Spice of life. Tyrant ants, above with whitebait, and crickets and meal-worms, below, are served at Stanley Street Merchants in Sydney.

'Prawns of the sky'. In evolutionary terms, arthropods such as locusts are related to lobsters and other crustaceans.

GRUB'S UP!

Eating insects is growing in popularity. Are they just a trendy addition to restaurants in our major cities, or might they be the solution to feeding the planet's burgeoning population?

STORY BY NATSUMI PENBERTHY PHOTOGRAPHY BY NICK CUBBIN

OPPOSITE: *Iridomyrmex rufoniger; Acheta domesticus; Tenebrio molitor.* THIS PAGE: *Locusta migratoria*

Flying feast. For generations, Aboriginal men have travelled in summer to the alps of south-eastern Australia to feast on Bogong moths.

ON MY PLATE, lightly battered whitebait is appetisingly piled next to a dollop of aioli. It looks delicious, but there's something a little different about this meal, served up at Stanley Street Merchants, a bustling pop-up restaurant in the inner-city suburb of Darlinghurst in Sydney. Stuck at odd angles to the batter are tiny legs, segmented black bodies and wiry antennae – peppered quite deliberately through my supper are the bodies of Australian tyrant ants.

As I eat, head chef Matt Stone talks to me from behind the wooden counter. He's telling me about Noma, the Copenhagen-based restaurant (often ranked one of the best in the world), which provided the inspiration for this entomological ingredient.

"I'd worked in Noma a few times," he says. "They use only Nordic ingredients, so they don't have any lemons or limes or citrus flavours – the designer finds a flavour using something that's native." Because citrus trees are not found naturally in Denmark, Noma's chef René Redzepi uses Scandinavian ants with a surprising citrusy flavour as a replacement for lemon in several dishes.

After returning to Australia, Matt – who is the executive chef of popular Perth and Melbourne restaurants known for their sustainability ethos – was inspired to look for ants to season dishes here. He argues that we have such an "abundance and variety" of foods in Australia that we don't need to look overseas for ingredients.

But sprinkling ants through fancy dishes is about more than just saving food miles. There are growing concerns about food security globally and studies suggest that eating insects could be part of the solution. By 2050 Earth will be home to 9 billion people; in developing countries, the desire for animal products is rising steeply as economies and incomes grow, meaning that demand for protein will increase 60 per cent by mid-century.

Conventional sources of protein in the form of meat from livestock are already taking an enormous toll on the environment – grazing land covers 26 per cent of the planet's ice-free regions, and one-third of the land used for crops goes to feed these animals. Livestock also produce about 18 per cent of greenhouse gas emissions, more than planes, trains and cars combined. ▸

The people's choice. Matt Stone's sustainability ethos and commitment to local produce (above) won him crowd-funding for his campaign to start pop-up restaurant Stanley Street Merchants (below).

NICK CUBBIN is a Sydney-based freelance photographer with a knack for capturing the essence of his subjects, as small as they (sometimes) are. His last assignment for AG was *Open house* in issue 117.

Bug bites. Chef Dan Lewinsky's pork char sui, pickled carrot and dehydrated ant canapé was a favourite at a 2014 Climate Institute fundraiser in Sydney.

Agrotis infusa

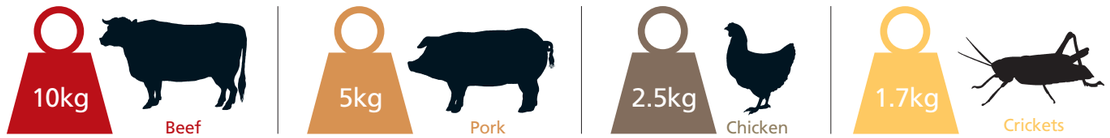
ARE **INSECTS** REALLY SUSTAINABLE?

Nutritious, efficient at producing protein and easy on the environment, insects are fast becoming an appealing 'alternative' food source.

BECAUSE INSECTS are cold-blooded and don't waste energy on producing internal body heat, they are a much more efficient source of protein than warm-blooded animals, such as pigs, cows and chickens. They can also be reared in small 'farms', cause none of the ground-cover damage that hooves do, and they produce little methane, compared with livestock. Here we look at how crickets stack up against other common sources of protein.

EDIBLE PERCENTAGE OF ANIMAL

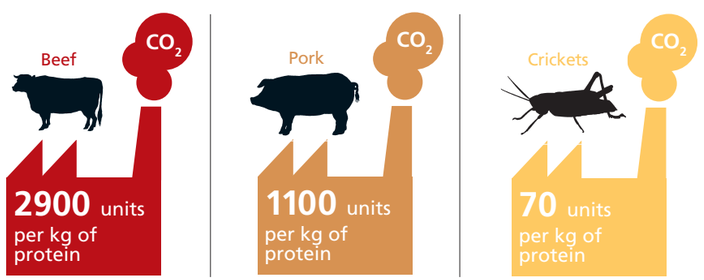
FEED NEEDED FOR 1KG OF LIVE ANIMAL WEIGHT



COMPOSITION

Ground **pork** per kilo*	Ground **beef** per kilo	Ground **chicken** per kilo	Ground **crickets** per kilo
11004 kilojoules	8033 kilojoules	5983 kilojoules	5866 kilojoules
16.88% protein	19.42% protein	17.44% protein	20.5% protein
21.19% fat	12.73% fat	8.1% fat	6.8% fat

GREENHOUSE GASES*



More than 1.3 billion tonnes of biowaste could be converted into protein by insects per year

FAO, EDIBLE INSECT: FUTURE OF FEED AND FOOD SECURITY, 2013; *GREENHOUSE GAS EQUIVALENCE PER KILOGRAM OF MASS GAIN

Tiny footprints. It only takes 20sq.m of land to produce 1kg of mealworm protein, but up to 260sq.m for 1kg of cow protein.

In Australia, restaurants have a fairly limited insect selection but it's on the increase.

'Entomophagy', or eating insects, makes a lot of sense according to a 2013 UN report, *Edible Insects: Future Prospects for Food and Feed Security*. And entomophagy advocates point to the 2 billion people who already consume them.

Aboriginal groups across Australia still rely on bush tucker that includes larvae, honey ants, scale insects, lerps and Bogong moths. New Zealand's huhu grub reportedly tastes like peanut butter. Caterpillars are popular across Africa, and, in Kenya, termites are crushed into 'milk' to feed babies. In South America, wasps, spicy red agave worms and apple-flavoured stinkbugs are favoured. While in Japan, silkworm pupae turn up 10 to a skewer, and in Thailand you can find nutty crickets and palm weevils with a hint of bacon flavour in many supermarkets.

Yet, although insects – which are low in saturated fats and rich in protein and micronutrients – have traditionally featured in the diets of people all over the world, they have rarely been used in Western cuisine. This may hark back to the development of large-scale agriculture, when they came to be seen as pests and a sign of disease.

In Australia, restaurants have a fairly limited insect selection but it's on the increase. The tyrant ants used by Matt at Stanley Street Merchants have been farmed and are not cheap to produce, commanding up to $600 per kilogram. They are difficult to cultivate and mustering them involves sucking each ant individually into a small vacuum, says Skye Blackburn, Australia's only major producer of edible insects on her 'farm' in Sydney's west. But Matt also serves slightly more economical crickets and mealworms ($120 per kilogram) in a pretty dish that looks like a Christmas wreath, and is at once nutty, crunchy and spicy.

"Crickets of [1–2cm] can be bred in about six weeks, will take up no agricultural land and they eat waste like food scraps," says Matt, who has a small cricket farm at Silo, his Melbourne restaurant. High in vitamin B12, which helps the body absorb calcium, they're also very nutritious, he says.

As well as needing little space, insects emit a fraction of the greenhouse gases of livestock and their 'feed conversion rate' is the stuff weathered cattle graziers dream of. A single kilogram of feed yields 12 times more edible cricket protein than beef protein, and roughly six times more than fish (see opposite). They also consume less than one-fifteenth of the water per kilo of protein compared with cattle, while also conserving habitats that would otherwise be damaged by livestock.

Aside from the logical arguments in favour of eating insects, you have to wonder whether the trend could catch on in prosperous Australia, where red meat and fish are affordable and linked to our national identity. As I sit chatting to Matt, a tattooed 27-year-old, I wonder whether these ants have been added more as a talking point than a genuine palate pleaser. But, I'm here to try the dish, so I pick up a forkful of whitebait and dig in.

I taste the lightness of the fish and the oily crunch of batter. As I chew, a burst of citrus-like flavour occasionally sparkles across my tongue. It's not as complex or fragrant as lemon, but close enough to seem natural in the dish. Not too experimental at all – in fact, rather good.

Continued page 72 ▶

Firm favourite. Brisbane lawyer Wayne Cochrane regularly orders the 'Can of Worms' mealworm dish at Brisbane restaurant Public.

WATCH
Use the free ***viewa*** app to scan this page and see a film about eating insects. You can also watch it on our website.

Worm wishes. A staple on Public's menu for two years, the Can of Worms starter of chilli, deep-fried mealworms (which taste like crunchy Asian noodles) and bean sprouts has a spicy, salty flavour.

More research is needed on the insects commonly eaten as bush tucker.

Physical reaction. Because those with shellfish allergies are sometimes sensitive to insects, Chef Damon Amos used to serve them together in the hope that such patrons would be deterred from ordering the dish.

Insect parade. Situated near the Brisbane Magistrates Court, Public has regular patrons and a frequently rotating menu. One of the latest dishes is this dehydrated apple, salmon and black ant concoction.

CRICKET FLOUR COOKIES

For cookies with a protein kick, use a combination of cricket flour and plain flour. Recipe will yield 30 medium-sized biscuits*.

Created by Skye Blackburn

160g plain flour **100g raw sugar** 100g butter **120g choc chips** 1 egg yolk **pinch salt** 1/2 tsp of baking powder **15g ground mealworm or cricket flour** 1 tsp vanilla extract

1. **Separate the egg and discard egg white. Add vanilla to yolk.**
2. Cream the butter and sugar together until lump-free.
3. **Sieve flour, salt and baking powder into a bowl.**
4. Add yolk to butter and sugar mixture and mix with a spoon.
5. **Mix in the flour, salt, baking powder, cricket flour and chocolate, and knead into a dough.**
6. Cover with plastic wrap and refrigerate the mixture for an hour.
7. **Take dough and roll into logs**.
8. Place on baking paper and cover in plastic wrap. Refrigerate until hard.
9. **Cut 1cm-thick rounds and lay on baking paper.**
10. Bake at 160°C for 18–20 minutes.

*DO NOT USE CRICKET FLOUR THAT HAS NOT BEEN PRODUCED SPECIFICALLY FOR HUMAN CONSUMPTION. FIND OUT MORE HERE: WWW.EDIBLEBUGSHOP.COM.AU

THE TASTE IS "like a dark honey, sweet but also sour, with a lingering flavour like wild strawberries, semi-dried in the sun", mused Josh Evans in April 2014 on the blog of the Nordic Food Lab. All in the name of research, he travelled to Yuendumu, north of Alice Springs in the Northern Territory, to sit in the dirt and suck honey ants with women from the Warlpiri Aboriginal community.

The Food Lab is a small research station on a houseboat in Copenhagen, and was set up in 2008 by René Redzepi to study novel foods for his restaurant. In 2013 it was awarded A$700,000 to run a project, in partnership with the University of Copenhagen, aimed at making insects more appealing to the Western palate by creating delicious new dishes.

Because insects have been a major component of Aboriginal diets, Australia is one of only 20 or so countries that boast 50 or more known edible insects – it's also the only one of those nations with a predominantly Western diet today. This made it an obvious place for Food Lab researchers Josh and Ben Reade to head in search of new ingredients.

And yet, despite their abundance, turning insects into commercially cultivated products in Australia may not be so easy, says Dr Alan Yen, an expert on entomophagy at the Victorian Department of Environment and Primary Industries and La Trobe University in Melbourne.

"We don't know what witjuti [witchetty] grubs really are," Alan tells me. "We can't even tell which grub belongs to which insect a lot of the time." Moves to commercialise grub breeding during the rise of the bush-tucker movement in the 1980s–2000s were stopped short by the fact that the grubs are, in fact, the larvae of many different insects, depending on which part of Australia they are from. Much more research is needed on the insects commonly eaten as bush tucker, he says.

Another unknown risk of cultivating insects is that they could carry diseases that we don't yet know anything about, so this is something researchers need to explore before insects start to be consumed on a large scale in the west.

Our neighbours in Asia are the world leaders at small-scale cultivation, Alan says. Thailand, for example, has 20,000 registered insect farmers, most running set-ups at home. They farm crickets in egg cartons and palm weevils in segments of palm tree trunks, and these command higher prices at market than beef, chicken or poultry.

Intriguingly though, many of the insects eaten in Asia, such as crickets and locusts, have never featured prominently in Aboriginal diets. This is despite the fact that the Australian plague locust has been identified as a highly nutritious species by the UN's Food and Agriculture Organisation.

In Australia, where insects are less culturally acceptable in dishes, and where food is secure, Alan believes the biggest current application of edible insects is as a partial fishmeal replacement. Fishmeal, made from ground-up schooling fish such as anchovies and sardines, is used to feed larger farmed fish such as salmon and tuna. "In the past 30 years, fishmeal prices have skyrocketed," he says. The fishmeal industry in Australia is currently worth more than $38 million a year.

Recognising that this demand is quickly outstripping supply, aquaculturalists have been experimenting with other sources of protein, such as algae, but these lack many of the nutrients of fish, including omega-3 fatty acids. Insects, however, have the protein and some of the missing nutrients, making them a possible substitute for fishmeal.

Many now-farmed fish, such as salmon, eat insects and other invertebrates in their natural environments, says Alan. "So we're not trying to get them to eat things they're not genetically used to eating."

Industrial production of insect meal is already being adopted overseas. A South African plant being built by multinational company AgriProtein is scheduled to open next year. It plans to produce 24 tonnes of fly larvae and 7t of maggot meal daily for agriculture, aquaculture feed and soil enrichment.

Other commercial insect production facilities include EnviroFlight in the USA, Ynsect in France, Enterra in Canada and Protix in the Netherlands. There is nothing on this scale yet planned for Australia, but there is interest from industry, Alan says. ▶

The daily grind. Fifteen minutes in the grinder is all it takes for roasted crickets to become the dense 'flour' that Skye Blackburn from The Edible Bug Shop uses to produce products such as protein shakes, cookies, trail and protein bars, banana bread and brownies.

SOME AUSSIES ARE still convinced there's a future for large-scale human consumption of insects Down Under – even if this means finding ways to ease consumers into it. In a commercial kitchen in western Sydney, Skye Blackburn and her team of five turn the crickets they farm into protein balls or flour.

"At the moment we're farming approximately 200kg of edible crickets per week," Skye says. "About 50kg of that goes straight out and the rest of it is turned into our retail products like the flour." The balls are a "natural form of protein and a lot more digestible than what people normally have, like soy isolate powder or whey protein", she adds.

Skye, both a food scientist and entomologist, was uniquely qualified to become Australia's first breeder of insects for human consumption. Her food science background helped her jump food regulation hurdles when she started up five years ago.

"We used to have to print out regulations and take them along with us to festivals, so we could pull them out whenever we were asked," she says.

But insects are now so common in commercial kitchens that in 2013 they were taken off a list of 'novel' foods kept by regulatory body Food Standards Australia New Zealand. Last spring, Skye was even asked to speak at a national environmental health symposium, where 100 food inspectors grilled her on regulations regarding insects in commercial kitchens.

Grub goodness. Witjuti grubs can take up to two years to grow to full size and are said to taste like bacon when cooked on a fire.

It's just a matter of exposure, before people become comfortable with insects as a foodstuff, she argues. "Look at sushi – 20 years ago everyone thought raw fish was disgusting; now it's in every shopping centre."

Interestingly, crustaceans – such as crabs, prawns and lobsters – are, in evolutionary terms, closely related to insects, more so than spiders. And yet eating crustaceans isn't seen as strange by Westerners, in the same way that eating insects is. Research by Professor Paul Rosin, a psychologist at the University of Pennsylvania in the USA, revealed that Americans found insects to be on par with Hitler in terms of disgust responses. In Australia, a 2006 survey by the Rural Industries Research and Development Corporation found the idea of consuming witjuti grubs was a challenge for about half the 1273 people interviewed.

Nevertheless, in recent years, a dozen or so Aussie chefs, such as Matt Stone, have set out to make insects more appealing. Celebrity chef Kylie Kwong has been serving green-tree ants, mealworms, cockroaches and crickets at her Sydney restaurant Billy Kwong since 2013. Also in Sydney, Matt Fitzgerald serves 'candied chilli, salt and lime seasoned crickets' at Bondi Junction taquería, El Topo. In Adelaide, Duncan Welgemoed has served crickets, bees, mealworms and grasshoppers at Bistro Dom.

Similarly in Brisbane, Damon Amos at Public – a popular haunt for judges and lawyers – has a mealworm dish called 'Can of Worms'. Damon also occasionally cooks with ants. "Dehydrated black ants are high in formic acid, which I reckon tastes a bit like citrus crossed with Vegemite," he says. Although the flavour is not the sole reason he adds insects to his dishes. "It is confronting," he says. "That is part of the appeal."

Insects have also become popular at commercial events. 'The Great Australian Dinner', part of Sydney's Good Food Month in 2013, served Australian green-tree ants in a dish devised by René Redzepi. Organisations such as the Museum of Old and New Art (MONA) in Hobart, Tasmania, and the Climate Institute in Sydney have since served them in environmentally friendly canapés at functions.

Entomophagy has become a trend, albeit a small one. But what happens next is anyone's guess. AG

GRUB: GETTY/DAVID KIRKLAND/*Endoxyla leucomochla*

Upping the ante. Eve Kantor, philanthropist and former part-owner of News Corp, tastes an ant and pork canapé at the 2014 Climate Institute Sydney fundraiser.

Leading the way. Skye Blackburn – pictured here grinding crickets with Glen Young, owner of The Cooking Room – is Australia's only commercial, edible-insect farmer.