

= Réunion ibis =

The Réunion ibis or Réunion sacred ibis (*Threskiornis solitarius*) is an extinct species of ibis that was endemic to the volcanic island of Réunion in the Indian Ocean . The first subfossil remains were found in 1974 , and the ibis was first scientifically described in 1987 . Its closest relatives are the Malagasy sacred ibis , the African sacred ibis , and the straw @-@ necked ibis .

Travellers ' accounts from the 17th and 18th centuries described a white bird that flew with difficulty , and it was subsequently referred to as the Réunion solitaire . In the mid 19th century , the old travellers ' accounts were incorrectly assumed to refer to white relatives of the dodo , due to one account specifically mentioning dodos on the island , and because 17th @-@ century paintings of white dodos had recently surfaced . However , no fossils referable to dodo @-@ like birds were ever found on Réunion , and it was later questioned whether the paintings had anything to do with the island . Other identities were suggested as well , based only on speculation . In the late 20th century , the discovery of a subfossil ibis led to the idea that the old accounts actually referred to an ibis species instead . The idea that the solitaire and the subfossil ibis are identical has only met with limited dissent , and is now widely accepted .

Combined , the old descriptions and subfossils show that the Réunion ibis was mainly white , with this colour merging into yellow and grey . The wing tips and plumes of ostrich @-@ like feathers on its rear were black . The neck and legs were long , the beak was relatively straight and short for an ibis . It was more robust in build than its extant relatives , but was otherwise quite similar to them . Subfossil wing @-@ bones indicate it had reduced flight capabilities , a feature perhaps linked to seasonal fattening . The diet of the Réunion ibis was worms and other items foraged from soil . It preferred solitude (hence the name " solitaire ") . In the 17th century , it lived in mountainous areas , but it may have been confined to these remote heights by heavy hunting by humans and predation by introduced animals in the more accessible areas of the island . Visitors to Réunion praised its flavour , and therefore sought after its flesh . These factors are believed to have driven the Réunion ibis to extinction by the early 18th century .

= = Taxonomy = =

The taxonomic history of the Réunion ibis is convoluted and complex , due to the ambiguous and meagre evidence that was available to scientists until recently . The supposed " white dodo " of Réunion is now believed to have been an erroneous conjecture based on the few contemporary reports which described the Réunion ibis , combined with paintings of white dodos from Mauritius by the Dutch painters Pieter Withoos and Pieter Holsteyn II (and derivatives) from the 17th century that surfaced in the 19th century .

The English Chief Officer John Tatton was the first to mention a specifically white bird on Réunion , in 1625 . The French occupied the island from 1646 and onwards , and referred to this bird as the " solitaire " . M. Carré of the French East Indies Company described the solitaire in 1699 , explaining the reason for its name :

I saw a kind of bird in this place which I have not found elsewhere ; it is that which the inhabitants call the Oiseaux Solitaire for to be sure , it loves solitude and only frequents the most secluded places ; one never sees two or more together ; it is always alone . It is not unlike a turkey , if it did not have longer legs . The beauty of its plumage is a delight to see . It is of changeable colour which verges upon yellow . The flesh is exquisite ; it forms one of the best dishes in this country , and might form a dainty at our tables . We wished to keep two of these birds to send to France and present them to His Majesty , but as soon as they were on board ship , they died of melancholy , having refused to eat or drink .

A marooned French Huguenot , François Leguat , used the name " solitaire " for the Raphine bird he encountered on the nearby island of Rodrigues in the 1690s , but it is thought he borrowed the name from a 1689 tract by Marquis Henri Duquesne which mentioned the Réunion species . Duquesne himself had probably based his own description on an earlier one . No specimens of the solitaire were ever preserved . The two individuals Carré attempted to send to the royal menagerie

in France did not survive in captivity . Billiard claimed that Bertrand @-@ François Mahé de La Bourdonnais sent a " solitaire " to France from Réunion around 1740 . Since the Réunion ibis is believed to have gone extinct by this date , the bird may actually have been a Rodrigues solitaire .

The only contemporary writer who referred specifically to " dodos " inhabiting Réunion was the Dutch sailor Willem Ysbrandtszoon Bontekoe , though he did not mention their colouration :

There were also Dod @-@ eersen [old Dutch for dodos] , which have small wings , and so far from being able to fly , they were so fat that they could scarcely walk , and when they tried to run , they dragged their under side along the ground .

When his journal was published in 1646 , it was accompanied by an engraving which is now known to have been copied after one of the dodos in the Flemish painter Roelant Savery 's " Crocker Art Gallery sketch " . Since Bontekoe was shipwrecked and lost all his belongings after visiting Réunion in 1619 , he may not have written his account until he returned to Holland , seven years later , which would put its reliability in question . He may have concluded in hindsight that it was a dodo , finding what he saw similar to accounts of that bird .

= = = Early interpretation = = =

In the 1770s , the French naturalist Comte de Buffon stated that the dodo inhabited both Mauritius and Réunion . It is unclear why he included Réunion , but he also combined accounts about the Rodrigues solitaire and a third bird (" oiseau de Nazareth " , now thought to be a dodo) under the same section . English naturalist Hugh Edwin Strickland discussed the old descriptions of the Réunion solitaire in his 1848 book *The Dodo and Its Kindred* , and concluded it was distinct from the dodo and Rodrigues solitaire . Baron Edmond de Séllys Longchamps coined the scientific name *Apterornis solitarius* for the Réunion solitaire in 1848 , apparently making it the type species of the genus , in which he also included two other Mascarene birds only known from contemporary accounts , the red rail and the Réunion swamphen . As the name *Apterornis* had already been used for a different bird by Richard Owen , and the other former names were likewise invalid , Bonaparte coined the new binomial *Ornithaptera borbonica* in 1854 (Bourbon was the original French name for Réunion) . In 1854 , Hermann Schlegel placed the solitaire in the same genus as the dodo , and named it *Didus apterornis* . He restored it strictly according to contemporary accounts , which resulted in an ibis or stork @-@ like bird instead of a dodo . As it was considered congeneric with the dodo , the Réunion solitaire was long believed to also be a member of the *Dididae* family of pigeons .

In 1856 , William Coker announced the discovery of a 17th @-@ century " Persian " painting of a white dodo among waterfowl , which he had been shown in England . The artist was later identified as Pieter Withoos , and many prominent 19th @-@ century naturalists subsequently assumed the image depicted the white solitaire of Réunion , a possibility originally proposed by ornithologist John Gould . Simultaneously , several similar paintings of white dodos by Pieter Holsteyn II were discovered in the Netherlands . In 1869 , the English ornithologist Alfred Newton argued that the Withoos ' painting and engraving in Bontekoe 's memoir depicted a living Réunion dodo that had been brought to Holland , while explaining its blunt beak as a result of beak trimming to prevent it from injuring humans . He also brushed aside the inconsistencies between the illustrations and descriptions , especially the long , thin beak implied by one contemporary account .

Newton 's words particularly cemented the validity of this connection among contemporary peers , and several of them expanded on his views . Dutch zoologist Anthonie Cornelis Oudemans suggested that the discrepancies between the paintings and the old descriptions were due to the paintings showing a female , and that the species was therefore sexually dimorphic . Walter Rothschild claimed the yellow wings might have been due to albinism in this particular specimen , since the old descriptions described these as black . By the early 20th century , many other paintings and even physical remains were claimed to be white dodos , amid much speculation . Some believed the solitaire of the old descriptions was rather a species similar to the Rodrigues solitaire . Rothschild commissioned British artist Frederick William Frohawk to restore the Réunion solitaire as both a white dodo , based on the Withoos painting , and as a distinct bird based on

Dubois ' description , for his 1907 book *Extinct Birds* . In 1953 , the Japanese writer Masauji Hachisuka went as far as referring to the white dodos of the paintings as *Victoriornis imperialis* , and the solitaire of the accounts as *Ornithaptera solitarius* .

= = = Recent interpretation = = =

Until the late 1980s , belief in the existence of a white dodo on Réunion was the orthodox view , and only a few researchers doubted the connection between the solitaire accounts and the dodo paintings . They cautioned that no conclusions could be made without solid evidence such as fossils , and that nothing indicated that the white dodos in the paintings had anything to do with Réunion . In 1970 , Robert W. Storer predicted that if any such remains were found , they would not belong to *Raphinae* , or even *Columbidae* .

The first subfossil bird remains on Réunion were found in 1974 , and assigned to a stork , *Ciconia* sp . The remains were found in a cave , which indicated it had been brought there and eaten by early settlers . It was speculated that the remains could have belonged to a large , mysterious bird described by Leguat , and called " Leguat 's giant " by some ornithologists . " Leguat 's giant " is now thought to be based on a locally extinct population of flamingos . In 1987 , subfossils of a recently extinct species of ibis from Réunion were described as *Borbonibis latipes* , and thought related to the bald ibises of the genus *Geronticus* . In 1994 , the " stork " remains were shown to belong to this ibis as well . The 1987 discovery led biologist Anthony S. Cheke to suggest to one of the describers , Francois Moutou , that the subfossils may have been of the Réunion solitaire . This suggestion was published by the describers of *Borbonibis* in 1995 , and they also reassigned it to the genus *Threskiornis* , now combined with the specific epithet *solitarius* from de Sélys @-@ Longchamps ' 1848 binomial for the solitaire . The authors pointed out that the contemporary descriptions matched the appearance and behaviour of an ibis more than a member of the *Raphinae* , especially since a fragment of a comparatively short and straight ibis mandible was discovered in 1994 , and because ibis remains were abundant in some localities ; it would be strange if contemporary writers never mentioned such a relatively common bird , whereas they mentioned most other species subsequently known from fossils .

The possible origin of the 17th @-@ century white dodo paintings has also recently been examined by biologist Arturo Valledor de Lozoya in 2003 , and independently by experts of Mascarene fauna Anthony Cheke and Julian Hume in 2004 . The Withoos and Holsteyn paintings are clearly derived from each other , and Withoos likely copied his dodo from one of Holsteyn 's works , since these were probably produced at an earlier date . All later white dodo pictures are thought to be based on these paintings . According to the aforementioned writers , it appears these pictures were themselves derived from a whitish dodo in a previously unreported painting containing , called *Landscape with Orpheus and the Animals* , produced by Roelant Savery c . 1611 . The dodo was apparently based on a stuffed specimen then in Prague ; a walghvogel (old Dutch for dodo) described as having a " dirty off @-@ white colouring " was mentioned in an inventory of specimens in the Prague collection of the Holy Roman Emperor Rudolf II to whom Savery was contracted at the time (1607 ? 1611) . Savery 's several later dodo images all show greyish birds , possibly because he had by then seen a normal specimen . Cheke and Hume concluded the painted specimen was white due to albinism , and that this peculiar feature was the reason it was collected from Mauritius and brought to Europe . Valledor de Lozoya instead suggested that the light plumage was a juvenile trait , a result of bleaching of old taxidermy specimens , or simply due to artistic license .

No fossil remains of dodo @-@ like birds have ever been found on Réunion . A few later sources take issue with the proposed ibis @-@ identity of the solitaire , and have even regarded the " white dodo " as a valid species . British writer Errol Fuller agrees that the 17th @-@ century paintings do not depict Réunion birds , but has questioned whether the ibis subfossils are necessarily connected to the solitaire accounts . He notes that no evidence indicates the extinct ibis survived until the time Europeans reached Réunion . Cheke and Hume have dismissed such sentiments as being mere " belief " and " hope " in the existence of a dodo on the island .

== Evolution ==

The volcanic island of Réunion is only three million years old , whereas Mauritius and Rodrigues , with each their flightless Raphine species , are eight to ten million years old , and it is unlikely that either bird would have been capable of flying after five or more million years of adapting to the islands . Therefore , it is unlikely that Réunion could have been colonised by flightless birds from these islands , and only flighted species on the island have relatives there . Three million years is enough time for flightless and weak flying abilities to have evolved in bird species on Réunion itself . But such species would have been wiped out by the eruption of the volcano Piton des Neiges between 300 @, @ 000 and 180 @, @ 000 years ago . Most recent species would therefore likely be descendants of animals which had recolonised the island from Africa or Madagascar after this event , which is not enough time for a bird to become flightless .

In 1995 , morphological study suggested the closest extant relatives of the Réunion ibis are the African sacred ibis (*T. aethiopicus*) of Africa and the straw @-@ necked ibis (*T. spinicollis*) of Australia . It has also been suggested that it was closest to the Malagasy sacred ibis (*T. bernieri*) , and therefore of ultimately African origin .

== Description ==

Contemporary accounts described the species as having white and grey plumage merging into yellow , black wing tips and tail feathers , a long neck and legs , and limited flight capabilities . Sieur Dubois ' 1674 account is the most detailed contemporary description of the bird , here as translated by Hugh Strickland in 1848 :

Solitaires . These birds are so called because they always go alone . They are the size of a large Goose , and are white , with the tips of the wings and tail black . The tail feathers resemble those of an Ostrich ; the neck is long , and the beak is like that of a Woodcock , but larger ; the legs and feet like those of Turkeys . This bird has recourse to running , as it flies but very little .

The plumage colouration mentioned is similar to that of the related African sacred ibis and straw @-@ necked ibis , which are also mainly white and glossy black . In the reproductive season , the ornamental feathers on the back and wing tips of the African sacred ibis look similar to the feathers of an ostrich , which echoes Dubois ' description . Likewise , a subfossil lower jaw found in 1994 showed that the bill of the Réunion ibis was relatively short and straight for an ibis , which corresponds with Dubois ' woodcock comparison . Cheke and Hume have suggested that the French word (*bécasse*) from Dubois ' original description , usually translated to " woodcock " , could also mean oystercatcher , another bird with a long , straight , but slightly more robust , bill . They have also pointed out that the last sentence is mistranslated , and actually means the bird could be caught by running after it . The bright colouration of the plumage mentioned by some authors may refer to iridescence , as seen in the straw @-@ necked ibis .

Subfossils of the Réunion ibis show that it was more robust , likely much heavier , and had a larger head than the African sacred and straw @-@ necked ibises . It was nonetheless similar to them in most features . Rough protuberances on the wing bones of the Réunion ibis are similar to those of birds that use their wings in combat . It was perhaps flightless , but this has not left significant osteological traces ; no complete skeletons have been collected , but of the known pectoral elements , only one feature indicates reduction in flight capability . The coracoid is elongated and the radius and ulna are robust , as in flighted birds , but a particular foramen between a metacarpal and the alular is otherwise only known from flightless birds , such as some ratites , penguins , and several extinct species . As contemporary accounts are inconsistent on whether the solitaire was flightless or had some flight capability , Mourer @-@ Chauvire suggested that this was dependent on seasonal fat @-@ cycles , meaning that individuals fattened themselves during cool seasons , but were slim during hot seasons ; perhaps it could not fly when it was fat , but could when it was not . However , Dubois specifically stated the solitaires did not have fat @-@ cycles , unlike most other Réunion birds .

= = Behaviour and ecology = =

The species was termed a land @-@ bird by Dubois , so it did not live in typical ibis habitats such as wetlands . It has been proposed that this is because the ancestors of the bird colonised Réunion before swamps had developed , and had therefore become adapted to the available habitats . They were perhaps prevented from colonising Mauritius as well due to the presence of red rails there , which may have occupied a similar niche . It appears to have lived in high altitudes , and perhaps had a limited distribution . The only mention of its diet and exact habitat is Jean Feuilley 's account from 1708 , which is also the last record of a living individual :

The solitaires are the size of an average turkey cock , grey and white in colour . They inhabit the tops of mountains . Their food is only worms and filth , taken on or in the soil .

The diet and mode of foraging described by Feuilley matches that of an ibis , whereas members of the Raphinae are known to have been fruit eaters . Accounts by early visitors indicate the species was found near their landing sites , but they were found only in remote places by 1667 . The bird may have survived in eastern lowlands until the 1670s . Though many late 17th century accounts state the bird was good food , Feuilley stated it tasted bad . This may be because it changed its diet when it moved to more rugged , higher terrain , to escape pigs that destroyed its nests ; since it had limited flight capabilities , it probably nested on the ground .

Many other endemic species of Réunion became extinct after the arrival of man and the resulting disruption of the island 's ecosystem . The Réunion ibis lived alongside other recently extinct birds such as the hoopoe starling , the Mascarene parrot , the Réunion parakeet , the Réunion swamphen , the Réunion owl , the Réunion night heron , and the Réunion pink pigeon . Extinct reptiles include the Réunion giant tortoise and an undescribed *Leiopisma* skink . The small Mauritian flying fox and the snail *Tropidophora carinata* lived on Réunion and Mauritius , but vanished from both islands .

= = Extinction = =

As Réunion was populated by settlers , the Réunion ibis appears to have become confined to the tops of mountains . Introduced predators such as cats and rats took a toll . Overhunting also contributed and several contemporary accounts state the bird was widely hunted for food . In 1625 , John Tatton described the tameness of the bird and how easy it was to hunt , as well as the large quantity consumed :

There is store of land fowle both small and great , plenty of Doves , great Parrats , and such like ; and a great fowle of the bignesse of a Turkie , very fat , and so short winged , that they cannot fly , being white , and in a manner tame : and so be all other fowles , as having not been troubled nor feared with shot . Our men did beat them down with sticks and stones . Ten men may take fowle enough to serve fortie men a day .

In 1671 , Melet mentioned the culinary quality of this species , and described the slaughter of several types of birds on the island :

(A) nother sort of bird called solitaires which are very good (to eat) and the beauty of their plumage is most fascinating for the diversity of bright colours that shine on their wing and around their necks ... There are birds in such great confusion and so tame that it is not necessary to go hunting with firearms , they can so easily be killed with a little stick or rod . During the five or six days that we were allowed to go into the woods , so many were killed that our General [de La Haye] was constrained to forbid anyone going beyond a hundred paces from the camp for fear the whole quarter would be destroyed , for one needed only to catch one bird alive and make it cry out , to have in a moment whole flocks coming to perch on people , so that often without moving from one spot one could kill hundreds . But , seeing that it would have been impossible to wipe out such a huge quantity , permission was again given to kill , which gave great joy to everyone , because very good fare was had at no expense .

The last definite account of the " solitaire " of Réunion was Feuilley 's from 1708 , indicating that the species probably became extinct sometime early in the century . In the 1820s , Louis Henri de Freycinet asked an old slave about drontes (old Dutch word for dodo) , and was told the bird

existed around Saint @-@ Joseph when his father was an infant . This would perhaps be a century earlier , but the account may be unreliable . Cheke and Hume suspect that feral cats initially hunted wildlife in the lowlands and later turned to higher inland areas , which were probably the last stronghold of the Réunion ibis , as they were unreachable by pigs . The species is thought to have been driven to extinction around 1710 ? 1715 .