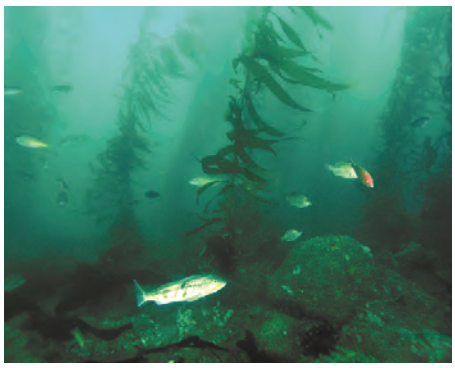
The Shelter Island public fishing pier in San Diego Bay where the sea squirt was first discovered in 2007. *Christina S. Johnson*

Artificial Reef Construction Underway



Richard Herrmann

Giant kelp grows on a rubble concrete module of the experimental San Clemente artificial reef.



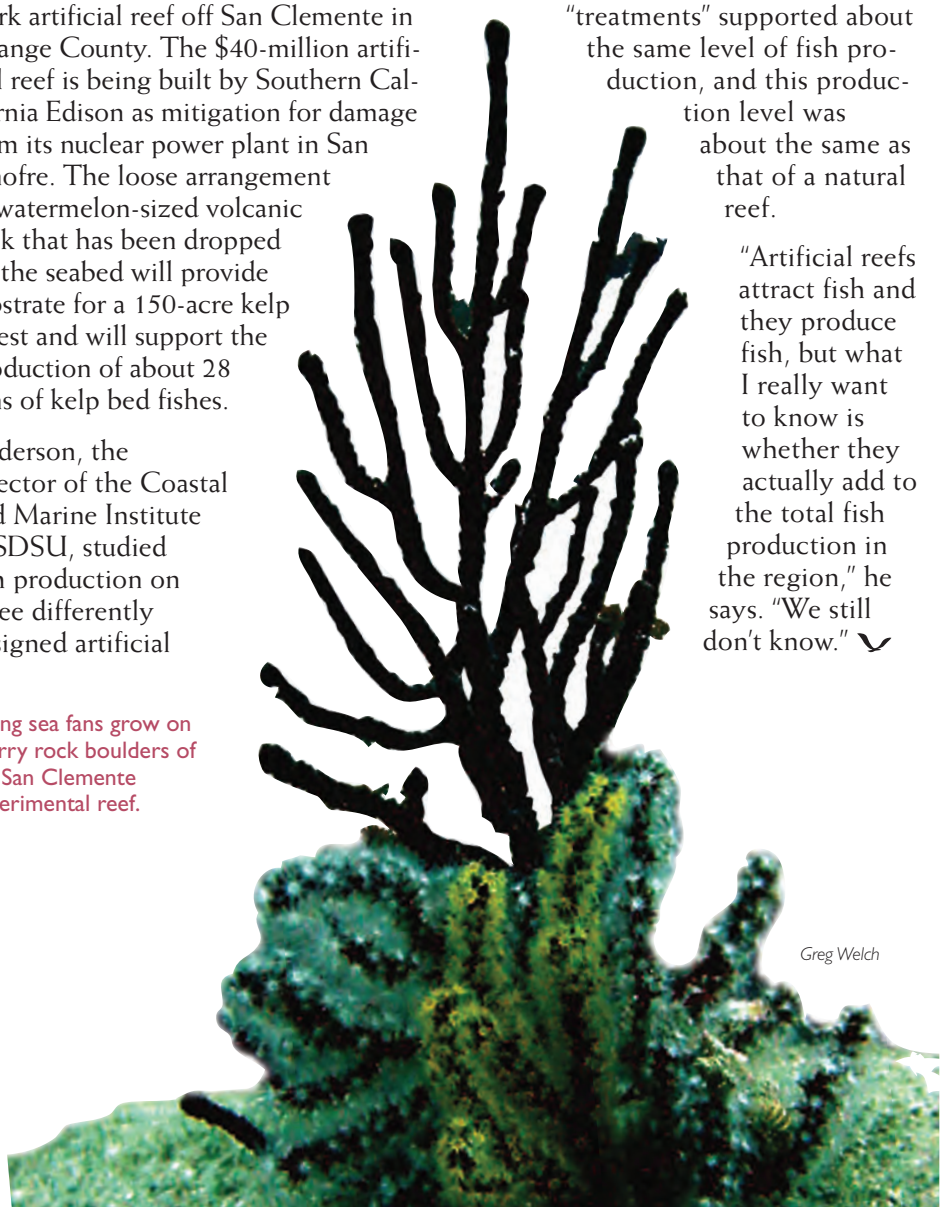
Richard Herrmann

Kelp bass and other reef fishes at the experimental reef.

SAN CLEMENTE – Findings from a California Sea Grant study led by Todd Anderson of San Diego State University have been incorporated into the final design of a landmark artificial reef off San Clemente in Orange County. The $40-million artificial reef is being built by Southern California Edison as mitigation for damage from its nuclear power plant in San Onofre. The loose arrangement of watermelon-sized volcanic rock that has been dropped on the seabed will provide substrate for a 150-acre kelp forest and will support the production of about 28 tons of kelp bed fishes.

Anderson, the director of the Coastal and Marine Institute at SDSU, studied fish production on three differently designed artificial reef modules for two years as part of a five-year pilot study led by the UC Santa Barbara for the California Coastal Commission. His research showed that all three "treatments" supported about the same level of fish production, and this production level was about the same as that of a natural reef.

"Artificial reefs attract fish and they produce fish, but what I really want to know is whether they actually add to the total fish production in the region," he says. "We still don't know."



Greg Welch

Young sea fans grow on quarry rock boulders of the San Clemente experimental reef.

Knauss Fellowships

The National Sea Grant Office has selected all of California Sea Grant's candidates as recipients of 2009 Knauss Fellowships in marine policy.

These five join 44 other graduate students from around the nation for paid, 12-month fellowships in the nation's capital with legislative and executive offices active in marine science and policy.

"Some of the professors I admire most are involved in policy," says Knauss finalist Jessica Dutton, a doctoral student in marine biology at UC Santa Barbara, explaining her interest in marine policy. "I like the idea of marrying science with something more applied, at the federal level."

Knauss finalists are not placed with their hosts until early 2009. Dutton has, however, identified a preference for an executive office such as the National Science Foundation, NOAA or the EPA, where she hopes to apply her scientific expertise in global climate change and ocean acidification to policy.

"I am really excited," she says.

THE FOUR OTHER KNAUSS FELLOWS FROM CALIFORNIA ARE:

Adam Baske, a master's student in marine biology and conservation at the Center for Marine Biology and Conservation at UC San Diego.

Alexandra Brown, above, a master's student at the Donald Bren School of Environmental Science and Management at UC Santa Barbara.

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Joshua L. Madeira, also a master's student at the Bren School at UC Santa Barbara.

Stephanie Ann Oakes, a doctoral student in the Department of Ecology, Evolution and Marine Biology at UC Santa Barbara.

THE DEADLINE TO APPLY FOR A 2010 KNAUSS FELLOWSHIP IS FEB. 23, 2009.

VISIT www.csgc.ucsd.edu

CSU Fullerton Biologist Awarded Grant to Study the Amazing Grunion

grunion.org

A spawning pair of grunion.

FULLERTON – A Cal State Fullerton biologist has been awarded a grant from California Sea Grant to study the amazing California grunion, one of only two marine fish species that leaves their watery world to spawn, bravely, on land.

The grant's recipient, Danielle Zacherl, a professor in the Biological Sciences Department at CSU Fullerton, will be looking at whether grunion are born with an instinct to spawn where they were born, like salmon.

Grunion are silver, sardine-like fish whose odd mating ritual is eerily tied to lunar, and hence tidal cycles. When the tide is right, grunion "body surf" onto sandy beaches. Females then frantically bury their tails into the wet sand, releasing eggs, while males curl themselves around upright females and deposit sperm.

Zacherl and her co-investigator on the project, Karen Martin, a grunion guru at Pepperdine University, theorize that the sand and seawater that bathe grunion eggs leave a chemical mark on their otoliths, creating a natural tag of where the fish were conceived. Otoliths are pebble-like calcified ear structures that grow in daily layers.

Next summer, the scientists will capture adult grunion and compare the chemistry of their otoliths to that of embryos collected in 2008.

"If the chemical signals of the adults from a particular beach match those of the embryos collected at that beach, it will tell us that the grunion do indeed return to their natal grounds," Zacherl says. "Alternatively, if all the grunion are coming from only a few beaches, it tells us you want to protect those beaches."

INTERESTING FACTOID

Pepperdine Biology Professor Karen Martin has found evidence of a northward range expansion of California grunion, consistent with global warming trends.

"It is really exciting to be working on such a charismatic species, and frankly the field work is really fun. A grunion run is a classic Southern California experience."

Danielle Zacherl, a professor in the Biological Sciences Department at CSU Fullerton

John D. Isaacs Marine Undergraduate Research

LA JOLLA – To look at a beaker full of algae the color of antifreeze, one would hardly imagine a link to human medicine. But as a John D. Isaacs Marine Undergraduate Research Assistant, Clarissa Reyes studied just that link this summer.

"We are trying to elicit compounds for medicine," Reyes explained, holding a beaker half full of the emerald potion. The lab in which she is standing is packed with similar green-liquid filled beakers. Some are on little shake tables; others are being aerated; many sit on shelves beside other beakers or algae culture plates.

Reyes, an undergraduate biology major at UC San Diego, was one of five undergraduates to receive a $2,500 stipend from California Sea Grant in 2008 to work with current Sea Grant investigators on summer research projects.

In her case, Reyes looked at how different "elicitor" compounds affect algae growth rates and the pharmaceutically relevant metabolites they produce. It is part of an ongoing effort by Lena and William Gerwick at the Center for Marine Biotechnology and Biomedicine at Scripps Institution of Oceanography to survey the biomedical potential of blue-green algae, also known as cyanobacteria, one of the oldest organisms on Earth.

Isaacs Assistant Clarissa Reyes holds a beaker of algae growing in liquid.

Christina S. Johnson

The John D. Isaacs program, named in honor of the oceanographer, was initiated in 2006 to encourage undergraduate research while providing current California Sea Grant researchers with extra help.

California Sea Grant Assistant Director Shauna Oh, who administers the Isaacs program, says that "undergraduate assistantships give students an opportunity to see how the theories presented in a classroom connect to people, real issues and real research and to see if research is something they want to pursue as a career."

Cameron Coates, a researcher in the Gerwick laboratory overseeing Reyes' summer project, explains his role as a mentor: "We gear her work to her level but also push her to a point she has not been before. She is in a lab that cares about her development."

"I am really happy with the goals of this lab," Reyes says.

The other recipients of the 2008 John D. Isaacs Marine Undergraduate Research Assistantship were:

Claire Baek, a chemical engineering major at Stanford University, who worked with environmental engineering professor Alexandria Boehm on understanding the role of submarine groundwater pollution on coastal water quality.

Andy Drake, a chemistry major at San Diego State University, who worked with chemistry professor Carl Carrano on the role of iron-binding compounds (siderophores) in the formation of harmful algal blooms.

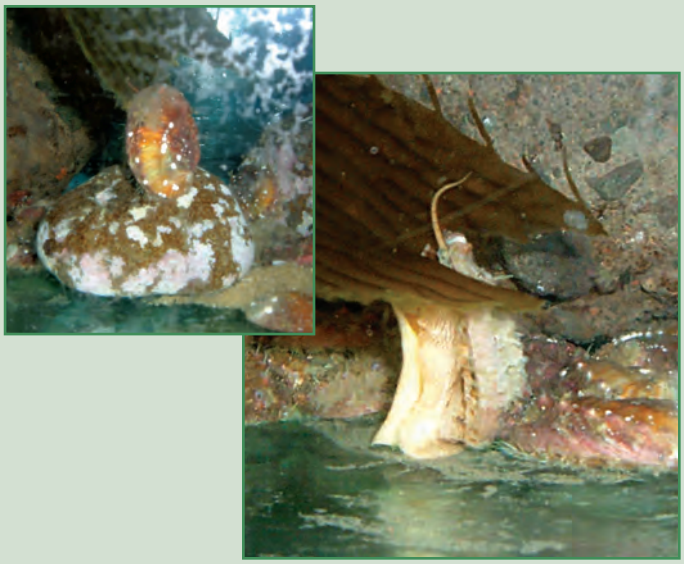
Tiana Egloff, a biology major at UC Santa Barbara, who worked with research biologist Jennifer Caselle on understanding the ecology of California sheephead.

Michelle Hook, an environmental biology major at UC Davis, who worked with UC San Diego professor Brad Moore on characterizing enzymes in marine bacteria of relevance to biosynthesizing antibiotics.

R. Cameron Coates

Through the John D. Isaacs Marine Undergraduate Research Program, undergraduate science majors are provided a summer stipend to work in the laboratory of a current California Sea Grant investigator.

The micrograph above is of a filamentous cyanobacteria magnified 600 times. Isaacs Assistant Clarissa Reyes spent her summer in the laboratory of California Sea Grant researchers William and Lena Gerwick at Scripps. The researchers are trying to figure out ways to increase yields of medically promising compounds produced by these blue-green algae.



Tom McCormick

A white abalone climbs onto a kelp blade.

Jumping Abalone, A New Mechanism for Dispersal?

In terms of basic science, one of the most exciting discoveries of a recent California Sea Grant abalone project is the observed rafting behavior of young white abalone on drifting pieces of giant kelp blades. This never-before-seen behavior may explain the species' historically wide distribution in the Southern California Bight.

In repeated tank experiments led by California Sea Grant biologist Tom McCormick, one- to three-year-old white abalone were observed to raise themselves onto their shell edge to reach drifting pieces of kelp. They then climbed onto the blades and remained attached for as long as 51 days. Rafting could potentially transport abalone far beyond the range of larval dispersal, McCormick says.

Abalone Restoration Update

SANTA BARBARA – Efforts to breed rare abalone for release in the wild are being stalled by a ubiquitous inability to find males able to and/or interested in spawning.

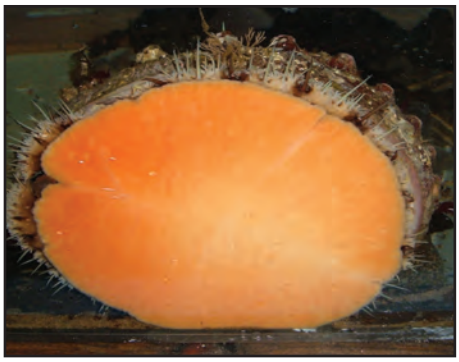
Wikipedia

"Everything is in place for outplanting to be a reality," says California Sea Grant biologist Hunter Lenihan of UC Santa Barbara, who is currently trying to spawn black abalone in captivity.

"But, ah, the agony of abalone," says Tom McCormick of the Channel Islands Marine Resource Institute, who is working on captive breeding of white abalone. Before the problem with male fertility surfaced, McCormick had planned to release about 150,000 white abalone larvae at three sites in the Channel Islands National Park. It would have been the first white abalone restocking effort on the West Coast, one that eventually could lead to releasing not just larvae but young adult abalone to help replenish decimated populations.

"During the past two weeks, we tried spawning the white abalone three times," McCormick says. "The females performed well each time, giving us over 10 million eggs. Only once did we get a little bit of sperm; it yielded very low fertilization rates."

Not just captive but also wild black and white abalone have "issues." "Our surveys up and down the coast indicate very few male black abalone have ripe gonads," Lenihan says.



Tom McCormick

A rare view of the underside of an endangered white abalone.

Black abalone is an intertidal species that NOAA Fisheries has recommended be listed as in danger of extinction. White abalone, a deep-water species, is already on the endangered species list.

"The wild white abalone that are left are so few and far between that they are functionally sterile," says shellfish pathologist Jim Moore of UC Davis and a co-investigator on the California Sea Grant project. "They can't contribute to future generations."

Like any good fertility clinic, the scientists plan to change the males' diet. It is also possible that disease, or even disease-resistance, has reduced their fertility. However, McCormick suspects that feminizing endocrine disrupting-compounds may be to blame.

"Endocrine disrupters, such as the bisphenol A in your plastic water bottle, are being released into the aquatic environment in large quantities, and we really have little idea how they affect the reproductive cycle of many invertebrates," he says.

Gabriela Navas, an undergraduate at UC Santa Barbara, is now studying the topic.

Does Riparian Restoration Harm Walnut Orchards?

A walnut orchard along the Sacramento River. *The Nature Conservancy*

SACRAMENTO – The Department of Water Resources plans to convert old farm fields in the Colusa-Sacramento River State Recreation Area to wildlife habitat.

Could the restoration plan exacerbate agricultural pests at nearby walnut orchards, as some farmers fear?

According to a CALFED Science Fellow, the preliminary answer is, "No."

Suzanne Langridge, a doctoral student at UC Santa Cruz, compared pest bird and insect abundances at 23 walnut orchards along the Sacramento River surrounded by various amounts of riparian habitat and found no link between the number of pest birds (e.g., American crow, Brewer's blackbird and European starling) and the amount of nearby riparian wilderness.

In some cases, there were fewer problem birds and more beneficial insect-eating ones in orchards surrounded by larger tracts of wilderness. Two major walnut nuisances, the navel orangeworm and codling moth, were also observed to be slightly less common at farms with greater proximity to restored habitats.

"Farmers are concerned about more pests coming into their orchards because of restoration," Langridge says. "The issue has come up over and over and is a reason some farmers have opposed restoration along the Sacramento River."

What this project shows is that natural habitat supports fewer pest birds and insects than cropland, says Gregg Werner, project director for The Nature Conservancy's Sacramento River project. "If you have habitat next to you, you will have fewer pests."

Langridge's research was incorporated into "The Pest and Regulatory Effects Study" for the Colusa Subreach Planning Committee.

"I hope my research will be some incentive to support restoration in the future."

– CALFED Fellow Suzanne Langridge

California Sea Grant

Russell A. Moll, Director
Shauna Oh, Assistant Director
Paul G. Olin, Extension Director
Marsha Gear, Communications Director

Sea Grant News
Christina S. Johnson, Editor and Writer
Abigail L.Clayton, Graphic Designer
Joann Furse, Assistant Editor
Steve Gabrysh, Marketing

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University of California San Diego
California Sea Grant College Program
9500 Gilman Drive Dept 0232
La Jolla CA 92093-0232
http://www.csgc.ucsd.edu

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SEPTEMBER 2008

California Sea Grant's Pamela Tom (right) and Yun-Hwa Peggy Hsieh, chair of the Chinese American Food Society's awards committee.

Ann He

Professional Achievement Award

California Sea Grant Seafood Extension Program Manager Pamela Tom is this year's recipient of the Chinese American Food Society's Professional Achievement Award. The award, presented at the society's annual banquet in New Orleans, recognizes members' outstanding contributions to the field of food science and engineering.

Tom, who has worked for UC Cooperative Extension since 1974, has provided technical assistance and training programs in the areas of fruit and vegetable processing, consumer food marketing and low-income consumers, and seafood processing. Currently, she is the Seafood Network Information Center director at UC Davis. Among her many professional activities, which include being a member of the HACCP Alliance Steering Committee, Tom has mentored dozens of international students.

Kudos!Kudos!Kudos!Kudos!Kudos!