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Fitting the Bill: Avian Structure and Function

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Softbill

It's a kind of misleading term. For me it suggests an appendage more suited to a rubber chicken than a fairy wren. Of course, we know it refers to avian dietary preference, predominantly to the consumption of soft-bodied foods such as insects, popularly associated with [passerine](#) birds and their counterparts from other [taxa](#). The definition may be expanded to include the flesh of anything: fish, furred or even feathered critters. A [pelican](#) or [eagle](#) is technically annexed into the title under this criterion. And in the cases of an [omnivore](#) such as a [bush stone-curlew](#) – just about anything does!

Softbill logically implies an opposite term – hardbill.

Seed eaters like finches and parrots are traditionally darlings of the avicultural fancy and definitely comprise the majority of birds being kept today. But soft or hard billed, it's imperative that a bird is precisely equipped for the tough though delicate art of survival, which means sporting refined tools of the trade.

Every bird's bill must fit the bill

That is the focus of our discussions here.

A natural selection

The avian beak, like just about any other avian feature, is a masterly construction. When birds were [prototypic reptile-birds](#) about 150 million years ago, they still had a gob full of enamelled teeth. To get into the air they had to chuck off this feature – too plain heavy! Enter the beak, along with similar design gems like hollow bones and air sacs, truly efficient aerial specialisation.

The bill comprises a bony core over an upper and lower mandible. Over this grows a horny sheath named the [Ramphotheca](#). The upper part of the beak is connected most flexibly to the skull with a [Naso-frontal hinge](#). This setup confers great strength with economical lightness. Team it up with appropriate muscles for leverage and the whole outfit really hums. In the case of a cockatoo, the bill is a hard and unrelentingly efficient gadget for dealing with tough, woody foods. But this is just the beginning.

A [Yellow-billed Spoonbill](#) sports a long monster hooter that actually has a soft rubbery tip that is packed with nerve endings. These little corpuscles are very sensitive and quickly transfer information to the brain about the nature of whatever they come in contact with. Hence this bird, a softbill, has 'fingertips' in its beak and this flexible structure physically supports the notion of a 'soft' bill. Notice that it is teamed with stilt-like legs for wading into swampy smorgasbords, swinging the submerged beak from side to side to snap shut on whatever it happens across.

The [Pelican](#) has a famous softbill. Often celebrated in human culture. With a capacity of some 13 litres, it is true that its beak holds more than its belly can! But technically, the thing that takes the water, and with it a load of fish, is the hugely expansive skin of the [gular pouch](#). And you guessed it, its also soft. This immensely useful tool can be used for food collection but the bill bit is up to the task of preening and even feeding minute portions of food to tiny chicks. In the breeding season, Australian pelicans advertise their randy condition by flushing the pouch with blue and pink markings, so the bill also becomes a sexual sign post. Versatility is a big part of the design brief.

For exclusive tastes, the laterally compressed bill of the [Pied Oyster-catcher](#) is a ripper. This beak deftly splices into the tightly clamped lips of the mollusc and finds the nerve that activates the oyster to relax, pressuring the shell top open and expose the juicy morsel. Like the spoonbill, the tip of the beak is packed with [mechanoreceptors](#) for foraging as a probe in mud. Already we are seeing some diverse variations on a basic theme.

The bill of the [Brolga](#) is not a spear but a probe. Just about anything is on the menu: rodents, lizards, frogs, tadpoles, insects, larvae, roots, tubers and sedges. Most of these morsels are submerged under water, buried in the mud or skulking in reeds and grasses, so the forward facing eyes work with the over-sized tweezers to great effect. Cosmopolitan tastes coupled with the right gear are a winning combination - and long legs are perfect for pursuit of a luscious locust.

If you thought the brolga is a gangly bird, the [Pied Stilt](#) boasts the longest legs in proportion to its body of any bird in the world. It is a wader that makes its living from tiny insects that gather on or near the surface of the water, plucking them up with its delicate tweezer-beak. They have highly developed *adductor* muscles connected to the bill that allow the rapid jaw action required for harvesting minuscule aquatic invertebrates.

Enter the humble [chook](#). You may perceive it as a 'hardbill', but its ancestor, the [Junglefowl](#) is an omnivore that will scoff a variety of foods. Anyone who has kept fowls will know how thorough they are at turning over a patch of ground - often one containing newly planted perennials or a row of fancy lettuces! And here the feet also come into play, uncovering all manner of snacks concealed by mulch and muck, with the stout beak attached to a strong peck reflex for harvesting the pickings. It's this adaptability and opportunism that has made the chicken the most economically important bird in the world.

The [Falconiformes](#), also known as raptors or birds of prey, make up one of the largest non passerine bird families. The [Wedge-tailed eagle](#) is one of the best known.

If you want to make a living from other creatures trying to do the same thing, you need some pretty heavy duty gear. Most beasties would rather stay off the menu of a rollicking great eagle, so they are usually fast, tough, or both. Wings give the necessary speed to nab a fleet footed snack but overpowering your prey safely without injury to yourself is of primary concern. That's why a wedge-tailed eagle has large feet furnished with butcher's hooks - and that's just one business end. Once dinner is served, the equipment for feeding is anything but 'soft', yet the eagle is, by our definition, one of the softbill set. The hooked beak teams with powerful neck muscles to rip and tear. And as this bird is a scavenger as well as a skilled hunter, the [lores](#) are bare to allow grotty feasting from mangled road kills and other delicacies.

Even our coat of arms features a famous softbill, the [Emu](#). Although science does not consider any extant species *primitive*, it is true to say that the emu does go back a long way. Thank God they are big and fast, because nature has not really over [endowed them with brains](#).

However, they are superbly adapted to make a living from whatever they can rustle up and they often remind me of a cross between a chook on steroids and tumbleweed as they stroll around pecking at whatever they can find. They are omnivores, eating much plant material but increasing their consumption of insects markedly in the summer months. The huge [gape](#) of the beak is ideal for swallowing large gulps of water, a great device for a bird that is often on the razor's edge of survival, with the boom and bust fluctuations of Australia's climate.

And talking of a big mouth, [Tawny frogmouths](#) are so named for good reason. Although they are often confused with owls, they are actually related to [nightjars](#).

This softbill has a huge gob that acts like a net for scooping up insect prey. It's here that we see that bill structure is only part of the picture: Frogmouths bear a set of fine hair-like feathers around their gape called [rectal bristles](#). These are very sensitive organs; they're kind of like [cat's whiskers](#). They increase the surface area of the bird's open mouth and provide something of an additional net to assist in sensing and scooping up insect prey. If you are out at night, pairing this apparatus with wing plumage fringed with fluffy edges puts on the mufflers and gives these cryptic customers the element of surprise when they want to pounce.

Famously, the [Kookaburra](#) can tackle quite hefty and dangerous prey. It has a patient wait and pounce approach to foraging. That beak always seems to me to be set in a permanently knowing grin but it's a grim prospect for any prey. The kookaburra is the largest of the [kingfisher](#) set, of which there are 90 species. The beak length varies enormously amongst them, influenced by dietary preferences, but the kooka has a fairly stout affair that can stab, parry and thrust with devastating effect.

It isn't simply a matter of catching the food. If you've secured a snake, you want to make pretty damn sure the damn thing is dead before you attempt to swallow it, so kookas bash their prey very soundly on a nice stout branch to not only make sure it's [carked it](#) but to tenderize it prior to the job of digesting it.

[Butcherbirds](#) are the Australian answer to the [shrikes](#) of the Northern hemisphere that 'larder' their food. This is a predatory bird that lacks the size and strength to work over its tucker like the kookaburra so it has come up with another strategy. It hangs it up in a safe spot, usually a 'y' junction of two branches, and then tears strips of it courtesy of that convenient little hook at the end of the upper mandible. A great example of how the pressure cooker of evolution refines animals into diverse models for optimal success.

Another softbill worth mentioning is the [Penguin](#). Broadly accepted as flightless albatross cousins, they are one of the most efficiently adapted birds for their niche. Their bill is a perfect fishing device but it's the inside story that really clinches the deal: Rows of rear facing rasps line the palate and create a 'fatal traction; for their slippery customers.

At last we reach the characters that many think of as true softbills, the [Passerines](#).

The term 'passer' is from the Latin for "sparrow-like", a reference to the structure of the foot with three forward toes and one rear digit called the [hallux](#). Many also boast higher intelligence and the capacity for complex song and are the largest order of the birds on the planet. With over 5,000 members they easily outnumber the other 28 or so orders put together. The songbirds are regarded as the pinnacle of avian evolutionary success. If diversity is anything to go by, that's certainly true.

A brief look at just two of these birds will demonstrate how their basic model can be tailored for any niche.

The [White-throated tree creeper](#) spends most of its time spiraling up and down trunks and branches, fossicking for insect prey hiding underneath the flaky bark, maybe flushing them with its [whirligig](#) action. Its slightly curved bill is a pincer that deftly works over the bush larder while the enormous hallux supports these gravity-defying sorties. Birds similar to this in the northern hemisphere are the [nuthatches](#) and [woodpeckers](#).

The [Yellow-bellied sunbird](#) is the sole Australian representative of the [Nectarinidae](#), known collectively as sunbirds. Not only is this a beautiful bird to end this journey with, it is a classic example of [evolutionary convergence](#).

Australia is blessed with a unique passerine assemblage. Much DNA work in systematics has yielded the revolutionary evidence that our songbirds may well have given rise to many songbird families in the Northern hemisphere. Our largest bird family in Australia is the [Meliphagidae, or honeyeaters](#).

There is a honeyeater for every ecological situation in this country as they developed in tandem with our unique flora, often exploited by plants as mobile and effective cross-pollinators.

Well, ours is not the only ecosystem with plants that require this attention. Africa and Asia have sunbirds. Hawaii has the gorgeous [honeycreepers \(Drepanidinae\)](#) and South America has the celebrated hummingbirds. All these little tykes are the variations on the theme of nectar guzzlers. Furthermore, [hummingbirds](#) are all the more outstanding for the fact that they are not passerine birds at all, but more closely allied to [swifts](#) in the order [Apodiformes](#)

The sunbird, just like the honeyeater, comes set up with a bill that fits the bill of flower-poker. Both also have a tongue tipped with hair-like fringes for lapping up the sugary carbs hidden within. So it's the whole package that makes every extant bird a biographical winner.

Now the only thing remaining is for us to make sure we give these gems half a chance in the survival stakes - not so just the so oft-quotes 'future generations' may enjoy them but because they are viable entities in their own right. In my opinion, they have been in the business of survival for a long time and deserve the chance to continue along the path of evolutionary destiny.

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