

= Komodo dragon =

The Komodo dragon ( *Varanus komodoensis* ), also known as the Komodo monitor , is a large species of lizard found in the Indonesian islands of Komodo , Rinca , Flores , Gili Motang , and Padar . A member of the monitor lizard family Varanidae , it is the largest living species of lizard , growing to a maximum length of 3 metres ( 10 ft ) in rare cases and weighing up to approximately 70 kilograms ( 150 lb ) .

Their unusually large size has been attributed to island gigantism , since no other carnivorous animals fill the niche on the islands where they live . However , recent research suggests the large size of Komodo dragons may be better understood as representative of a relict population of very large varanid lizards that once lived across Indonesia and Australia , most of which , along with other megafauna , died out after the Pleistocene . Fossils very similar to *V. komodoensis* have been found in Australia dating to greater than 3 @. @ 8 million years ago , and its body size remained stable on Flores , one of the handful of Indonesian islands where it is currently found , over the last 900 @, @ 000 years , " a time marked by major faunal turnovers , extinction of the island 's megafauna , and the arrival of early hominids by 880 ka [ kiloannums ] . "

As a result of their size , these lizards dominate the ecosystems in which they live . Komodo dragons hunt and ambush prey including invertebrates , birds , and mammals . It has been claimed that they have a venomous bite ; there are two glands in the lower jaw which secrete several toxic proteins . The biological significance of these proteins is disputed , but the glands have been shown to secrete an anticoagulant . Komodo dragon group behaviour in hunting is exceptional in the reptile world . The diet of big Komodo dragons mainly consists of deer , though they also eat considerable amounts of carrion . Komodo dragons also occasionally attack humans in the area of West Manggarai Regency where they live in Indonesia .

Mating begins between May and August , and the eggs are laid in September . About 20 eggs are deposited in abandoned megapode nests or in a self @- @ dug nesting hole . The eggs are incubated for seven to eight months , hatching in April , when insects are most plentiful . Young Komodo dragons are vulnerable and therefore dwell in trees , safe from predators and cannibalistic adults . They take 8 to 9 years to mature , and are estimated to live up to 30 years .

Komodo dragons were first recorded by Western scientists in 1910 . Their large size and fearsome reputation make them popular zoo exhibits . In the wild , their range has contracted due to human activities , and they are listed as vulnerable by the IUCN . They are protected under Indonesian law , and a national park , Komodo National Park , was founded to aid protection efforts .

= = Etymology = =

The Komodo dragon is also known as the Komodo monitor or the Komodo Island monitor in scientific literature , although this is not very common . To the natives of Komodo Island , it is referred to as ora , buaya darat ( land crocodile ) , or biawak raksasa ( giant monitor ) .

= = Evolutionary history = =

The evolutionary development of the Komodo dragon started with the *Varanus* genus , which originated in Asia about 40 million years ago and migrated to Australia . Around 15 million years ago , a collision between Australia and Southeast Asia allowed the varanids to move into what is now the Indonesian archipelago , extending their range as far east as the island of Timor . The Komodo dragon was believed to have differentiated from its Australian ancestors 4 million years ago . However , recent fossil evidence from Queensland suggests the Komodo dragon evolved in Australia before spreading to Indonesia . Dramatic lowering of sea level during the last glacial period uncovered extensive stretches of continental shelf that the Komodo dragon colonised , becoming isolated in their present island range as sea levels rose afterwards .

= = Description = =

In the wild , an adult Komodo dragon usually weighs around 70 kg ( 150 lb ) , although captive specimens often weigh more . According to the Guinness Book of World Records , an average adult male will weigh 79 to 91 kg ( 174 to 201 lb ) and measure 2 @. @ 59 m ( 8 @. @ 5 ft ) , while an average female will weigh 68 to 73 kg ( 150 to 161 lb ) and measure 2 @. @ 29 m ( 7 @. @ 5 ft ) . The largest verified wild specimen was 3 @. @ 13 m ( 10 @. @ 3 ft ) long and weighed 166 kg ( 366 lb ) , including undigested food . The Komodo dragon has a tail as long as its body , as well as about 60 frequently replaced , serrated teeth that can measure up to 2 @. @ 5 cm ( 1 in ) in length . Its saliva is frequently blood @-@ tinged , because its teeth are almost completely covered by gingival tissue that is naturally lacerated during feeding . It also has a long , yellow , deeply forked tongue . Komodo dragon skin is reinforced by armoured scales , which contain tiny bones called osteoderms that function as a sort of natural chain @-@ mail . This rugged hide makes Komodo dragon skin poorly suited for making into leather .

#### = = = Senses = = =

As with other varanids , Komodo dragons have only a single ear bone , the stapes , for transferring vibrations from the tympanic membrane to the cochlea . This arrangement means they are likely restricted to sounds in the 400 to 2 @, @ 000 hertz range , compared to humans who hear between 20 and 20 @, @ 000 hertz . It was formerly thought to be deaf when a study reported no agitation in wild Komodo dragons in response to whispers , raised voices , or shouts . This was disputed when London Zoological Garden employee Joan Proctor trained a captive specimen to come out to feed at the sound of her voice , even when she could not be seen .

The Komodo dragon can see objects as far away as 300 m ( 980 ft ) , but because its retinas only contain cones , it is thought to have poor night vision . The Komodo dragon is able to see in colour , but has poor visual discrimination of stationary objects .

The Komodo dragon uses its tongue to detect , taste , and smell stimuli , as with many other reptiles , with the vomeronasal sense using the Jacobson 's organ , rather than using the nostrils . With the help of a favorable wind and its habit of swinging its head from side to side as it walks , a Komodo dragon may be able to detect carrion from 4 ? 9 @. @ 5 km ( 2 @. @ 5 ? 5 @. @ 9 mi ) away . It only has a few taste buds in the back of its throat . Its scales , some of which are reinforced with bone , have sensory plaques connected to nerves to facilitate its sense of touch . The scales around the ears , lips , chin , and soles of the feet may have three or more sensory plaques .

#### = = Behaviour and ecology = =

The Komodo dragon prefers hot and dry places , and typically lives in dry , open grassland , savanna , and tropical forest at low elevations . As an ectotherm , it is most active in the day , although it exhibits some nocturnal activity . Komodo dragons are solitary , coming together only to breed and eat . They are capable of running rapidly in brief sprints up to 20 km / h ( 12 mph ) , diving up to 4 @. @ 5 m ( 15 ft ) , and climbing trees proficiently when young through use of their strong claws . To catch out @-@ of @-@ reach prey , the Komodo dragon may stand on its hind legs and use its tail as a support . As it matures , its claws are used primarily as weapons , as its great size makes climbing impractical .

For shelter , the Komodo dragon digs holes that can measure from 1 to 3 m ( 3 @. @ 3 to 9 @. @ 8 ft ) wide with its powerful forelimbs and claws . Because of its large size and habit of sleeping in these burrows , it is able to conserve body heat throughout the night and minimise its basking period the morning after . The Komodo dragon hunts in the afternoon , but stays in the shade during the hottest part of the day . These special resting places , usually located on ridges with cool sea breezes , are marked with droppings and are cleared of vegetation . They serve as strategic locations from which to ambush deer .

#### = = = Diet = = =

Komodo dragons are carnivores . Although they eat mostly carrion , they will also ambush live prey with a stealthy approach . When suitable prey arrives near a dragon 's ambush site , it will suddenly charge at the animal and go for the underside or the throat . It is able to locate its prey using its keen sense of smell , which can locate a dead or dying animal from a range of up to 9 @. @ 5 km ( 5 @. @ 9 mi ) . Komodo dragons have been observed knocking down large pigs and deer with their strong tails .

Komodo dragons eat by tearing large chunks of flesh and swallowing them whole while holding the carcass down with their forelegs . For smaller prey up to the size of a goat , their loosely articulated jaws , flexible skulls , and expandable stomachs allow them to swallow prey whole . The vegetable contents of the stomach and intestines are typically avoided . Copious amounts of red saliva the Komodo dragons produce help to lubricate the food , but swallowing is still a long process ( 15 ? 20 minutes to swallow a goat ) . A Komodo dragon may attempt to speed up the process by ramming the carcass against a tree to force it down its throat , sometimes ramming so forcefully , the tree is knocked down . A small tube under the tongue that connects to the lungs allows it to breathe while swallowing . After eating up to 80 % of its body weight in one meal , it drags itself to a sunny location to speed digestion , as the food could rot and poison the dragon if left undigested for too long . Because of their slow metabolism , large dragons can survive on as few as 12 meals a year . After digestion , the Komodo dragon regurgitates a mass of horns , hair , and teeth known as the gastric pellet , which is covered in malodorous mucus . After regurgitating the gastric pellet , it rubs its face in the dirt or on bushes to get rid of the mucus , suggesting it does not relish the scent of its own excretions .

The largest animals eat first , while the smaller ones follow a hierarchy . The largest male asserts his dominance and the smaller males show their submission by use of body language and rumbling hisses . Dragons of equal size may resort to " wrestling " . Losers usually retreat , though they have been known to be killed and eaten by victors .

The Komodo dragon 's diet is wide @-@ ranging , and includes invertebrates , other reptiles ( including smaller Komodo dragons ) , birds , bird eggs , small mammals , monkeys , wild boar , goats , deer , horses , and water buffalo . Young Komodos will eat insects , eggs , geckos , and small mammals . Occasionally , they attack and bite humans ( see first paragraphs of this article ) . Sometimes they consume human corpses , digging up bodies from shallow graves . This habit of raiding graves caused the villagers of Komodo to move their graves from sandy to clay ground and pile rocks on top of them to deter the lizards . The Komodo dragon may have evolved to feed on the extinct dwarf elephant *Stegodon* that once lived on Flores , according to evolutionary biologist Jared Diamond .

The Komodo dragon drinks by sucking water into its mouth via buccal pumping ( a process also used for respiration ) , lifting its head , and letting the water run down its throat .

= = = Saliva = = =

Although previous studies proposed that Komodo dragon saliva contains a variety of highly septic bacteria that would help to bring down prey , research in 2013 suggested that the bacteria in the mouths of Komodo dragons are ordinary and similar to those found in other carnivores . They actually have surprisingly good mouth hygiene . As Bryan Fry put it : " After they are done feeding , they will spend 10 to 15 minutes lip @-@ licking and rubbing their head in the leaves to clean their mouth ... Unlike people have been led to believe , they do not have chunks of rotting flesh from their meals on their teeth , cultivating bacteria . " The observation of prey dying of sepsis would then be explained by the natural instinct of water buffalos , who are not native to the islands where the Komodo dragon lives , to run into water when attacked . The warm , faeces @-@ filled water would then cause the infections . The study used samples from 16 captive dragons ( 10 adults and six neonates ) from three U.S. zoos .

= = = Venom = = =

In late 2005 , researchers at the University of Melbourne speculated the perentie ( *Varanus giganteus* ) , other species of monitors , and agamids may be somewhat venomous . The team believes the immediate effects of bites from these lizards were caused by mild envenomation . Bites on human digits by a lace monitor ( *V. varius* ) , a Komodo dragon , and a spotted tree monitor ( *V. scalaris* ) all produced similar effects : rapid swelling , localised disruption of blood clotting , and shooting pain up to the elbow , with some symptoms lasting for several hours .

In 2009 , the same researchers published further evidence demonstrating Komodo dragons possess a venomous bite . MRI scans of a preserved skull showed the presence of two glands in the lower jaw . The researchers extracted one of these glands from the head of a terminally ill dragon in the Singapore Zoological Gardens , and found it secreted several different toxic proteins . The known functions of these proteins include inhibition of blood clotting , lowering of blood pressure , muscle paralysis , and the induction of hypothermia , leading to shock and loss of consciousness in envenomated prey . As a result of the discovery , the previous theory that bacteria were responsible for the deaths of Komodo victims was disputed .

Kurt Schwenk , an evolutionary biologist at the University of Connecticut , finds the discovery of these glands intriguing , but considers most of the evidence for venom in the study to be " meaningless , irrelevant , incorrect or falsely misleading " . Even if the lizards have venom @-@ like proteins in their mouths , Schwenk argues , they may be using them for a different function , and he doubts venom is necessary to explain the effect of a Komodo dragon bite , arguing that shock and blood loss are the primary factors .

Other scientists have stated that this allegation of venom glands " has had the effect of underestimating the variety of complex roles played by oral secretions in the biology of reptiles , produced a very narrow view of oral secretions and resulted in misinterpretation of reptilian evolution " . According to these scientists " reptilian oral secretions contribute to many biological roles other than to quickly dispatch prey " . These researchers concluded that , " Calling all in this clade venomous implies an overall potential danger that does not exist , misleads in the assessment of medical risks , and confuses the biological assessment of squamate biochemical systems " .

= = = Reproduction = = =

Mating occurs between May and August , with the eggs laid in September . During this period , males fight over females and territory by grappling with one another upon their hind legs , with the loser eventually being pinned to the ground . These males may vomit or defecate when preparing for the fight . The winner of the fight will then flick his long tongue at the female to gain information about her receptivity . Females are antagonistic and resist with their claws and teeth during the early phases of courtship . Therefore , the male must fully restrain the female during coitus to avoid being hurt . Other courtship displays include males rubbing their chins on the female , hard scratches to the back , and licking . Copulation occurs when the male inserts one of his hemipenes into the female 's cloaca . Komodo dragons may be monogamous and form " pair bonds " , a rare behavior for lizards .

Female Komodos lay their eggs from August to September and may use several types of locality ; in one study , 60 % laid their eggs in the nests of orange @-@ footed scrubfowl ( a moundbuilder or megapode ) , 20 % on ground level and 20 % in hilly areas . The females make many camouflage nests / holes to prevent other dragons from eating the eggs . Clutches contain an average of 20 eggs , which have an incubation period of 7 ? 8 months . Hatching is an exhausting effort for the neonates , which break out of their eggshells with an egg tooth that falls off soon after . After cutting themselves out , the hatchlings may lie in their eggshells for hours before starting to dig out of the nest . They are born quite defenseless and are vulnerable to predation . Sixteen youngsters from a single nest were on average 46 @.@ 5 cm long and weighed 105 @.@ 1 grams .

Young Komodo dragons spend much of their first few years in trees , where they are relatively safe from predators , including cannibalistic adults , as juvenile dragons make up 10 % of their diets . The habit of cannibalism may be advantageous in sustaining the large size of adults , as medium @-@

sized prey on the islands is rare . When the young approach a kill , they roll around in faecal matter and rest in the intestines of eviscerated animals to deter these hungry adults . Komodo dragons take approximately 8 to 9 years to mature , and may live for up to 30 years .

= = = Parthenogenesis = = =

A Komodo dragon at London Zoo named Sungai laid a clutch of eggs in late 2005 after being separated from male company for more than two years . Scientists initially assumed she had been able to store sperm from her earlier encounter with a male , an adaptation known as superfecundation . On 20 December 2006 , it was reported that Flora , a captive Komodo dragon living in the Chester Zoo in England , was the second known Komodo dragon to have laid unfertilised eggs : she laid 11 eggs , and seven of them hatched , all of them male . Scientists at Liverpool University in England performed genetic tests on three eggs that collapsed after being moved to an incubator , and verified Flora had never been in physical contact with a male dragon . After Flora 's eggs ' condition had been discovered , testing showed Sungai 's eggs were also produced without outside fertilization . On 31 January 2008 , the Sedgwick County Zoo in Wichita , Kansas , became the first zoo in the Americas to document parthenogenesis in Komodo dragons . The zoo has two adult female Komodo dragons , one of which laid about 17 eggs on 19 ? 20 May 2007 . Only two eggs were incubated and hatched due to space issues ; the first hatched on 31 January 2008 , while the second hatched on 1 February . Both hatchlings were males .

Komodo dragons have the ZW chromosomal sex @-@ determination system , as opposed to the mammalian XY system . Male progeny prove Flora 's unfertilised eggs were haploid (  $n$  ) and doubled their chromosomes later to become diploid (  $2n$  ) ( by being fertilised by a polar body , or by chromosome duplication without cell division ) , rather than by her laying diploid eggs by one of the meiosis reduction @-@ divisions in her ovaries failing . When a female Komodo dragon ( with ZW sex chromosomes ) reproduces in this manner , she provides her progeny with only one chromosome from each of her pairs of chromosomes , including only one of her two sex chromosomes . This single set of chromosomes is duplicated in the egg , which develops parthenogenetically . Eggs receiving a Z chromosome become ZZ ( male ) ; those receiving a W chromosome become WW and fail to develop , meaning that only males are produced by parthenogenesis in this species .

It has been hypothesised that this reproductive adaptation allows a single female to enter an isolated ecological niche ( such as an island ) and by parthenogenesis produce male offspring , thereby establishing a sexually reproducing population ( via reproduction with her offspring that can result in both male and female young ) . Despite the advantages of such an adaptation , zoos are cautioned that parthenogenesis may be detrimental to genetic diversity .

= = History = =

= = = Discovery by the Western world = = =

Komodo dragons were first documented by Europeans in 1910 , when rumors of a " land crocodile " reached Lieutenant van Steyn van Hensbroek of the Dutch colonial administration . Widespread notoriety came after 1912 , when Peter Ouwens , the director of the Zoological Museum at Bogor , Java , published a paper on the topic after receiving a photo and a skin from the lieutenant , as well as two other specimens from a collector . The first two live Komodo dragons to arrive in Europe were exhibited in the Reptile House at London Zoo when it opened in 1927 . Joan Beauchamp Procter made some of the earliest observations of these animals in captivity and she demonstrated the behaviour of one of these animals at a Scientific Meeting of the Zoological Society of London in 1928 . The Komodo dragon was the driving factor for an expedition to Komodo Island by W. Douglas Burden in 1926 . After returning with 12 preserved specimens and 2 live ones , this expedition provided the inspiration for the 1933 movie King Kong . It was also Burden who coined

the common name " Komodo dragon . " Three of his specimens were stuffed and are still on display in the American Museum of Natural History .

= = = Studies = = =

The Dutch , realizing the limited number of individuals in the wild , outlawed sport hunting and heavily limited the number of individuals taken for scientific study . Collecting expeditions ground to a halt with the occurrence of World War II , not resuming until the 1950s and 1960s , when studies examined the Komodo dragon 's feeding behavior , reproduction , and body temperature . At around this time , an expedition was planned in which a long @-@ term study of the Komodo dragon would be undertaken . This task was given to the Auffenberg family , who stayed on Komodo Island for 11 months in 1969 . During their stay , Walter Auffenberg and his assistant Putra Sastrawan captured and tagged more than 50 Komodo dragons . The research from the Auffenberg expedition would prove to be enormously influential in raising Komodo dragons in captivity . Research after that of the Auffenberg family has shed more light on the nature of the Komodo dragon , with biologists such as Claudio Ciofi continuing to study the creatures .

= = Conservation = =

The Komodo dragon is a vulnerable species and is on the IUCN Red List . The Komodo National Park was founded in 1980 to protect Komodo dragon populations on islands including Komodo , Rinca , and Padar . Later , the Wae Wuul and Wolo Tado Reserves were opened on Flores to aid with Komodo dragon conservation .

Komodo dragons avoid encounters with humans . Juveniles are very shy and will flee quickly into a hideout if a human comes closer than about 100 metres ( 330 ft ) . Older animals will also retreat from humans from a shorter distance away . If cornered , they will react aggressively by gaping their mouth , hissing , and swinging their tail . If they are disturbed further , they may start an attack and bite . Although there are anecdotes of unprovoked Komodo dragons attacking or preying on humans , most of these reports are either not reputable or caused by defensive bites . Only a very few cases are truly the result of unprovoked attacks by abnormal individuals , which lost their fear towards humans .

Volcanic activity , earthquakes , loss of habitat , fire , loss of prey due to poaching , tourism , and illegal poaching of the dragons themselves have all contributed to the vulnerable status of the Komodo dragon . Under Appendix I of CITES ( the Convention on International Trade in Endangered Species ) , commercial trade of skins or specimens is illegal .

In 2013 , total population in the wild was assessed as 3 @,@ 222 individuals , declining to 3 @,@ 092 in 2014 and 3 @,@ 014 in 2015 . Populations remained relatively stable on the bigger islands ( Komodo and Rinca ) , but decreased on smaller island such as Nusa Kode and Gili Motang , likely due to diminishing prey availability . On Padar , a former population of the Komodo dragon became extinct , of which the last individuals were seen in 1975 . It is widely assumed that the Komodo dragon died out on Padar after a strong decline of the populations of large ungulate prey , for which poaching was most likely responsible .

= = = In captivity = = =

Komodo dragons have long been great zoo attractions , where their size and reputation make them popular exhibits . They are , however , rare in zoos because they are susceptible to infection and parasitic disease if captured from the wild , and do not readily reproduce . As of May 2009 , there were 13 European , 2 African , 35 North American , 1 Singaporean , and 2 Australian institutions that kept Komodo dragons .

The first Komodo dragons were displayed at London Zoo in 1927 . A Komodo dragon was exhibited in 1934 at the National Zoo in Washington , D.C. , but it lived for only two years . More attempts to exhibit Komodo dragons were made , but the lifespan of these animals was very short , averaging

five years in the National Zoological Park . Studies done by Walter Auffenberg , which were documented in his book *The Behavioral Ecology of the Komodo Monitor* , eventually allowed for more successful managing and reproducing of the dragons in captivity .

A variety of behaviors have been observed from captive specimens . Most individuals are relatively tame within a short time , and are capable of recognising individual humans and discriminating between familiar keepers . Komodo dragons have also been observed to engage in play with a variety of objects , including shovels , cans , plastic rings , and shoes . This behavior does not seem to be " food @-@ motivated predatory behavior " .

Even seemingly docile dragons may become unpredictably aggressive , especially when the animal 's territory is invaded by someone unfamiliar . In June 2001 , a Komodo dragon seriously injured Phil Bronstein , the then husband of actress Sharon Stone , when he entered its enclosure at the Los Angeles Zoo after being invited in by its keeper . Bronstein was bitten on his bare foot , as the keeper had told him to take off his white shoes and socks , which the keeper stated could potentially excite the Komodo dragon as they were the same colour as the white rats the zoo fed the dragon . Although he escaped , Bronstein needed to have several tendons in his foot reattached surgically .