The Natural News

Central North Field Naturalists Inc.

No. 83 ~ DECEMBER 2022

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Cover photo: Matt Testoni. Details p. 12

As cute as a cunjevoi

Rod McQueen

Indigenous peoples ate them. Rock fishermen use their soft inner parts as bait. Children poke them to make them squirt like water pistols. "They" are cunjevoi, icons of exposed rocky coastlines around northwest and southern Africa, northern New Zealand, and southwest and southeastern Australia, including Tasmania. Extensive carpets of individuals growing cheek by jowl, often wearing a covering of green and brown algae, can be seen on rocky out-crops and platforms at low tide.

Cunjevoi, aka *Pyura stolonifera*, look like nothing so much as shrivelled, browny-green potatoes when closed for business at low tide. (Fig. 1) When covered by water, they stretch into a stubby cylinder along their vertical axis and begin feeding. The flat, rounded upper surface is ringed by a low ridge and—drum roll—sports two bump-like openings, called "siphons", lying close together and projecting slightly above the flat surface. These siphons, one inhalant and one exhalant, spurt a thin column of water when squeezed, giving rise to the common name of cunjevoi and their kin—"sea squirts" (Fig. 2). Giants among their sea squirt kin, cunjevoi occasionally grow up to 30 cm "tall" when relaxed; 10–15 cm is more the norm. Most other sea squirts range between 0.5 and 10 cm. Encrusting specimens of many different species just a few centimetres or less across are common on the underside of rocks of the intertidal zone in Tasmania.

Sea squirts come in two main flavours: solitary and colonial. Colonial species consist of many small individuals that share a continuous tunic; sometimes they share the exhalant siphon. Though sometimes found clumped together, as is the case with cunjevoi, members of solitary species are anatomically and physiologically independent of their neighbours.

The 3000 or so species of sea squirts belong

Fig. 1. Cunjevoi on rocks in the intertidal zone. Image: ClimateWatch

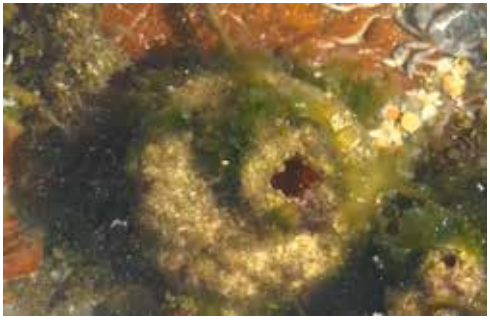


Fig. 2. Inhalant siphon open during feeding. Image: Australian Museum

to the same phylum you and I belong to—phylum Chordata. They comprise the class Ascidiacea of the subphylum Tunicata, or Urochordata. Included among the features that define phylum Chordata are the possession, at some stage in their life cycle, of a hollow nerve cord on the upper side of the body and a rod-like support structure below it called the notochord. In tunicates, these chordate features are found only in the larval dispersal stage; they disappear when the swimming larva attaches to a suitable rock surface and metamorphoses into a sessile "lump".

Cunjevoi and other sea squirts are rum creatures. Crosbie Morrison's description in his book "Along the Track" says it well:

It has no fins or legs… It has no eyes, nothing to take the place of ears, no head, and, unless you take one of the openings… for a mouth, you might be inclined to say it has no mouth. When you have dissected it, on the other hand, you may be inclined to think it is all mouth and nothing else, for the other organs form just a tiny shapeless mass at the bottom of the mouth cavity.

Cunjevoi is surrounded by an outer jacket, known as the "tunic"—a thick, rough, fibrous, leathery rind—which in turn is lined by a muscular mantle. The tunic is a story in its own right, being partly composed of cellulose, an ingredient of plant cell walls. Many functionally-specialised, free cells roam in the tunic. While the function of some, such as phagocytes (immune system cells which ingest microbes and cellular debris), is known, the role of many cell types remains undetermined.

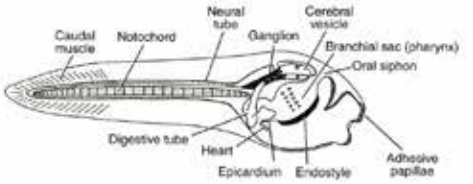


Fig. 3. Typical sea squirt tadpole larva. The stiff cartilaginous notochord, lying beneath the nerve cord (neural tube), provides support for the tail, allowing it to be used for swimming.
From Brusca and Brusca 1990.

In the beginning…

The weird adult phase of a sea squirt's life cycle gives no hint of its buccaneering beginnings. Sea squirts are hermaphroditic and generally release sperm and eggs simultaneously. Eggs usually hatch about 24 hours after fertilization as tiny tadpole larvae sporting a head and a tail (Fig. 3). They range in length from 0.6 mm to 11 mm, cunjevoi larvae being

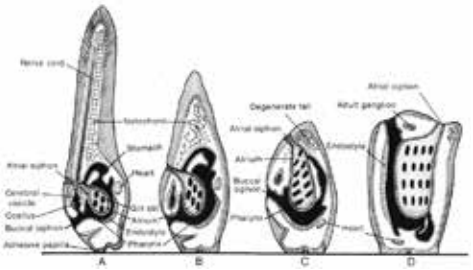


Fig. 4. Sea squirt metamorphosis. A. Lateral view of larva attaching to substratum. B and C. Metamorphosis. D. A young individual just after metamorphosis. After Seeliger from Brien.

roughly 3 mm long. The non-feeding larva "smells out" a suitable substrate and settles after anywhere from a few minutes to several days of swimming the life of Riley. After attaching and cementing itself to the substrate by means of a little glandular pimple under the chin, the magic of metamorphosis transforms the active tadpole into an adult in about four hours. Both tail and "backbone" are absorbed. What started off life with so much promise, backbone and all, fizzles. Thus begins life as a lazy bottom feeder (Fig. 4).

Feeding

I picture the basic structure of a cunjevoi as a lidded bucket with an inflated balloon inside attached along a seam to the inside bucket wall and held in place by thin strings coming from numerous points of the bucket wall. The balloon doesn't occupy the entire bucket but is surrounded by a water-filled space dubbed the atrium which connects with the wild sea outside through the exhalant opening, known as the atrial siphon. The mouth of the balloon attaches to the inhalant opening in the lid, known as the oral siphon.

The balloon corresponds to Morrison's "mouth", known technically as the "pharynx, pharyngeal basket, branchial basket or branchial sac". We'll call it the pharynx. It

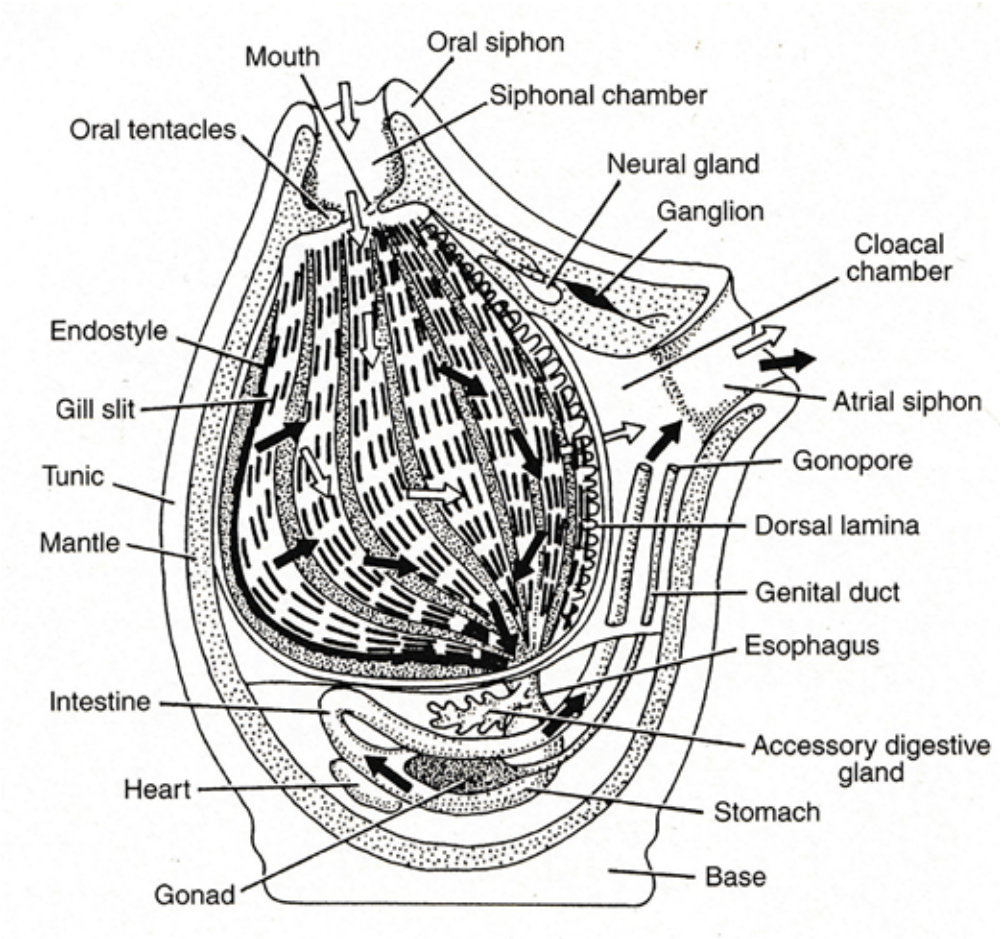


Fig. 5. Diagrammatic bodyplan of "typical" adult sea squirt: Brusca and Brusca 1990

constitutes the feeding organ. All the other organs—gut, heart, gonads—are located in the bottom of the atrium (Fig. 5).

Ascidians are filter feeders, dining on tiny fragments of decomposing algae, faeces, and plankton of all sorts, including diatoms, algal spores, invertebrate gametes, and even bacteria which are sieved out of the water in the pharynx. Cunjevoi can pump prodigious quantities of water while feeding, each individual processing hundreds of litres per day. A study at Hastings Point in Victoria estimated that the local population collectively filters 180 million litres of water per day—72 Olympic-sized swimming pools.

Many scientific articles describe the details of the filtering apparatus and process. (Fig. 6). In brief, it goes like this. The pharynx is a complicated, folded structure, the folding serving to increase the surface area for filtration. (Fig. 7) It consists of horizontally stacked rows of tiny pores called stigmata (Fig. 8) which, in cunjevoi, are about 30-37 μm (microns; one mi-cron is 1/1000 mm) in width (Klumpp). The stigmata are surrounded by tracts of cilia—short, hairlike filaments—whose synchro-

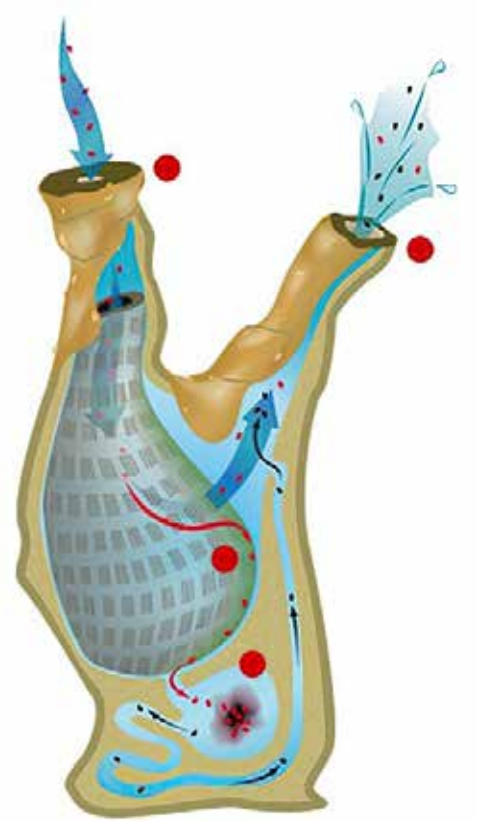


Fig. 6. Sea squirt filter feeding process. Woods Hole Oceanographic Institute.

nized, choreographed lashing is responsible for pumping water through the system. Water is sucked in through the inhalant siphon into the lumen of the pharynx; from there it passes out through the pores of the pharyngeal wall into the atrium and back to the sea. The pharynx also serves in respiration by absorbing gases.

The current is pre-filtered before reaching the pharynx to remove larger particles that would clog the stigmata. This function is carried out by a cage of flexible, elongated fingers called "tentacles" encircling the base of the oral siphon. Thus, 80% of the particles that reach the cunjevoi pharynx are less than 20 μm in diameter (Klumpp).

Fig. 7. This is not a cunjevoi, but the pharynx is clearly visible in this transparent species of sea squirt. Marevision

Fig. 8. Stigmata of *Pyura* spp. Rius and Teske.

Intuitively we might think that food particles are sieved out by the stigmata themselves, lodging on the inside of the basket and then being transported to the gut. But no. As just noted, particles can pass through them. The bars surrounding the pores merely provide somewhere for the cilia to be rooted! The filtering magic is carried out inside the basket. How? Glad you asked. Mucus!

Along the vertical line of attachment of the pharynx to the outer wall a tiny miracle of nature is found—the endostyle (Fig. 9).

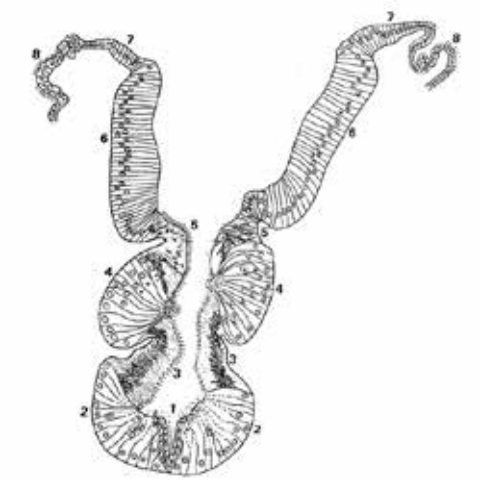


Fig. 9. Diagrammatic cross section of a "typical" sea squirt endostyle. Godeaux and Firkett 1968

This microstructure secretes mucus in large quantities. Not just any old snot, but in the form of two thin sheets or curtains studded with tiny pores that allow the water to pass through. These sheets of mucus are the "filter paper". As these sheets slowly wend their way around opposite internal walls of the pharynx, food particles carried on the current heading out into the atrium stick to them. They join up again on the opposite side where another vertical microstructure, the dorsal lamina, is found. The mucus and attached particles are then rolled into a food string in the dorsal lamina and passed downwards to the oesophagus and intestines for digestion.

The last point to be made has to do with the means by which the mucus sheets are carried from endostyle to dorsal lamina. A second, larger set of cilia found on the bars surrounding the pores hold and move the mucus. As one author puts it, "The cilia seem partially to enter the sheet of mucus and force it forward" (MacGinitie).

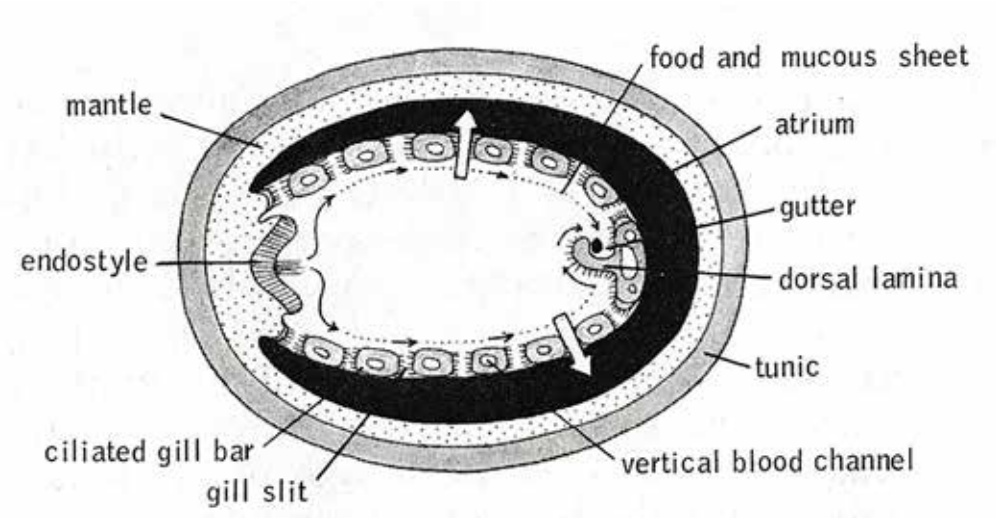
Cunjevoi in Tasmania

Along large stretches of the eastern Australian coast, cunjevoi form highly conspicuous mats encrusting rocky sur-faces that receive a jolly good thrashing by heaving waves between the tides. Mysteriously, though many similar habitats are found in Tasmania, the author has never found cunjevoi on any intertidal rock platforms, including Penguin, where conditions appear to match mainland intertidal zones closely. But don't be fooled. Cunjevoi, you see, is quite fond of Tasmania. You just have to look elsewhere for it.

In April, 2022, Martha and I walked the Arm End Circuit, sandwiched between Opossum Bay and Ralphs Bay at the far end of South Arm. At the end of the circuit, the path pulls up alongside a sandy beach just a few metres wide and stretching for over one kilometre. Large shadowy clumps in the water caught our eye. Climbing onto the beach to get a better view we found similar-sized and -shaped objects littering the sand. What the dickens? Surely not. But yes, cunjevoi.

Answering the question of how they got there is fairly easy. Clumps are often flung onto beaches after storms. But figuring out where they came from is harder. The nearest

Cunjevoi from Arm End Beach. Rod McQueen



Top view of generalised sea squirt showing the endostyle, dorsal lamina, and mucus sheet.
Barnes: Invertebrate Zoology.

high-energy rocky coasts are many kilometres away around Tasman Peninsula and Bruny Island. They must come from much closer by. When I floated the question about the source of Arm End cunjevoi on "Tasmanian Marine and Seashore Life" Facebook wall, the answer became clearer. Richard Mason and John Wilkins suggested they had been scraped off a nearby jetty or fish farm cages. Clive Calver has observed them commonly growing on sand in places like Coningham and Killora Bay. Likewise, Bob Fletcher reported seeing them frequently whilst snorkeling off Droughty Point Beach around the police academy.

Cunjevoi, you see, are like people. Some individuals, bold as brass, love the spotlight, boasting of their prowess by sparring with crashing waves. Shyer specimens thrive on mooring ropes, jetties and fish cages under much gentler conditions up to twelve metres below low tide mark. Some, as Clive Calver observed, even "anchor themselves into softer sediments using root-like projections". [www.qm.qld.gov.au/Explore/Find-+out+about/Animals+of+Queensland/Sea+Life/Ascidians/Cunjevoi]

Keep your eyes open whenever you are visiting our rocky shores. If you do chance to see browny-green lumps growing on exposed rocks, now you know what you are looking at.

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Smithton Sewage Ponds

Richard Ashby

In the Tasmanian waterfowl stakes, Smithton Sewage Ponds, or the northern ones at least, are up there with the best of them – Queechy Pond in Launceston and Goulds Lagoon in Hobart – though the range of species which may be found differ somewhat.

I've been doing Birdata surveys at the Smithton ponds since 1996 and monthly since 2016, during which time eleven species of duck have presented themselves for scrutiny, including the infrequently seen Pink-Eared Duck but not yet the even more elusive Freckled Duck.

A Straw-Necked Ibis turns up from time to time, a Royal Spoonbill or two more frequently but the Yellow-Billed Spoonbill only once so far in winter 2002. A solitary White-Winged Black Tern has visited on three occasions and seven Black-Winged Stilts graced us in 1996. Small Palearctic shorebirds may put in a showing if there is exposed, wet mud but are much more commonly found on the islands and spits to the north and west and in the inlets near Stanley. (See my article 'Shorebird roosts in NW Tasmania: 35years of change' in Tasmanian Bird Report no. 41, Aug 2021). Minor but ongoing earthworks in the northeast ponds make conditions sporadically unsuitable for these northern visitors.

Peter and Hazel Britton spotted a Terek Sandpiper in Oct 2002, rarely seen in Tasmania but White-Fronted Chats and Black-Fronted Dotterels, year-round residents that like similar habitats, are more reliable. You might be lucky enough to flush a Lathams Snipe on its southern vacation from Japan but these beautiful birds are easily seen just across the Duck River at a children's play area in suburban Smithton. This is a Tasmanian hotspot for the species, normally flushed in dribs and drabs from heavy cover but up to

Royal Spoonbills turn up from time to time at the sewage ponds.

124 have been counted here in a small area in summer surveys.

As always with freshwater wetlands (yes, even a sewage pond is a freshwater wetland, as opposed to saline) in cool, temperate zones, water levels are usually higher with winter and spring rainfall, although this needs to be modulated for sewage treatment to be properly controlled. Things tend to be more interesting and rewarding for the human observer if there is exposed, wet mud with the added advantage that birds that feed underwater don't need to dip and dive as much. Only the northern ponds, the final stage for sewage treatment, are of interest but the whole plant is immediately adjacent to the tidal estuary of Duck Bay. If the tide is full, therefore, a couple of dozen Pied Oystercatchers may avail themselves of a spacious roost along with pelicans, four species of cormorant and four species of egret, usually Great.

Sewage system operators have legal responsibilities and their plant needs to be heavily fenced. I approached Taswater's Head Office some years ago, seeking permission to access the Smithton ponds, citing mainland examples like Werribee in Geelong, where birders

sign a legal waiver and are given a key on the assumption that they sufficiently grown-up to look after themselves. I explained what happens to the data generated but was refused point blank. The manager of the neighbouring farm was much more accommodating. Ti- tree windbreaks compromise the view somewhat but viewing conditions are much better with the midday sun to the north and therefor behind the observer.

My personal contributions to Birdata show that in 113 surveys since 1996, 85 species – including all the above-mentioned waterfowl and shorebirds – have put in an appearance within a 500m radius. A few of those may have been one-offs but with climate change ramping up, who knows what surprises may wing their way over the horizon?

White-fronted Chats (left) and Black-fronted Dotterels (right) occupy similar habitats and are reliably seen at the sewage ponds.

Pink-eared Duck (left) are infrequent visitors to the sewage ponds; Australian Pelicans (right), along wth egrets and cormorants, avail themselves of a spacious roost if the tide is full.

Solastalgia – a new and growing issue

Ian Ferris

Solastalgia is a neologism – a new word coined from the Latin 'solacium meaning comfort with your surrounds, peacefulness and harmony (from which we get 'solace'), and Greek 'algos', pain or suffering. The term is mainly used more or less interchangeably with 'eco-anxiety', if used environmentally.

In the world of nature and our appreciation of it, we might find ourselves struggling against an uncaring, ignorant, and frustratingly inactive (or sometimes frustratingly active, but in a wrong way) majority. People either can't or won't understand, as we can see what is happening, and there is nothing we do that seems to work – this can lead to depression and anxiety.

There are three main forms:

1) The angst we feel when the personal comforts that we had are no longer present. This can be loss of a house, loss of a lifestyle, loss of a tree, loss of a forest, or loss of a plant or animal – either at local scale or worldwide. Solastalgia is what people feel when their house is lost after a bushfire, but also when an area of old-growth forest is logged, your land becomes a desert or sensitive habitat is cleared for housing. Note that Nostalgia is the feeling we have for a place or thing we knew, and liked, but was not really connected to us.

2) The despair we feel when we think that we can foresee the future, and it isn't good. We know that things are going to change for the worse, but there seems to be nothing that we can do that will effect that change. This is the sense of loss after you see that your children or grandchildren might be living in a world very different to ours, and probably less pleasant. It is the realisation that there might be no alpine vegetation, that snow is less common, that in future there might be no Devils, Platypus or Koalas.

3) The frustration we feel because we all know what is happening, but nothing is being done to change the course of the degradation of our world. Despite enormous amounts of knowledge, and clear evidence of potential disaster, the majority of people and especially governments, seem not to care and rarely act. The losses are because of your generation's actions, or in-actions.

In recent times, the pandemic has taken away our normal lives, our freedoms and sometimes our health. The anxiety some of us feel is partly due to Solastalgia, because our lives might not be the same ever again. In general Solastalgia is a 'place-based' affliction.

These are forms of induced depression, and some of us will feel them more than others. Importantly, it might not affect people who have no connection to the environment, no feeling for their society, or might not even care about the future.

Perhaps the safest way to avoid Solastalgia is just not to accept that anything is changing, so that nothing is needing to be fixed, and life goes on as normal. Some people completely ignore the problem, especially if it hinders their lifestyle. This is often avoidance, but might result from just not comprehending the issue at its full extent. Although the evidence of change is clear, it is not a problem if you don't/won't listen to it. It can also be because of a belief that it is just natural and all we (or our children) need to do is adapt.

Solastalgia affects the rich less than the poor, and it is not an affliction restricted to western societies. Loss of your lifestyle can be rectified by simply rebuilding, replacing or moving if

you have enough resources. A well off person can spend time and money doing something to ease their loss. That's very tough for someone who has lost all, or never had it, and can't replace it – consider the environmental refugees in North Africa, or even a bankrupt farmer in a drought.

Psychologists internationally have found (by research) that there is no real "cure" for Solastalgia, but there are some prevention and mitigation measures. Prevention is the tough one: avoid the losses that cause the problem. Simply, reduce to insignificance the bulk of environmental harm we all do. That is a very big ask.

Mitigation of this form of depression has been found to have several treatments, including the usual drugs and therapy. Millions worldwide who have lost their homes, land, families or lifestyles may have no solution or mitigation, and must learn to adapt to having Solastalgia for their lifetimes.

Mass migration to try to start again somewhere else is part of their solution, as they see it, but that is simply avoidance or transference.

Similarly, optimists might have faith in the future, that people (usually others) will rise up and force change, or that governments will be made to take notice, or that nature itself will drive changes. Therefore, it will be all OK in the end, so nothing needs to be done now.

Others might not agree that nothing needs to be done, and will struggle and fight to convince others that action of some form is necessary, or physically perform acts that aim to address the issues they feel are important. Many will perform relatively small acts, in the hope that others will copy their actions; the more people that do something, the closer they get to the target. Some will simply try to spread the word – to change attitudes, and bring on change that way.

The most effective treatment for us well-off westernised folk has pleasingly been found to be: a simple walk in the bush. This is actually prescribed by some psychologists. It brings tranquility, peacefulness, self-awareness, and of course, solace. However, the more you know and understand the bigger picture of ecology, the less effective this form of treatment is, because as we all know, "Given time, nature always wins". The damage that humans are doing is having an effect, and there will be some form of opposite reaction sometime in the future.

The important thing is to not give up, not shrug the shoulders, and not do anything. Educating the young and old to see the beauty in the natural world, leads to them valuing it. If they value it, they will try to protect it, and save it. That is a worthwhile cause, and worth doing well.

Walks and other events

All walks are scheduled for the first Sunday of the month unless otherwise stated. Meeting time is usually 10am. Please check the disjunct e-news for details.

Bring food, water, clothes for all weather, hand lens, binoculars, note book & curiosity.

8 January 2023 (**NOT** 1 Jan) Balfour Track, south of Smithton: Leader Ian Ferris 0401434080.
5 Feb A return to Lades Road, Harford.
Thursday 16 February 2023 5.30–7.30pm Evening with the Birds, Tasmanian Arboretum. Please register your interest with Sarah Lloyd Ph: 6396 1380; email: blacksugarloaf@gmail.com
5 March Narawntapu NP

The Strong-billed Honeyeater, whose IUCN conservation status is 'vulnerable', is one of Tasmania's endemic bird species we are hoping to see during evening bird walks at the Arboretum.

Front page image: A Spotted Handfish (*Brachionichthys hirsutus*) guarding eggs. This beautiful fish is critically endangered and is now only found in small populations in the Derwent Estuary in southern Tasmania. Its decline may have started unintentionally during near-shore dredging for scallops, and hastened more recently by the invasive Northern Pacific seastar, and destruction of their breeding habitats from yacht mooring chains.

Spotted handfish usually lay their eggs on stalked Ascidians (seasquirts), and will sit nearby for weeks guarding and tending to their clutch. Once ready, the tiny young that are half the size of a grain of rice, emerge to blanket the seafloor. Photo: Matt Testoni.

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