PLANTS & BIRDS · POLLINATION

Ornithophily: Flowers Built for Birds

How flowers recruit birds as pollinators — the colours, shapes and nectar recipes of bird flowers, and the hummingbirds and sunbirds that serve them.

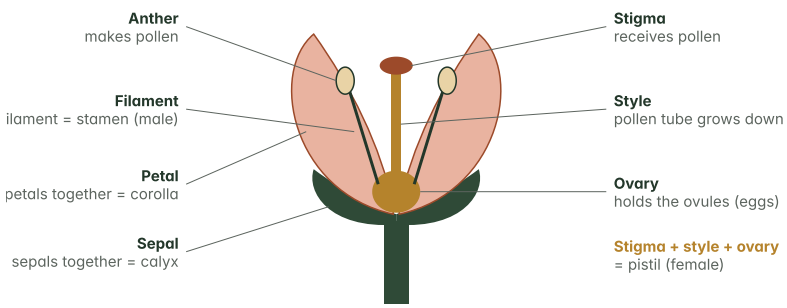
SERIES **SAFARI NOTES** FORMAT **FIELD & GUIDING NOTES** PUBLISHED BY **THE SAFARI SHOW**

> An aloe in winter bloom, buzzing with sunbirds, is ornithophily in action — "bird-loving" flowers that have evolved to be pollinated by birds. In the tropics and the southern temperate zones, birds are at least as important as insects as pollinators, yet they are often overlooked because the science of pollination began in Europe, where pollinating birds are rare.

01 Flowering plants in context

Plants are divided into **seed plants** (flowering plants, or angiosperms, plus the gymnosperms: conifers, cycads and ginkgo) and **seedless plants** that reproduce by spores (mosses, liverworts, horsetails and ferns). Kew's 2016 *State of the World's Plants* report counted about **391,000 known species of vascular plants**, of which roughly **369,000 — about 94% — are flowering plants**.

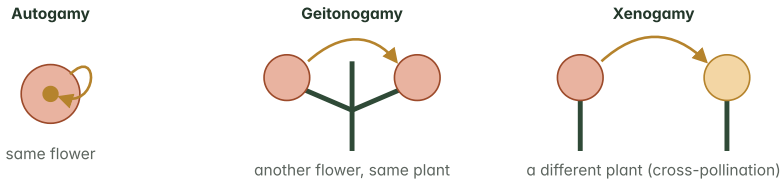
THE PARTS OF A FLOWER



*The **perianth** is the non-reproductive envelope around the sexual parts: the calyx (sepals) plus the corolla (petals).*

02 Pollination

Pollination is the transfer of pollen from an **anther** to a **stigma**. For seed to form, the pollen must normally come from the same species. The pollen grain grows a **pollen tube** down through the style to the ovary, carrying sperm cells to the egg cells. Fertilisation follows, and the ovule develops into a seed.



Autogamy and geitonogamy are both forms of self-pollination genetically, because the pollen comes from the same plant.

SELF-POLLINATION

Reliable but risky long-term

Occurs in plants with **bisexual flowers** (both male and female parts) or with male and female flowers on the same plant. It needs no partner or pollinator, so seed is more assured where pollinators are scarce. But selfing increases **homozygosity**, which exposes harmful recessive genes and can cause **inbreeding depression** — weaker, less fit offspring.

CROSS-POLLINATION

Mixing genes

Pollen from a different plant (**xenogamy**) mixes the genetic information of two parents, increasing **genetic diversity**. It always depends on an outside agent to carry the pollen — wind, water or an animal.

KEEP THE TERMS STRAIGHT

"Dioecious" plants have male and female flowers on *separate* plants, so they cannot self-pollinate. Self-pollination brings harmful recessive characters out into the open, which is why it can weaken a lineage.

AGENTS OF POLLINATION

AGENT	TERM	AGENT	TERM
Wind	Anemophily	Animals (general)	Zoophily
Water	Hydrophily	Insects	Entomophily
Bees	Melittophily	Hawkmoths	Sphingophily
Bats	Chiropterophily	Birds	Ornithophily

The second half of each word comes from the Greek *philia*, love or friendship: ornithophily is literally "bird-loving", anemophily "wind-loving".

03 Birds as pollinators

~1 in 3

PLANT FAMILIES

About a third of the 300 or so flowering-plant families have at least some members with bird-pollinated flowers.

~2,000

BIRD SPECIES

About 2,000 bird species, from 50 or more families, visit flowers more or less regularly for nectar, pollen or the insects and spiders on them.

Most of those birds are **occasional (facultative)** nectar-feeders. A few families are **specialists** that depend heavily on nectar:

FAMILY	COMMON NAME	WHERE
Trochilidae	Hummingbirds	The Americas
Nectariniidae	Sunbirds (and spiderhunters)	Africa, the Middle East, southern Asia to northern Australia
Meliphagidae	Honeyeaters	Australia, New Guinea and nearby islands
Promeropidae	Sugarbirds	Southern Africa only

04 The bird-flower “syndrome”

Plants pollinated mainly by birds have evolved a recognisable suite of traits — a **pollination syndrome**. These traits fall into four broad jobs: **attracting** birds, **excluding** nectar thieves, **protecting** the flower from a large, rough visitor, and **placing pollen** precisely on the bird.

SHAPE

Tubes and perches

Often tubular, with nectar held deep at the base. Hummingbird flowers often hang freely, since hummingbirds hover; in Africa, flowers usually offer something to perch on, because sunbirds normally perch to feed. Stamens and stigma are placed to touch the bird — often its forehead or throat.

COLOUR

Red and orange

Many bird flowers are a pure red or orange, though other combinations occur.

SCENT

Usually none

Bird flowers generally lack scent and open by day.

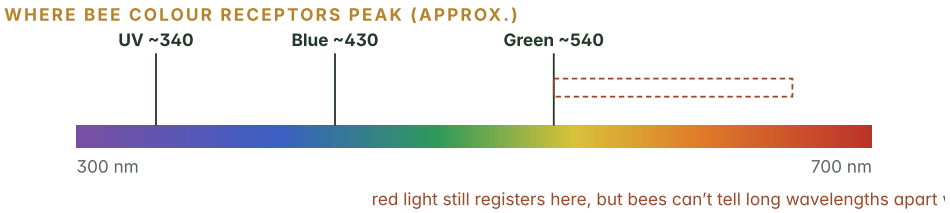
STRENGTH

Sturdy build

Bird flowers are sturdily built to survive a probing bill, and are often grouped in dense clusters that a perching bird can work from one spot.

WHY RED? IT’S NOT THAT BEES CAN’T SEE IT

It used to be said that bees are blind to red. In fact bees’ vision does extend into the red: most bees have three colour receptors, with peaks in the ultraviolet, blue and green, and bright red light (to about 650 nm) still stimulates the green receptor. What bees probably **can’t** do well is tell different long wavelengths apart, so a red flower is harder for a bee to pick out from green leaves. Birds, with their four-cone colour vision (see Safari Notes 06), separate red flowers from foliage easily.



WHY NO SCENT?

Insects rely heavily on smell. The honeybee genome, for example, contains genes for about **170 odorant receptors**, compared with 62 in the fruit fly and 79 in a malaria mosquito. Flower-feeding birds forage mainly by sight, so bird flowers typically put their energy into colour rather than perfume — and scentless flowers are less attractive to insects.

05 The nectar recipe

Nectar is mainly water with three sugars: **sucrose** (a disaccharide) and the two **hexoses**, glucose and fructose. A key study by Johnson & Nicolson (2008) showed that the nectar of bird flowers depends on *which* birds the plant relies on:

	SPECIALIST-BIRD FLOWERS (HUMMINGBIRDS, SUNBIRDS)	GENERALIST-BIRD FLOWERS (WHITE-EYES, WEAVERS, BULBULS…)
Volume	Small, about 10–30 µl	Large, about 40–100 µl
Sugar concentration	Moderate, about 15–25%	Very dilute, about 8–12%
Sucrose share	About 40–60% sucrose	Very low (0–5%) — mostly glucose and fructose

Generalist birds such as the **Village Weaver** prefer hexose sugars at the low concentrations typical of these flowers, and absorb sucrose less efficiently than hexoses — which helps explain why their flowers offer hexose-rich, watery nectar.

RED NECTAR

A few vertebrate-pollinated plants even colour their nectar. *Nesocodon mauritianus* of Mauritius (thought to be pollinated by geckos) makes blood-red nectar using a pigment named **nesocodin**; the same pigment evolved independently in *Jaltomata herrerae*, a hummingbird-visited plant.

06 Hummingbirds: the extreme specialists

Guests often ask about hummingbirds. They are the best-studied nectar specialists, and a useful comparison for our own sunbirds.

- **The tongue is a nectar trap.** Its forked tip is fringed with hair-like **lamellae** that spread open in the nectar, then roll inward and trap it as the tongue is withdrawn. The tongue can flick in and out up to about **20 times a second**.
- **A bendy bill.** The lower half of the bill can bend downward part-way along its length, with no joint, flaring the mouth open wide to catch flying insects — important protein, especially when feeding young.
- **A big memory centre.** Relative to the rest of the forebrain, a hummingbird's hippocampal formation is **two to five times larger** than in songbirds, seabirds and woodpeckers. The authors link this to remembering where flowers are and how much nectar they hold.

- **True hovering.** Hummingbirds are the only birds that can truly hover, and they can fly backwards. In hovering they get about **75% of their lift on the downstroke and 25% on the upstroke**; other birds rely almost entirely on the downstroke. Wings beat roughly 20–80 times a second, depending on species.
- **Specialised muscle.** The large flight muscles are made entirely of **fast oxidative-glycolytic (type IIa)** fibres, packed with mitochondria.
- **Racing heart.** An active hummingbird's heart can beat around **1,200 times a minute**.
- **Sugar straight to the muscles.** Within about 20 minutes of feeding, hummingbirds were fuelling more than 90% of their hovering with the sugar they had just drunk. An elite cyclist can only cover about 15–30% of their energy needs from sugar consumed during exercise.
- **Remarkable kidneys.** Hummingbirds can take in four to five times their body mass in nectar every 12 hours, and absorb about 80% of that water through the gut, so their kidneys must get rid of it. Researchers think the rate at which the kidneys can process water may limit how much energy they can take in — in cold weather they can't drink enough to keep warm.
- **Torpor.** To survive cold nights, many enter torpor. The record is a Black Metaltail in the Andes whose body temperature fell to **3.26 °C** (from about 40 °C by day), cutting energy use by about 95% and its heart rate to as few as 40 beats a minute.

07 Sunbirds and sugarbirds: Africa's answer

In southern Africa the specialist nectar-feeders are the **sunbirds** and **sugarbirds**. Sunbirds look and live much like hummingbirds, but the two groups are not closely related: hummingbirds are usually grouped with the swifts, while sunbirds are perching songbirds (passerines). The resemblance is **convergent evolution** driven by the same nectar-feeding lifestyle.

	HUMMINGBIRDS	SUNBIRDS
Feeding posture	Hover at the flower	Usually perch; some species can hover briefly
Bill & tongue	Flexible lower bill; tongue tips fringed with lamellae	Long, thin, down-curved bill; brush-tipped tubular tongue
Diet	Nectar plus insects	Largely nectar, plus insects and spiders, especially when feeding young
Handling water	Absorb most water (about 80%) and pass it through the kidneys	Can reduce how much water they absorb in the gut, so much of it bypasses the kidneys

That last difference matters. Palestine Sunbirds have been found to avoid absorbing up to **60%** of the water in their diet, and White-bellied Sunbirds also adjust intestinal water absorption to their intake. This may mean their kidneys limit their energy intake less than a hummingbird's do.

08 Bill length, tube length and nectar theft

Many long-tubed flowers match the bills of particular long-billed sunbirds. Short-billed birds can still reach the nectar by piercing the base of the tube, taking the reward without touching the anthers or stigma — **nectar theft**.

A study in the Cape Floristic Region looked at *Chasmanthe floribunda*, a long-tubed plant that relies on the long-billed **Malachite Sunbird**. Malachite Sunbirds are scarce or absent in transformed landscapes, where

short-billed, nectar-thieving sunbirds remain. In single-visit experiments, the short-billed sunbirds produced lower seed set, and the study concluded they **could not fully replace the Malachite Sunbird** as a pollinator.

09 Flowers for generalist birds

Many birds — in our region white-eyes, weavers, orioles, mousebirds, bulbuls, greenbuls and starlings among others — take nectar opportunistically. Flowers adapted to them tend to differ from specialist flowers:

- Shorter, wider or more open flowers, with no long narrow tube, so short-billed birds can reach the nectar.
- Often prominent, brush-like stamens that dust pollen over the bird rather than placing it on one exact spot.
- Large volumes of very dilute, hexose-rich nectar (about 8–12% sugar).

HOW BIRD BEHAVIOUR MAY SHAPE POLLINATION

This part is a **reasonable inference rather than an established finding**; it has been little studied in Africa. Territorial sunbirds that feed from a central perch, working one plant's flowers before moving on, would be expected to cause more pollination within the same plant (geitonogamy). Non-territorial birds that roam in mixed "bird parties" would be expected to carry more pollen between plants (xenogamy).

AT THE ALOE — HOW TO SAY IT

"Notice the flowers are red, tubular and have no scent. That's a flower designed for birds, not bees. Bees can see red, but they struggle to pick it out from green leaves, while birds see it easily."

WHEN A SUNBIRD ARRIVES

"Watch the sunbird's forehead as it feeds — it gets dusted with pollen, and carries it to the next plant. It looks like a hummingbird, but it isn't related; it perches to feed, while hummingbirds hover. It's the same job, solved twice by evolution."

10 Key terms

Ornithophily	Pollination by birds; "bird-loving" flowers.
Perianth	The calyx (sepals) and corolla (petals) together.
Autogamy / geitonogamy	Self-pollination within one flower / between flowers on the same plant.
Xenogamy	Cross-pollination between different plants.
Pollination syndrome	A suite of flower traits that evolved in response to a particular type of pollinator.
Specialist (obligate) nectarivore	A bird that depends heavily on nectar, such as a sunbird or hummingbird.

Generalist (facultative) nectarivore	A bird that takes nectar opportunistically.
Hexoses	The simple sugars glucose and fructose.
Nectar theft	Taking nectar without pollinating, often by piercing the flower tube.
Torpor	A controlled drop in body temperature and metabolism to save energy.

In summary

- About a third of flowering-plant families include bird-pollinated species, visited by some 2,000 bird species.
- Bird flowers tend to be red or orange, tubular, sturdy, scentless and nectar-rich.
- Bees can see red but struggle to separate it from green, so red flowers suit birds better.
- Specialist-bird flowers offer moderate, sucrose-rich nectar; generalist-bird flowers offer dilute, hexose-rich nectar.
- Sunbirds and hummingbirds are a classic case of convergent evolution.

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