

Permaculture Cairns July Newsletter

EMPOWERING COMMUNITIES WITH SUSTAINABLE SOLUTIONS



Care for the Earth, Care for people, Share the excess

Permaculture Cairns Incorporated

Web Site: www.permaculturecairns.org.au

PERMACULTURE CAIRNS AUGUST MEETING

16TH August 2016

ARC Disability Centre in Little Street

6pm for a 6.30pm start.

We will be hearing all about Aquaponics, so come along and find out how to grow fish and veggies in a complementary way.

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Report on the Backyard Meeting for JULY

We toured the Johnston River Gardens in Innisfail on 3rd July.

It was a very informative and interesting day, Bernard gave us a tour of the gardens and we were also treated to the NAIDOC celebrations and opening of the new Garden being developed on site.

The garden is being planted with food and useful plants with permanent tags to show the uses and will also contain the common, scientific and Aboriginal names.

It was a little wet but we all had a good time, time to catch up with Jenny, Peter and Craig our Management Committee members and to tour the wonderful gardens.

If you have an idea for a Backyard outing – talk to one of the committee – Jenny, Peter or Craig.

Permaculture Principle No. 7 - Design from patterns to details

"Can't see the forest for the trees"

By stepping back, we can observe patterns in nature and society. These can form the backbone of our designs, with the details filled in as we go.

Every spider's web is unique to its situation, yet the general pattern of radial spokes and spiral rings is universal. The proverb "can't see the forest for the trees" reminds us that the closer we get to something, the more we are distracted from the big picture.



A paddock becomes a permaculture

"I came here to a bare paddock, adjoining Violet Town. The land form gave me a pattern to follow. I put grassy woodland on the floodplain, and fruit, nuts and olives in pasture on the higher land. Mixed tree and shrub habitat plantings shelter the tree crops. I identified the existing landscape patterns, and the patterns that I wanted to apply. Then the design for this land fell into place."

Photo and text contributed by David Arnold, taken at 'Murrnong' in Australia

GROWING FOOD IN THE WET TROPICS IN JULY/AUGUST

Gardening in July was not easy as I said in the last newsletter. With all the rain and no sun the plants have suffered. Winter hasn't really happened as yet and now we are almost into August it seems we aren't going to have a winter.

Kale, Florence fennel, Wom bok and the other Asian greens are still growing, but at a reduced size. Celery is loving it, and the eggplant in the raised bed is producing at a great rate. Tomatoes have been slow due to the lack of sunlight.

All the herbs are growing well, especially the garlic chives, chives, bunching shallots, basil, parsley, dill, fennel, coriander, oregano and marjoram.

Remember to feed your plants every two weeks, foliar sprays are probably best while this rain continues. Worm liquid is also a great all round fertilizer, but dilute to weak tea before using.

Fruit fly are still about, not cold enough to deter them, so use exclusion bags/mesh and traps. Bananas need to be covered as Banana Fruit Fly (not the Queensland fruit fly) operates all year round and will sting green bananas, bananas and papaya are producing wildly at present.

I have been growing Oyster Mushrooms this year in a green house and about to try growing them in the backyard. Also experimenting with growing them on coffee grounds mixed with other materials. Paddy Straw Mushrooms have popped up in my banana patch, so now I am encouraging them to spread.

Also been recycling coffee grounds and shredded paper. Coffee grounds are a good slow release fertilizer for the garden, and to include in compost bins and worm farms - they love coffee grounds. The shredded paper is great for adding to compost bins when no dry leaves or mulch materials are available, this stops the bin from becoming too wet and smelly. Shredded paper is good for mulching in the garden if mixed with lawn cuttings, leaves or mulch. It turns brown after a few days or you can cover with a light dressing of a more acceptable mulch for appearances sake.

PS All the Tropical Perennials are going gang busters, the - Okinawa spinach and Samburg spinach, Kang Kong greens, Sweet Leaf, Ceylon Spinach, Taro and Cocoyam never looked so good or tasted so good. This is what we should be planting and eating here in the Tropics, and they are there all year round. They make great ground covers under fruit trees. Easy peasy to grow toooooo.

Go get your hands dirty and grow something to eat. Cheers Carol

If you want to know more contact me at email: permicarol@gmail.com

LOCAL WORKSHOPS AND EVENTS

Cairns Seed Savers Meeting

Cairns Seed Savers is an informal group of individuals with a passion for saving seeds and growing fruit, vegetable and other useful plants that have been passed down through generations and are adapted to our local conditions.

WHEN: Sunday 21st August 2016

WHERE: Jo's place, 39A Clifton Road, Clifton Beach.

PHONE: Jo 40553053 WHAT TO BRING:

- Organically grown, non-hybrid seeds for our Seed Bank
- A plate of food to share for lunch • Your own chair, plate and cutlery
- Your spare seedlings, cuttings, plants and produce for the Share Table

AGENDA: 10 – 11:00AM Meet'n'greet, general housekeeping, seed sorting and access to Seed Bank

11:00 – 12 Talk by Paul Richardson on that amazing seed – the COCONUT – how to select for planting, growing requirements and all its many uses (including a demo on making coconut milk). Paul will have his ingenious Cocotap tool for sale (\$35). If you want to buy coconut seedlings contact Paul via www.cocotap.com

12 - 12:30 Enjoy a shared lunch

12:30 – 1PM "Show and tell" of any great ideas/inventions.

Tour of Jo's amazing and expanding garden – please wear closed shoes.



seedsavers meetings in far north queensland – august 2016

mareeba seedsavers and gardening group

sunday 14th of august – mr. and mrs. mikits, 33 hastings drive, mareeba : contact lindy on 40921116

our meetings are friendly and informal, we meet to share / exchange seeds and plant materials, to swap ideas with and gather knowledge from other gardeners. **come anytime from 10 am to 4 pm. we pack, clean & register seeds, share lunch and then wander through the garden, followed by afternoon tea.**

please bring a chair, and if staying for lunch, cutlery, mug and plate and lunch/ afternoon tea to share, any seeds or planting material you have to share and a gold coin donation.
also remember your hat and sensible shoes for the garden walk.

special guest speaker at 1pm – margaret mikits – bees and vegies on ¼ acre

kuranda-sprouts seedsavers

sunday - 21st of august 2016 at bec's – 9 brickworks road, koah,

(turn of hi-way a few k's west of koah servo) follow the signs - 10am til 4pm (come any time for however long :)

☀please bring any presents for bec's garden that you have to spare☀
♥...seedlings, cuttings, fruit tree-lings, etc. to gift to this growing-food-garden adventure...♥
bec will talk with us about what has happened since our last visit to her garden, including the banana-circle

from 10am we will be sorting our organically and locally-grown non-hybrid **seeds into our seedbank**,
we'll have a **talking circle** about what is happening in our gardens – lots to share and learn from each other
we'll enjoy a typically awesome seedsavers **share-lunch** extravaganza with everyones beautiful creations

please bring – any spare organically-grown, non-hybrid **seeds** you have to spare from your garden,
any spare seedlings, cuttings, fruit tree-lings, garden produce etc you have for the **share-table**
something delicious to share for lunch and/or morning/afternoon tea (a cup/plate/cutlery/folding chair if possible)
any **small donation** to assist with seedsavers seedbank requirements and administration,
friends, and family, or **just bring you!! - all welcome !**

CAIRNS SEED SAVERS

phone jo - 40553053

for seedsavers and other gardening videos, go to 'kuranda.tv' youtube channel
any further enquiries email lisa@realfoodnetwork.com.au

INFORMATION – USEFUL STUFF

Become a Control Freak with K (Potassium) and Reap the Rewards

This article was written by Graeme Sait, CEO of Nutri-tech Solutions and is aimed at farmers but it shows how important Potassium is in the production of our food, please take the time to read it.

17 June 2016

Innovative crop monitoring is an essential component of the **Nutrition Farming®** approach. This involves learning simple, inexpensive strategies that can help you to rapidly identify potential problems. The idea is to stay ahead of the game, so you are always in control. This improved management can often serve as the stress buster that turns fear into fun. There is no better example of the rewards from this due diligence, than the gains we can gather through improved potassium (K) management. In this two-part article, we will look more closely at potassium management. In this first segment, we will look at the chief roles of potassium and in the second installment, next week, I will explore innovative monitoring strategies and optimal solutions for correction of deficits.

Managing the "Money Mineral"

I have recently returned from a highly successful tour of the UK. Several times, during my farm visits, I encountered winter wheat and other crops that were struggling for potassium during the business end of the season. The growers were surprised that a previously healthy crop had suddenly developed deficiency symptoms from one day to the next. In most cases, the crops were suffering a dry finish and this is what had created the burnt leaf tips and other symptoms of a K shortage. It is important to understand that any shortage of potassium at this time will reduce yield and, if that shortage persists for more than a week, there is no way to play catch-up.



I often call **potassium** the "money mineral", because it can have more direct impact on yield than any other mineral. Potassium is involved in moving sugars into grains, fruits and pods. These sugars govern fruit size and sweetness and ensure plump, fine flavoured grains, beans and peas. More potassium is always required during fruiting and seed-fill, simply because so much more sugar is required at this time. This is when we can see K levels in the leaf plummet, if we are monitoring with leaf tests or a potassium meter. This will always prove costly if we do not respond quickly. Below, I have outlined three ways in which your crop might be impacted:

The Price of Potassium Neglect

1) If we do not respond to a K shortage there will always be **less yield and reduced quality**. Grains will not fill out to their full potential and legumes will not fill their pods. Citrus fruit will be sour and small in size and your small tomatoes will be similarly lacking in flavour.

2) The second price to pay can be an **increase in disease pressure**. Potassium is a very mobile mineral in the plant and, in the absence of sufficient K, it will abandon the lower leaves to satisfy fruiting requirements further up. This will lower the sap pH in the lower leaves, making them the first port of call for marauding microbes. Think of the brown spot that shortens the life of most tomato plants. It always begins in the lower leaves (as do many diseases) and this is directly related to the K shortage.



3) The third cost relates to **reduced stem strength** and the associated impact on photosynthesis. It is common to see the plant or tree droop in the dry, and we assume this is all about moisture. It is a serious issue because when the solar panel is not presented to the sun, the wheels begin to fall off quite quickly. Many times you will find that much of this damaging drought stress is due to reduced stem strength from potassium deficiency, rather than just moisture stress. A potassium foliar spray at this time can often result in an impressive and unexpected bounce back.

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Creating Disease Suppressive Soils

14 July 2016

There is a growing recognition that pest management with chemicals is an inherently bankrupt approach. We pour on more and more of this "solution" each year, with less and less response. In fact, we have increased our global tonnage of rescue chemicals every year for ten decades and, every year, there is an overall increase in pest and disease pressure. We use our brilliance in technological innovation to relentlessly improve efficiency. GPS, satellite imaging, drone surveillance and robotic helpers are part of this revolution, but we have missed the most important and most basic component of stress-free food production. That missing link is **soil health**. The vitality of this magic mix of sand, clay, microbes, minerals and humus is the determinant of

sustainable profitability for the grower, and it is the very essence of the ongoing viability of our struggling planet.

There is a very similar disconnect in the realms of **human health**. While thousands queue for the replacement of hips, hearts and assorted body parts, there is minimal focus on creating a healthy, resilient human who can avoid the scalpels, saws and suffering. Resilience is about nutrition, and nutrition in the soil and in our bodies chiefly involves the interrelationship between **minerals** and **microbes**. The burgeoning use of symptom-treating drugs is a direct parallel to the soil/chemical story. Both approaches are proving more destructive than productive. Prescription drugs have just become our third largest killer, while our compromised topsoil is eroding at such a rate, that in just 60 years' time, there will be none remaining.

In this two-part article we will return to **root causes**, in an exploration of strategies to create a **disease suppressive soil** that reduces the need for chemical intervention and improves our farming fun. In this week's instalment, we will look at creating optimal conditions for soil life while increasing their numbers and diversity. In the second instalment, we will look at how we can feed, nurture and protect this critically important workforce.

Mastering the Milieu

The milieu is the physical environment that fosters rather than flusters, the soil life that determines problem-free farming. This vast diversity of interrelated organisms needs three things:

1. These creatures are largely **aerobic**, so they must have ongoing access to **oxygen**. The mineral ratio that determines the breathing capacity of the soil involves the balance between **calcium** and **magnesium**. Calcium opens up the soil (flocculation), allowing easy entry for all-important oxygen, while excess magnesium tightens the soil and restricts this breathing capacity. You might be thinking, "alright, let's open her up with calcium and forget the magnesium", but this would be a grave mistake. Magnesium is the central molecule in **chlorophyll**, the green pigment housed within the sugar factories that drive every process within the plant. We can't "forget the magnesium" but we can optimise the **calcium to magnesium ratio** in our soil to maximise oxygen delivery. It is essential to choose a soil test that provides reliable guidelines for the ideal Ca/Mg ratio for your soil.
2. This workforce **needs each other**. Nature demands **diversity**. Most urban dwellers soon discover that a multicultural melting pot is more fun and more supportive than a monoculture. Similarly, our soils flourish in the midst of as many different species as possible. The soil foodweb involves a

diverse chain of creatures that support and sustain each other. When we kill off large segments of this chain with nematicides or soil sterilisation techniques like solarisation, we often find we have inadvertently selected for the very creatures we were trying to avoid. The first creature that returns to ground zero after a nematicide, for example, is the root knot nematode – he thrives in the absence of the foes and competitors that were initially taken out with this soil poison. If you can bring back and sustain diversity, then you have created a soil workforce that works for you, rather than against you.

3. **Humus** is created by soil microbes and is the homebase in which they survive and thrive. It houses the moisture that sustains both soil and plant life, and buffers the salts that might otherwise damage both life forms. The crop plants, supported by humus and microbes, pump one third of their glucose into the soil to maintain that support. We have lost two thirds of our humus via chemical, extractive agriculture and **humus building** is a central strategy for creating a disease suppressive soil. Let's talk about how we can best achieve these requirements.

Oxygen Drives Everything

Oxygen is the single most important requirement for plants, microbes, animals and humans. In the soil, as mentioned earlier, the calcium to magnesium ratio governs oxygen intake. There is a different ideal for this ratio depending upon the amount of clay present in your soil. A heavy clay soil requires more calcium to push apart the clay colloids, while a light, sandy soil needs more magnesium to provide structure to a soil that has none. There is also a biological link to the creation of a soil that breathes. It is a bit of a chicken/egg scenario, in that soil life helps create the soil structure that supports itself. Bacteria exude a sticky gel that creates mini aggregates in the soil and fungi wrap those tiny particles into larger particles. Thus, we have the creation of **crumb structure**, the most desirable of all soil conditions. Oxygen moves freely into this biologically active soil, and CO₂ (the byproduct of the utilisation of oxygen) moves freely out. When diffusing from the soil, this gaseous form of carbon is captured by the tiny breathing pores beneath the leaf, called stomata, and combined with water and sunlight to generate **glucose**, the building block of all living things.

It is common sense that we should be doing everything in our power to improve **oxygen delivery** in our soils, but unfortunately compaction, monoculture, over-cultivation, toxic chemistry, unbuffered salts and misuse of nitrogen can combine to do the opposite.

I have been monitoring a technology from South Africa called **PuriCare**, which exemplifies better than anything I have ever seen, the incredible importance of oxygen in the soil health equation.

This technology delivers a variety of oxygen radicals through the irrigation system via a combination of ozone and hydrogen peroxide called **peroxone**. The oxygen is delivered at a similar rate to that provided when brewing beneficial microbes, and this infusion provides a remarkable response in the soil. Crumb structure rapidly develops, earthworms return, hardpans dissolve and water infiltration and utilisation are dramatically enhanced. It doesn't stop there, however; this technology also cleans irrigation lines and neutralises substandard irrigation water. The variance in delivery of both irrigation water and nutrition, through clogged lines, is remarkably common, and it can seriously impact crop performance. There are over 1000 of these **PuriCare** units now operating in South Africa with impressive reports of yield increases and reduced water use. At a time when the planet screams for the restoration of the humus building capacity of our agricultural soils to counter climate change, this exciting technology looks like a genuine breakthrough to fast track positive change.



The PuriCare unit is demonstrating the immense fertility-building potential of oxygen across South Africa, and it will soon be available globally.

Diversity Drives Diversity

Diversity of plant life sponsors diversity of soil life, and Nature is all about "the more the merrier". Herein lies the fatal flaw in the monoculture model, but there are strategies that can help neutralise the negatives. The most important of these involves the inclusion of **cover crops** above ground and the introduction of a diverse **new workforce** below ground.

Why is it that cover crops always deliver more benefits when they involve multiple plant species? It is quite simple – different plants feed different microbes. If your farm features a single crop, then

your soil life diversity always suffers. In my recent interview with leading cover crop expert **Jeff Rasawehr**, there was a discussion of surprise findings in multiple cover crop trials in multiple states. In these comprehensive evaluations of different cover crops, it was found that, in every instance, the final trial plot in each study that just haphazardly received all the remaining seed varieties always performed the best. It had considerably more diversity than the more controlled plots and this was the key to better performance. There is a lesson here, whether you are growing pasture or underseeding broadacre crops. If you add four clovers rather than one under a cereal crop, for example, you will do better. Similarly, if you can direct drill plantain, chicory, timothy, more clovers and perhaps some cereals into your pasture, there will be considerable gains in both soil and herd health.



A healthy, multi-species cover crop in Scotland soon to become soil-supporting mulch to sustain a new crop of honey berries. Honey berries are a new superfood with huge potential in temperate climates.

How to Build Humus

A good starting point for increasing organic matter involves bringing back your **earthworms**. How long has it been since the birds partied behind your plough in a worm-fueled feeding frenzy? Earthworms decompose organic matter to create humus at four times the rate of standard decomposition. They also oxygenate your soil and incubate new soil life, while fertilising with their nutrient-dense castings. In most soils they are sadly lacking due to salts, farm chemicals, over-cultivation and food shortages. The solution is to counter this dark side with reduced chemistry, buffering of salts and the supply of more food for the earthworms. **Humates** are the best tools for buffering the salts and chemicals, while **cover crops** are the best food source. Earthworms also love to eat beneficial fungi and protozoa, and both of these species are missing from many of our farming soils. You can brew your own fungal inoculums and you can make a simple protozoa tea

from lucerne hay to regenerate these missing microbes. Then, you can watch your earthworm counts increase and your problems reduce.

Graeme Sait Author of hundreds of articles and a popular book, 'Nutrition Rules!'. Travels the world educating and inspiring growers and often consults at a government level. CEO of Nutri-Tech Solutions (NTS).

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Tips for Using Baking Soda

- Add baking soda to your bath water to [relieve sunburned or itchy skin](#).
- Make a paste of baking soda and water, and apply to a burn or an [insect bite for relief](#).
- Clean your refrigerator with a solution of one-teaspoon baking soda to one quart of warm water.
- Pour a cup of baking soda into the opening of your clogged drain and then add a cup of hot [vinegar](#). After a few minutes, flush the drain with a quart of boiling water.
- To remove perspiration stains, make a thick paste of baking soda and water. Rub paste into the stain, let it sit for an hour, and then launder as usual. Find out how to [remove other common stains](#).
- If you crave sweets, rinse your mouth with one-teaspoon baking soda dissolved in a glass of warm water. Don't swallow the mixture; spit it out. Your craving should disappear instantly.
- Add a pinch of baking soda to boiled syrup to prevent it from crystallizing.
- To remove pesticides, dirt, and wax from fresh fruits and vegetables, wash them in a large bowl of cool water to which you've added two to three tablespoons of baking soda.
- Soak toothbrushes in baking soda and warm water overnight to clean bristles.
- Gasoline and oil odors can be removed by putting clothes in a trash bag with baking soda for a few days before washing them.
- Lay down barrier of baking soda under sink-pipe openings and along basement windows to keep carpenter ants, silverfish, and roaches from invading. Roaches eat the baking soda, dehydrate, and die.
- A light baking soda paste on a damp cloth will remove bugs and tar from cars without damaging the paint. Let paste sit for a few minutes before wiping and rinsing clean.
- To remove stains from your coffee and tea cups, wipe them with a damp sponge dipped in baking soda paste.

- Keep your rubber gloves dry and smelling good by sprinkling baking soda inside them. They'll slip on more easily too!
- Sprinkling baking soda on your front steps will provide traction and melt the ice. Unlike rock salt, kitty litter, or sand, it won't damage outdoor or indoor surfaces or shoes.
- Boil two inches of water in a pan with a burned bottom, turn off the heat, then add half a cup of baking soda. Let it sit overnight. In the morning it will be easy to clean.
- Sprinkle a teaspoon of baking soda on the bottom of your toaster oven to eliminate the burned smell from drippings and crumbs.
- A paste of baking soda removes red sauce stains from plastic.

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INTERESTING NEWS FROM HOME & AROUND THE WORLD

Healthy microbes make for a resilient Great Barrier Reef

From The Conversation June 24 2016

Healthy microbes make for a healthy coral reef. And if that microbiological community is disrupted by overfishing, pollution or climate change, it can contribute to the decline of reefs.

A three-year study published this month in [Nature Communications](#), conducted on a reef in the Florida Keys, United States, has shed light on how microbes living on corals are instrumental to keeping coral reefs healthy, and how overfishing, pollution and climate change can destabilise the coral's natural defence and disrupt ecological communities.

According to the lead author of the study Dr Rebecca Thurber, from Oregon State University, healthy corals normally recover easily from small injuries, such as fish bites.

"In our experiment, 100% of the corals bitten in normal waters recovered. But in the presence of elevated nutrients, 66% died after they were bitten by fish, showing that nutrient pollution increases the vulnerability of corals to normal every day events," she said.

Although this study focused on Caribbean ecosystems, it can inform threats to the Great Barrier Reef, said Dr Jon Brodie from James Cook University, who was not involved in the study.

[Coral bleaching](#) and warming [ocean temperatures](#) are already affecting tropical reefs, with coral cover already on the decline.

The addition of overfishing and nutrient pollution interact with the elevated temperatures creating more disease-causing bacteria, and this may make reefs less resilient to disruptive events such as cyclones.

According to Dr Zoe Richards, from Western Australian Museum, who was not involved in the study, the study shows “how easily an innocuous interaction like a fish feeding on a coral can turn deadly in overfished and polluted habitats, especially in summer”.

Adding protection

The results suggest it’s especially important to manage overfishing around important reefs, says Richards. This will help sustain the population of fish that feed on microbes that might otherwise increase in numbers and disrupt the normal microbial ecology.

“This will help suppress algal overgrowth and blooms of harmful bacteria, which are major drivers of coral mortality,” said Richards.

Another strategy to protect reefs is to protect the environment around them.

“Rehabilitating catchment areas, preventing clearing and erosion, along with protecting natural waterways and limiting herbicide and pesticide run-off are integral components of reducing nutrient pollution,” said Richards.

Even though climate change is warming the Great Barrier Reef, reducing the impact of other stressors could help maintain a healthy microbial balance.

“If we reduce ocean pollution and ensure that there are abundant fishes to remove the algae on reefs, corals can likely tolerate some increases in water temperatures,” said Thurber

How Growing Sea Plants Can Help Slow Ocean Acidification

by Nicola Jones, originally published by [Yale Environment 360](#) | JUL 12, 2016

Researchers are finding that kelp, eelgrass, and other vegetation can effectively absorb CO₂ and reduce acidity in the ocean. Growing these plants in local waters, scientists say, could help mitigate the damaging impacts of acidification on marine life.



Robert Schwemmer/NOAA Harvesting kelp, shown here off the California coast, removes CO₂ from the ecosystem.

Oregon's picturesque Netarts Bay has long been known for its oysters. But Netarts, like the whole west coast of North America, **is getting more acidic**. And the oysters don't like it.

Since the Industrial Revolution, carbon dioxide in the air has seeped into ocean waters and boosted acidity by 30 percent. Globally, the oceans' pH has dropped from 8.2 to 8.1, and could drop another 0.4 units by the end of the century. The **problem is worse** off the west coast of North America, where acidic bottom-waters are brought up to the surface by onshore winds. Corrosive waters like those suck up the building blocks for shells, and can literally eat away at the skeletons of corals.

Last summer, Oregon State University marine ecologist George Waldbusser and his team boated around Netarts Bay planting baby oysters to see how they would fare. The only ones that thrived were those protected by beds of eelgrass, which seemed to swallow up enough carbon dioxide during the peak of each day to give the oysters a break from acid and a window of opportunity for growth.

"Basically nothing outside of those beds survived," says Waldbusser, who hasn't yet published the work. Meanwhile, the Whiskey Creek Shellfish Hatchery in Netarts Bay has started only pulling water into their tanks in the afternoon, when photosynthesis peaks and the water is less acidic.

Waldbusser is part of a small team of scientists now exploring the idea that seagrasses, kelps, and shell beds might be able to counteract the rising tide of ocean acidity in local hot spots, making life a little easier for struggling animals. He and other experts on the West Coast Ocean Acidification and Hypoxia Science Panel, which released its **first report** this April, recommended that scientists and managers push forward such strategies to suck CO₂ out of the water.

The idea is a smaller, gentler cousin to grander schemes of geo-engineering. There have been proposals to soak up the ocean's excess acid by throwing iron, limestone, or olivine into the water, boosting plankton growth, adding the building blocks for shells, or chemically absorbing CO₂. But the general **response** to such plans usually ranges from head-shaking disbelief that they might be feasible or effective, to **widespread concern** about the possible ecological side effects. The energy needed to mine and distribute rocks, and the unpredictable shift in food webs, have made these schemes unappealing on a global scale. On the local scale, however, lower-cost, lower-risk ecological restoration might have the dual benefit of giving threatened sea creatures both a better place to live and a refuge from ocean acid.

Oysters would not be the only creatures to benefit. Derek Manzello manages a long-term ocean acidification monitoring site at Cheeca Rocks in the Florida Keys, as part of the National Oceanic and Atmospheric Administration's (NOAA) **National Coral Reef Monitoring Program**. That particular patch of coral is one of the only reefs in the Florida Keys that is still growing; in other reefs, most corals have died from disease and bleaching since the early 1980s. This is odd because Cheeca Rocks, like other near-shore spots in Florida, sees high temperature swings and large amounts of soil and nutrients dumped into the water, which should limit coral growth. There

are several possible explanations for Cheeca Rocks' resistance to these problematic conditions, including that the corals there might be genetically adapted to thrive in harsh conditions. But another possible explanation is that they are living in a low-acidity refuge created by nearby seagrass beds.

In 2012, Manzello showed that Florida's inshore waters, including where Cheeca Rocks sits, are **packed with dissolved aragonite**, the material that corals need to grow. Acids in the water decrease the aragonite saturation value; if it gets below 1, corals and shells start to dissolve. In pre-industrial times, these inshore waters typically had a saturation value of 4.6. Today, most reefs in Florida and the Caribbean have been eked down to 3.8. But Florida's inshore waters have a happy 4.7.

"This is a huge difference," says Manzello. The reason is the banks of seagrass growing in Florida's inshore waters, like turtle grass and manatee grass, that suck up CO₂ as they photosynthesize — particularly in the spring.

Another study out that same year showed the **same effect in the tropical Indo-Pacific**. Seagrass meadows there have the potential to increase aragonite saturation by up to 2.9 units, and the pH by 0.38. That should give corals about an 18 percent boost in growth, making seagrass a potential tool for marine park managers, the authors write.



George Waldbusser/OSU. Stephanie Smith, a recent graduate of Oregon State University, standing in a dense bed of Zostera marina seagrass in Netarts Bay with the CO₂ sensor she designed.

The **potential is huge**. Plants in the ocean, from seagrasses to plankton, add up to just 0.05 percent of the plant biomass on land, but are so pervasive and efficient at sucking up carbon that they cycle through roughly the same amount of carbon every day as all the land-based plants. Yet seagrass ecosystems are being wiped out, thanks to everything from pandemic disease to water pollution and coastal construction projects. The rate of loss has **skyrocketed** from less than 1 percent of global seagrass cover per year in the 1970s to 7 percent annually in the 2000s, making seagrasses one of the planet's most threatened ecosystems. Efforts to restore or farm such plants could have a host of benefits, including soaking up atmospheric carbon.

Waldbusser cautions that many scientists don't yet know about the effect of seagrasses on ocean chemistry. Some breeds, like the invasive *Zostera japonica* eelgrass in Oregon, tend to shed their leaves in the winter, and the degrading plant matter boosts carbon dioxide levels in the water rather than lowering them. And if the water is swift flowing, then any patches of water made less acidic by plants will likely be swept away before they have a chance to benefit local shellfish or corals.

Seagrasses aren't the only possible solution. Kelp is also well known for soaking up excess nutrients and making waters cleaner for shellfish. Most academic papers looking at the benefits of kelp don't even mention acidification. But it didn't take much for Nichole Price of the Bigelow Laboratory for Ocean Science in Maine to put two and two together. "The biggest challenge in land-based kelp nurseries is keeping the pH low enough because they consume so much CO₂," says Price, who wondered how those same photosynthetic algae were affecting ocean waters.

Price teamed up with [Ocean Approved](#), North America's first commercial kelp farmer, to put instruments inside and outside of its kelp farms to see what was going on. In as-yet-unpublished work, they show that the aragonite saturation level is half a unit to a full unit higher within the kelp farm. "That's bigger than the change we expect from ocean acidification," she says. Next year they plan to map the extent of the impact, and test the effect of the kelp on a mussel farm around the corner. That farm, says Price, has already started growing kelp based on these preliminary results.

The key, says Price, is to harvest the kelp so that the carbon it extracts gets removed from the ecosystem. It's hard to compete with Asian kelp suppliers, but local kelp could be dried and used as food or fertilizer, adding a layer of economic diversity to a struggling coastal economy. "There's a lot of potential for shellfish aquaculture, but people are really hesitant [because of acidification]," says Price, who now heads up Bigelow's Centers for Venture Research. Pairing up with seaweeds might be the trick to buy new businesses a bit of insurance against future conditions, she says.

This autumn, researchers will start the first large-scale project to intentionally plant and grow kelp to suck up carbon dioxide. [The Puget Sound Restoration Fund](#), based in Bainbridge Island, Washington, [won \\$1.5 million](#) from the Paul G. Allen Ocean Challenge in April 2015 to investigate the potential for sugar kelp to reduce acidity in local waters, where the pH can hit 7.8. Plans call for starting farming an acre of kelp this October.

Ocean waters can be buffered against acids by non-living material, too. Instead of soaking up carbon dioxide, the strategy here is to add more carbonate to the water. That shifts the aragonite saturation point and, again, makes it easier for shells to grow.

Nearly every estuary that once had a thriving oyster industry hosts an effort to put old shells back into the water, says Waldbusser. Most, if not all, of these projects are focused on giving the oysters or other shellfish something to grow on — their babies prefer to sit on piles of old shells, rather than getting buried or choked by mud. The fact that these shells help to buffer water acidity is an added bonus.

The Chesapeake Bay, he notes, has seen the largest oyster reef restoration effort to date and also possibly the largest (and unintentional) ocean acidification buffering experiment. About 196 million bushels of dredged oyster shells were put back into Chesapeake Bay from 1960 until 2006, before the project coordinators ran low on shells. They're still about 100 million bushels short of where the Chesapeake's ecology would have been had oysters not been extracted for centuries, notes Waldbusser, and the effects on the bay's complex water chemistry have so far been hard to track. But that doesn't mean that shells can't shift pH significantly under different conditions.

In previous work off the coast of Maine, Waldbusser's team, led by Mark Green of Saint Joseph's College of Maine, mixed old ground-up shells with ocean sediments and replanted them. They then looked to see how that affected oysters. Three times as many oyster larvae settled in the shell-rich soils as in the non-shelled soils, they found. The reason, Waldbusser thinks, is because of a change in water acidity within the pores of the sediment.

"You have this incredibly hostile environment in the pore water, which is generally more acidic than the overlying water," says Waldbusser. "Mix shell in and it's a little less hostile."

Waldbusser is familiar with other proposed ways of shifting ocean pH. He wrote a proposal to use the waste CO₂ emitted from a hatchery to dissolve calcium carbonate rocks and bubble the products back into the ocean, helping to buffer acidity in much the same way as is done in home aquariums. But it didn't get funded. "There are lots of technologies that exist and things you can do, but it comes back to scalability and unintended consequences," says Waldbusser. Using rocks to buffer ocean water, for example, involves using energy to treat the minerals beforehand so they dissolve, and then you have to worry about toxic levels of nickel or cadmium hitching a ride along with the rocks.

In the end, says Waldbusser, "I always come back to restoration." Replanting the seagrasses or shell banks that used to exist in an estuary is much safer, and often easier, than some industrial schemes. And, he adds, it probably comes with "built-in benefits that we don't even recognize."

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If anyone has information they would like included in this newsletter, especially about workshops and events, please send me the information so I can copy and paste into the newsletter.

My email is - newsletter@permaculturecairns.org.au

Editor - Carol Laing

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