

= Mantis =

Mantises are an order ( Mantodea ) of insects that contains over 2 @, @ 400 species and about 430 genera in 15 families . The largest family is the Mantidae ( " mantids " ) . Mantises are distributed worldwide in temperate and tropical habitats . They have triangular heads with bulging eyes supported on flexible necks . Their elongated bodies may or may not have wings , but all Mantodea have fore legs that are greatly enlarged and adapted for catching and gripping prey ; their upright posture , while remaining stationary with fore arms folded , has led to the common name praying mantis .

They are mostly ambush predators , but a few ground @-@ dwelling species are found actively pursuing their prey . They normally live for about a year . In cooler climates , the adults lay eggs in autumn then die . The eggs are protected by their hard capsules and hatch in the spring . Females sometimes practice sexual cannibalism , eating their mates after copulation . Occasionally , the females decapitate the males just before or during mating .

The closest relatives of mantises are the termites and cockroaches ( Blattodea ) , which are all within the superorder Dictyoptera . Mantises are sometimes confused with stick insects ( Phasmatodea ) , other elongated insects such as grasshoppers ( Orthoptera ) , or other insects with raptorial fore legs such as mantisflies ( Mantispidae ) .

Mantises were considered to have supernatural powers by early civilizations , including Ancient Greece , Ancient Egypt , and Assyria . A cultural trope popular in cartoons imagines the female mantis as a femme fatale . Mantises are among the insects most commonly kept as pets .

= = Taxonomy and evolution = =

Over 2 @, @ 400 species of mantis in about 430 genera are recognized . They are predominantly found in tropical regions , but some live in temperate areas . The systematics of mantises have long been disputed . Mantises , along with stick insects ( Phasmatodea ) , were once placed in the order Orthoptera with the cockroaches ( now Blattodea ) and rock crawlers ( now Grylloblattodea ) . Kristensen ( 1991 ) combined the Mantodea with the cockroaches and termites into the order Dictyoptera , suborder Mantodea . The name mantodea is formed from the Ancient Greek words ????? ( mantis ) meaning " prophet " , and ????? ( eidos ) meaning " form " or " type " . It was coined in 1838 by the German entomologist Hermann Burmeister . The order is occasionally called the mantes , using a Latinized plural of Greek mantis . The name mantid properly refers only to members of the family Mantidae , which was , historically , the only family in the order . The other common name , praying mantis , applied to any species in the order , but in Europe mainly to *Mantis religiosa* , comes from the typical " prayer @-@ like " posture with folded fore limbs .

The classification most commonly adopted is that proposed by Beier in 1968 . He divided the order into eight families . Klass , in 1997 , studied the external male genitalia and postulated that the families Chaeteessidae and Metallyticidae diverged from the other families at an early date . However , the Mantidae and Thespidae are both polyphyletic , so the Mantodea will have to be revised .

The earliest mantis fossils are about 135 million years old , from Siberia . Fossils of the group are rare : by 2007 , only about 25 fossil species were known . Fossil mantises , including one from Japan with spines on the front legs as in modern mantises , have been found in Cretaceous amber . Most fossils in amber are nymphs ; compression fossils ( in rock ) include adults . Fossil mantises from the Crato Formation in Brazil include the 10 @-@ mm @-@ long *Santanmantis axelrodi* , described in 2003 ; as in modern mantises , the front legs were adapted for catching prey . Well @-@ preserved specimens yield details as small as 5 ?m through X @-@ ray computed tomography .

Because of the similar raptorial fore legs , mantidflies may be confused with mantises . This similarity is an example of convergent evolution ; mantidflies do not have the leathery forewings of mantises .

= = Biology = =

= = = Anatomy = = =

Mantises have large , triangular heads with a beak @-@ like snout and mandibles . They have two bulbous compound eyes , three small simple eyes , and a pair of antennae . The articulation of the neck is also remarkably flexible ; some species of mantis can rotate their heads nearly 180 ° . The mantis thorax consists of a prothorax , a mesothorax , and a metathorax . In all species apart from the genus *Mantoida* , the prothorax , which bears the head and fore legs , is much longer than the other two thoracic segments . The prothorax is also flexibly articulated , allowing for a wide range of movements of the head and fore limbs while the remainder of the body remains more or less immobile .

Mantises have two spiked , grasping fore legs ( " raptorial legs " ) in which prey items are caught and held securely . In most insect legs , including the posterior four legs of a mantis , the coxa and trochanter combine as an inconspicuous base of the leg ; in the raptorial legs , however , the coxa and trochanter combine to form a segment about as long as the femur , which is a spiky part of the grasping apparatus ( see illustration ) . Located at the base of the femur is a set of discoidal spines , usually four in number , but ranging from none to as many as five depending on the species . These spines are preceded by a number of tooth @-@ like tubercles , which , along with a similar series of tubercles along the tibia and the apical claw near its tip , give the fore leg of the mantis its grasp on its prey . The fore leg ends in a delicate tarsus used as a walking appendage , made of four or five segments and ending in a two @-@ toed claw with no arolium .

Mantises can be loosely categorized as being macropterous ( long @-@ winged ) , brachypterous ( short @-@ winged ) , micropterous ( vestigial @-@ winged ) , or apterous ( wingless ) . If not wingless , a mantis has two sets of wings : the outer wings , or tegmina , are usually narrow and leathery . They function as camouflage and as a shield for the hind wings , which are clearer and more delicate . The abdomen of all mantises consists of 10 tergites , with a corresponding set of nine sternites visible in males and seven visible in females . The abdomen tends to be slimmer in males than females , but ends in a pair of cerci in both sexes .

= = = Vision = = =

Mantises have stereo vision . They locate their prey by sight ; their compound eyes contain up to 10 @, @ 000 ommatidia . A small area at the front called the fovea has greater visual acuity than the rest of the eye , and can produce the high resolution necessary to examine potential prey . The peripheral ommatidia are concerned with perceiving motion ; when a moving object is noticed , the head is rapidly rotated to bring the object into the visual field of the fovea . Further motions of the prey are then tracked by movements of the mantis 's head so as to keep the image centered on the fovea . The eyes are widely spaced and laterally situated , affording a wide binocular field of vision and precise stereoscopic vision at close range . The dark spot on each eye that moves as it rotates its head is a pseudopupil . This occurs because the ommatidia that are viewed " head @-@ on " absorb the incident light , while those to the side reflect it .

As their hunting relies heavily on vision , mantises are primarily diurnal . Many species , however , fly at night , and then may be attracted to artificial lights . Nocturnal flight is especially important to males in locating less @-@ mobile females by detecting their pheromones . Flying at night exposes mantises to fewer bird predators than diurnal flight would . Many mantises also have an auditory thoracic organ that helps them avoid bats by detecting their echolocation calls and responding evasively .

= = = Diet and predation = = =

Mantises are generalist predators of arthropods . The majority of mantises are ambush predators

that only feed upon live prey within their reach . They either camouflage themselves and remain stationary , waiting for prey to approach , or stalk their prey with slow , stealthy movements . Larger mantises sometimes eat smaller individuals of their own species , as well as small vertebrates such as lizards and frogs .

Most mantises chase tempting prey if it strays close enough , and will go further when they are especially hungry . Once within reach , mantises strike rapidly to grasp the prey with their spiked raptorial fore legs . Some ground and bark species pursue their prey in a more active way . For example , members of a few genera such as the ground mantises , *Entella* , *Ligaria* , and *Ligariella* run over dry ground seeking prey , much as tiger beetles do .

The fore gut of some species extends the whole length of the insect and can be used to store prey for digestion later . This may be advantageous in an insect that feeds intermittently . Chinese mantises live longer , grow faster , and produce more young when they are able to eat pollen .

#### = = = Antipredator adaptations = = =

Mantises are preyed on by vertebrates such as frogs , lizards , and birds , and by invertebrates such as spiders and ants . Generally , mantises protect themselves by camouflage , most species being cryptically colored to resemble foliage or other backgrounds , both to avoid predators and to better snare their prey . Those that live on uniformly colored surfaces such as bare earth or tree bark are dorsoventrally flattened so as to eliminate shadows that might reveal their presence . The species from different families called flower mantises are aggressive mimics : They resemble flowers convincingly enough to attract prey that come to collect pollen and nectar . Some species in Africa and Australia are able to turn black after a molt towards the end of the dry season ; at this time of year , bush fires occur and this coloration enables them to blend in with the fire @-@ ravaged landscape ( fire melanism ) .

When directly threatened , many mantis species stand tall and spread their fore legs , with their wings fanning out wide . The fanning of the wings makes the mantis seem larger and more threatening , with some species enhancing this effect with bright colors and patterns on their hind wings and inner surfaces of their front legs . If harassment persists , a mantis may strike with its fore legs and attempt to pinch or bite . As part of the bluffing ( deimatic ) threat display , some species may also produce a hissing sound by expelling air from the abdominal spiracles . Mantises lack chemical protection , so their displays are largely bluff . When flying at night , at least some mantises are able to detect the echolocation sounds produced by bats ; when the frequency begins to increase rapidly , indicating an approaching bat , they stop flying horizontally and begin a descending spiral toward the safety of the ground , often preceded by an aerial loop or spin . If caught , they may slash captors with their raptorial legs .

Mantises , like stick insects , show rocking behavior in which the insect makes rhythmic , repetitive side @-@ to @-@ side movements . Functions proposed for this behavior include the enhancement of crypsis by means of the resemblance to vegetation moving in the wind . However , the repetitive swaying movements may be most important in allowing the insects to discriminate objects from the background by their relative movement , a visual mechanism typical of animals with simpler sight systems . Rocking movements by these generally sedentary insects may replace flying or running as a source of relative motion of objects in the visual field . As ants may be predators of mantises , genera such as *Loxomantis* , *Orthodera* , and *Statilia* , like many other arthropods , avoid attacking them . Exploiting this behavior , a variety of arthropods , including some early @-@ instar mantises , mimic ants to evade their predators .

#### = = = Reproduction and life history = = =

The mating season in temperate climates typically takes place in autumn , while in tropical areas , mating can occur at any time of the year . To mate following courtship , the male usually leaps onto the female 's back , clasping her thorax and wing bases with his fore legs . He then arches his abdomen to deposit and store sperm in a special chamber near the tip of the female 's abdomen .

The female lays between 10 and 400 eggs , depending on the species . Eggs are typically deposited in a frothy mass @-@ produced by glands in the abdomen . This froth hardens , creating a protective capsule , which together with the egg mass is called an ootheca . Depending on the species , the ootheca can be attached to a flat surface , wrapped around a plant , or even deposited in the ground . Despite the versatility and durability of the eggs , they are often preyed on , especially by several species of parasitoid wasps . In a few species , mostly ground and bark mantises in the family Tarachodidae , the mother guards the eggs . The cryptic *Tarachodes maurus* positions herself on bark with her abdomen covering her egg capsule , ambushing passing prey and moving very little until the eggs hatch . A unique reproductive strategy is adopted by Brunner 's stick mantis from the southern United States . No males have ever been found in this species , and the females breed parthenogenetically . In temperate climates , adults do not survive the winter and the eggs undergo a diapause , hatching in the spring .

As in closely related insect groups in the superorder Dictyoptera , mantises go through three life stages : egg , nymph , and adult ( mantises are among the hemimetabolous insects ) . For smaller species , the eggs may hatch in 3 ? 4 weeks as opposed to 4 ? 6 weeks for larger species . The nymphs may be colored differently from the adult , and the early stages are often mimics of ants . A mantis nymph grows bigger as it molts its exoskeleton . Molting can happen five to 10 times before the adult stage is reached , depending on the species . After the final molt , most species have wings , though some species remain wingless or brachypterous ( " short @-@ winged " ) , particularly in the female sex . The lifespan of a mantis depends on the species ; smaller ones may live 4 ? 8 weeks , while larger species may live 4 ? 6 months .

#### == Sexual cannibalism ==

Sexual cannibalism is common among most predatory species of mantises in captivity . It has sometimes been observed in natural populations , where about a quarter of male @-@ female encounters results in the males being eaten by the female . Around 90 % of the predatory species of mantises participate in sexual cannibalism . Adult males typically outnumber females at first , but their numbers may be fairly equivalent later in the adult stage , possibly because females selectively eat the smaller males . In *Tenodera sinensis* , 83 % of males escape cannibalism after an encounter with a female , but since multiple matings occur , the probability of a male 's being eaten increases cumulatively .

The female may begin feeding by biting off the male 's head ( as they do with regular prey ) , and if mating has begun , the male 's movements may become even more vigorous in its delivery of sperm . Early researchers thought that because copulatory movement is controlled by a ganglion in the abdomen , not the head , removal of the male 's head was a reproductive strategy by females to enhance fertilization while obtaining sustenance . Later , this behavior appeared to be an artifact of intrusive laboratory observation . Whether the behavior is natural in the field or also the result of distractions caused by the human observer remains controversial . Mantises are highly visual organisms and notice any disturbance in the laboratory or field , such as bright lights or moving scientists . Chinese mantises that had been fed *ad libitum* ( so that they were not hungry ) actually displayed elaborate courtship behavior when left undisturbed . The male engages the female in a courtship dance , to change her interest from feeding to mating . Under such circumstances , the female has been known to respond with a defensive deimatic display by flashing the colored eyespots on the inside of her front legs .

The reason for sexual cannibalism has been debated ; experiments show that females on low quality diets have a higher chance to engage in sexual cannibalism compared to females on high quality diets . Some consider that submissive males gain a selective advantage by producing offspring . This theory is supported by a quantifiable increase in the duration of copulation among males which are cannibalized , in some cases doubling both the duration and the chance of fertilization . This is contrasted by a study where males were seen to approach hungry females with more caution , and were shown to remain mounted on hungry females for a longer time , indicating that males that actively avoid cannibalism may mate with multiple females . The same study also

found that hungry females generally attracted fewer males than those that were well fed . The act of dismounting after copulation is dangerous for males , for at this time , females most frequently cannibalize their mates . An increase in mounting duration appears to indicate that males wait for an opportune time to dismount a hungry female , who would be likely to cannibalize her mate .

= = Relationship with humans = =

= = = In literature and art = = =

One of the earliest mantis references is in the ancient Chinese dictionary Erya , which gives its attributes in poetry , where it represents courage and fearlessness , and a brief description . A later text , the Jingshi Zhenglei Daguan Bencao ( " Great History of Medical Material Annotated and Arranged by Types , Based upon the Classics and Historical Works " ) from 1108 , gives accurate details of the construction of the egg packages , the development cycle , anatomy , and the function of the antennae . Although mantises are rarely mentioned in Ancient Greek sources , a female mantis in threat posture is accurately illustrated on a series of fifth @-@ century BC silver coins , including didrachms , from Metapontum in Sicily . In the 10th century AD , Byzantine era Adages , Suidas describes an insect resembling a slow @-@ moving green locust with long front legs . He translates Zenobius 2 @.@ 94 with the words seriphos ( maybe a mantis ) and graus , an old woman , implying a thin , dried @-@ up stick of a body .

Western descriptions of the biology and morphology of the mantises became more accurate in the 18th century . Roesel von Rosenhof illustrated and described mantises and their cannibalistic behavior in the Insekten @-@ Belustigungen ( Insect Entertainments ) .

Aldous Huxley made philosophical observations about the nature of death while two mantises mated in the sight of two characters in his 1962 novel Island ( the species was *Gongylus gongylodes* ) . The naturalist Gerald Durrell 's humorously autobiographical 1956 book *My Family and Other Animals* includes a four @-@ page account of an almost evenly matched battle between a mantis and a gecko . Shortly before the fatal dénouement , Durrell narrates :

he [ Geronimo the gecko ] crashed into the mantis and made her reel , and grabbed the underside of her thorax in his jaws . Cicely [ the mantis ] retaliated by snapping both her front legs shut on Geronimo 's hind legs . They rustled and staggered across the ceiling and down the wall , each seeking to gain some advantage .

M. C. Escher 's woodcut *Dream* depicts a human @-@ sized mantis standing on a sleeping bishop . The 1957 film *The Deadly Mantis* features a mantis as a giant monster .

A cultural trope imagines the female mantis as a femme fatale . The idea is propagated in cartoons by Cable , Guy and Rodd , LeLievre , T. McCracken , and Mark Parisi , among others . It ends Isabella Rossellini 's short film about the life of a praying mantis in her 2008 *Green Porno* season for the Sundance Channel .

= = = Martial arts = = =

Two martial arts separately developed in China have movements and fighting strategies based on those of the mantis . As one of these arts was developed in northern China , and the other in southern parts of the country , the arts are nowadays referred to ( both in English and Chinese ) as ' Northern Praying Mantis ' and ' Southern Praying Mantis ' . Both are very popular in China , and have also been exported to the West in recent decades .

= = = In mythology and religion = = =

The mantis was considered a god in southern African Khoi and San tradition for its praying posture ; the word for the mantis in Afrikaans is *Hottentotsgot* ( " god of the Khoi " ) . Several ancient civilizations considered the insect to have supernatural powers ; for the Greeks , it had the ability to

show lost travelers the way home ; in the Ancient Egyptian Book of the Dead the " bird @-@ fly " is a minor god that leads the souls of the dead to the underworld ; in a list of 9th @-@ century BC Nineveh grasshoppers ( buru ) , the mantis is named necromancer ( buru @-@ enmeli ) and soothsayer ( buru @-@ enmeli @-@ ashaga ) .

= = = As pets = = =

Mantises are among the insects most widely kept as pets . Because the lifespan of a mantis is only about a year , people who want to keep mantises often breed them . At least 31 species are kept and bred in the United Kingdom , the Netherlands , and the United States . The Independent described the " giant Asian praying mantis " as " part stick insect with a touch of Buddhist monk " , and stated that they needed a vivarium around 30 cm ( 12 in ) on each side . The Daily Mail recorded that a pet " budwing mantis " in Arizona " lifted a dead goldfish " out of its bowl and ate it . The Daily South argued that a pet insect was no weirder than a pet rat or ferret , and that while a pet mantis was unusual , it would not " bark , shed , [ or ] need shots or a litter box " .

= = = For pest control = = =

Gardeners who prefer to avoid pesticides may encourage mantises in the hope of controlling insect pests . However , mantises do not have key attributes of biological pest control agents ; they do not specialize in a single pest insect , and do not multiply rapidly in response to an increase in such a prey species , but are general predators . They eat whatever they can catch , including both harmful and beneficial insects . They therefore have " negligible value " in biological control .

Two species , the Chinese mantis and the European mantis , were deliberately introduced to North America in the hope that they would serve as pest controls for agriculture ; they have spread widely in both the United States and Canada .

= = = Mantis @-@ like robot = = =

A prototype robot inspired by the fore legs of the praying mantis has front legs that allow the robot to walk , climb steps , and grasp objects . The multi @-@ jointed leg provides dexterity via a rotatable joint . Future models may include a more spiked fore leg to improve the grip and ability to support more weight .