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The 'Meidum geese' revisited: Early historical art is not a suitable basis for taxonomic speculation

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ABSTRACT

Romilio (2021) used a taxonomic scoring system to compare differences between three species of geese (Anseriformes) depicted in the Chapel of Itet, one of which he speculated might represent an undescribed (presumably now extinct) species. Despite some apparently distinctive features, the depiction has traditionally been associated with the well-known modern species, red-breasted goose (*Branta ruficollis*). We discuss limitations in applying the Tobias et al. (2010) scoring system to cases such as this, for which it was not designed, and we outline the many pitfalls that must be considered when attempting to identify historical artwork of birds using examples discussed recently in the ornithological literature. We conclude that the illustrations proposed by Romilio to represent a new *Branta* goose species are within the range of known plumage variation and potential artistic licence for red-breasted goose, and that this very probably is the species upon which the artwork was based. More generally, we caution against applying the Tobias criteria to cases where a series of specimens cannot be measured, and highlight the difficulties of using illustrations to inform taxonomy.

1. Introduction

One of the most widely known examples of Ancient Egyptian art depicts three species of geese (Anseriformes) and was found in the Chapel of Itet; it is now housed in the Egyptian Museum in Tahrir Square, Cairo. Recently, in this journal, Romilio (2021) re-examined the taxonomic assignment of these species, including two strikingly patterned birds that have usually been identified as a well-known extant species, the red-breasted goose (*Branta ruficollis*) (Nicoll, 1919; Raven, 1947; Houlihan, 1986; Goodman and Meininger, 1989; Wyatt, 2013), although this was not universally accepted (Weesie 1988). Analysing the depictions using the Tobias et al. (2010) criteria for species delimitation, Romilio (2021) concluded that these two birds represent "an extinct taxon that has no modern counterpart, or a partially accurate extant but locally extinct species, or a fabricated bird that includes elements of goose morphologies."

Although Romilio (2021) accepted the potential validity of all three different interpretations, his paper clearly suggests that the initial option, an undescribed but extinct species, was the favoured hypothesis. This eye-catching conclusion attracted considerable international media attention (Hurrell, 2021), often of the more sensationalist clickbait variety ("Extinct species of goose discovered in ancient Egyptian pyramid": www.express.co.uk/news/science). In this commentary, we focus on two potential pitfalls in the Romilio paper: misapplication of the Tobias et al. criteria, and the difficulties associated with diagnosing taxa based solely on historical images, especially a unique iconography. We go on to highlight variation in red-breasted goose phenotypes which are similar to the birds illustrated from Itet, and thereby offer a more straightforward conclusion as to the latter's identity.

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2. Historical artwork for species delimitation

The gold standard for taxonomists is the complete specimen (e.g., Collar, 1999, Raposo & Kirwan, 2017). Taxonomic determination can be (and frequently is) based on a single representative of an organism, the type specimen or holotype. However, a range of material that encapsulates variation, especially in morphology, provides greater confidence in the validity of a diagnosis. For example, in describing *Scytalopus petrophilus* (rock tapaculo), a new species of Rhinocryptidae from southeast Brazil, Whitney et al. (2010) nominated an additional 19 specimens as paratypes. Irrespective of the designation of paratypes, it is standard in modern ornithology to base taxonomic decisions on evidence sampled from a larger series of specimens or, in the case of vocalisations, from recordings taken from many living individuals (Tobias et al., 2010).

The validity, or otherwise, of bird species known from single specimens remains of considerable interest to ornithologists (Kirwan & Schweizer, 2020). Due to inferior methods of preservation available at the time, in addition to natural disasters (e.g., fires), poor curation and unsuitable maintenance of collections, type specimens of many taxa described in the initial post-Linnaeus wave of scientific discovery and global exploration no longer exist (Sharpe, 1906, Jansen, 2015), despite avian taxidermy being of interest among sections of Western society since at least the 13th century (Schulze-Hagen et al., 2003).

Extant pre-19th century bird specimens in museums were recently estimated to number just 1500–3000, the vast majority of them in just six, well-curated European institutions (Steinheimer, 2005; Gouraud, 2014) highlighted the relative importance of a seventh, otherwise relatively minor collection (Baillon, La Châtre, France) for such material. Overall, the world's museums have been estimated to house c. 9,000,000 bird specimens (Goodman & Lanyon, 1994), indicating just how few (scarcely 0.03%) from the 'Linnean and pre-Linnean eras' survive.

Given this temporal bias, our knowledge of most taxa is reliant on relatively modern specimen material. This is often abundant for widespread species, but can be extremely limited in the case of very rare or extinct species, despite some evidence of collection bias in favour of the latter (Gotelli et al. 2021). Between at least 80 and 100 described species are generally considered to have become extinct in relatively modern times (post-1600; an arbitrary date selected by several authors for such analyses) (e.g., Fuller, 2002). The number is potentially even higher than this considering that many species probably became extinct before they could be described by scientists (e.g., Lees & Pimm, 2015). For a small subset of extinct species, no specimen exists, and our knowledge of them rests solely on illustrations or descriptions by early naturalists (e.g., Fuller, 2002, Wiley & Kirwan, 2013).

Examples of these include the drawings of zoological novelties commissioned by Sir Stamford Raffles (Wilson, 2021). In addition, several members of Captain James Cook's circumnavigatory second (1772–75) and third expeditions (1776–80) produced natural history artwork (Sawyer, 1949, Stresemann, 1950). In some cases, the relevant accounts and illustrations represent virtually our entire knowledge of the species they 'discovered', with resultant uncertainty surrounding their taxonomic diagnosis. For example, the Polynesian genus *Prosobonia* (Scolopacidae) is currently believed to comprise five species, of which just one is extant (Tuamotu sandpiper *P. parvirostris*), and the four extinct species are represented by just a single known specimen (Cibois et al. 2012, De Pietri et al., 2021). However, variations in both the descriptions and artwork representing some of these other species recently led Jansen et al. (2021) to postulate that Moorea sandpiper (*P. ellisi*) should be considered a synonym of Tahiti sandpiper (*P. leucoptera*) and that the originally perceived differences between these two species can be attributed to artistic freedom.

Another example is the echo parakeet (*Psittacula eques*) (Psittaciformes), an endemic of Mauritius and Réunion (Juniper & Parr, 1998). Clarifying the taxonomic status of the now extinct population on the latter island, of which specimens no longer exist, is especially complicated. Although there was just one original artistic representation of the unique but now lost specimen from Réunion (Cheke & Hume, 2008, Cheke & Jansen, 2016), by François-Nicolas Martinet, each copy of the work in which his drawing appeared (Daubenton 1770–83) had to be coloured separately. Jansen & Cheke (2020) determined, via analysis of five different copies of Buffon's work, that the presumably different colourists responsible, none of whom probably had access to the specimen itself, introduced differences in the colour of the irides, bill and peri-ocular ring, the colour and pattern of the underparts, the shape and colour of the neck-ring, and the precise colour of the wings. None of the plates examined by Jansen and Cheke (2020) precisely matched the detailed description that Brisson (1760) made of the same specimen which served as Martinet's basis for the original illustration.

Similar problems exist in relation to other birds depicted in Daubenton's work, the *Planches enluminées* (see Hume 2007), with one such image of the so-called 'Oiseau de Paradis de la Nouvelle Guinée, dit le Superbe' (*Lophorina superba*) at the heart of recent controversy caused by the almost certain loss of the physical type specimen on which it is based (Elliott et al., 2020, Schodde et al., 2021).

Problems of artistic license do not only affect our knowledge of extinct species without specimen material. The very distinctive white-eyed river martin (*Pseudochelidon sirintarae*) (Hirundinidae) was described on the basis of nine specimens from Thailand in 1968 (Thonglongya, 1968), but has not been seen since 1980 (Tobias, 2000). In the knowledge that all records of this species were from the winter period, Dickinson (1986) suggested that a Chinese scroll painting thought to date from sometime pre-1970 was a clear depiction of this ornithological enigma, and could provide an indication of where the species might breed. However, Parkes (1987) noted that the painting was not an accurate illustration of any known species, but given the degree of concordance between the observable features might equally be identified as an Oriental pratincole (*Glareola maldivarum*), a relatively abundant shorebird, and a far more parsimonious interpretation. All of these examples offer serious counterweight to the hypothesis that it is possible or even advisable to diagnose species on the basis of illustrations alone, especially unique depictions by artists of unknown credentials.

As further evidence of the challenges involved, Romilio (2021) reported uncertainty over the species identification of the 'grey geese' in the Chapel of Itet illustration, which may have been either greylag geese (*Anser anser*) or bean geese sp. (*Anser fabalis/serrirostris*), as their features as depicted provide no more than an imperfect match for either. Such uncertainty among the depicted birds in the Chapel of Itet underlines the risks inherent to using these illustrations as a taxonomic voucher for a suggested new species.

3. Using the Tobias et al. Criteria

Romilio (2021) applied the points-based scoring system published by Tobias et al. (2010) to assess the number and extent of differences between the Meidum artwork and known species of geese. The Tobias criteria provide a flexible system with a degree of objectivity in estimating such differences, offering fresh perspective on the identity of the illustrations. However, the system was designed to be applied to samples of individuals, typically museum specimens, with a minimum of 10 individuals recommended for calculating morphological differences in plumage, body parts and vocal traits. There is nothing to prevent an author from using a pared-down version of the Tobias et al. (2010) criteria, based on scores of visual differences, as attempted by Romilio (2021). Such an approach could provide a useful 'litmus test' of morphological divergence between related taxa, to assess whether the divergence is likely to reflect species status. The main difficulty is that such an approach relies heavily on the least quantitative, and consequently most subjective, aspect of the Tobias et al. criteria.

In their complete form, the criteria place more weight on the effect

Fig. 1. Mixed-species flocks of geese, predominantly red-breasted geese *Branta ruficollis*, including varying numbers of young birds, with much smaller numbers of greater white-fronted geese *Anser albifrons* photographed in Bulgaria, showing variation, much of it age-related, in the first-named species in the colour of the red feathers on the head, neck and breast, and the shape and extent of the intervening and bordering white areas, e.g., the young bird (marked by the black arrow) in the foreground just right of centre in Fig. 1, but many more such individuals in Fig. 2 (three of which are denoted by the letters A, B, and C). Note also the variation in shape and prominence of the white markings on the flanks and wings. Fig. 1 (Viktor Vasilev) and 2 (Mladen Vasilev). Colour online. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

sizes of quantitative differences measured directly from specimens, rather than on visual impressions. For example, to remove the subjectivity of scoring bill size differences, a series of measurements permits a taxonomist to assess whether the differences between two taxa pass a quantitative threshold linked to the scoring system (1 for a minor difference, 2 for a medium difference, etc.). Estimating differences on a single measurement alone is risky because it is difficult to know whether a unique individual is especially large or small. This risk is elevated to extremes when the distinctions are estimated on the basis of an illustration, for all the many reasons that an artist may have depicted an inaccurately large or small bill.

Another aspect of the Tobias et al. (2010) criteria that does not appear to have been applied consistently is the need to avoid duplication of characters used in the scoring system. The fact that "covariance in colour-related traits, such as a whiter belly, broader white wing-bars and a larger white rump-patch, may be driven by the same genes underlying pigmentation" means that these differences need to be collapsed into a single character to avoid inflation of scores (Tobias et al., 2010). Incautious application of the Tobias criteria may have led to different traits of the Meidum Geese being scored independently, e.g., the pattern of white on the head, neck, and breast, whereas they are clearly interconnected, requiring a single score.

4. Variation in red-breasted geese

The notion that the 'Meidum Geese' represent a novel phenotype that can be recognized as an extinct taxon appears to overlook the issue of artistic licence, but also the degree of variation that exists in red-breasted geese, which can be seen in photos of individuals of captive and wild origin (Fig. 1 and 2). Romilio (2021) highlighted a number of differences, of varying levels of significance, between the Chapel of Itet depictions, and illustrations and online photos of undoubted red-breasted geese. The most salient of these differences were the predominately white faces and necks, with comparatively little red coloration on these feather tracts.

In addition, Romilio (2021) suggested that the slightly different characters of the two 'Meidum Geese' provided evidence of the species 'strongly dimorphismic' nature, and that the frontal of the two individuals sports three greatly elongated flank-feathers (rather than wingbars as interpreted by others, including many ornithologists). It is difficult to be absolutely definitive either way on the latter point, but what Romilio considers to be dimorphism could clearly be interpreted as individual variation. For example, none of three captive birds in one photo online (https://www.animal.photos/bird3/goos-rb_files/rbg_young.jpg) has identical face, neck and upper breast patterns, with the birds showing varying degrees of white, black and red coloration. Indeed, plumage variation appears to be quite frequent in red-breasted geese, particularly among young birds; in addition to being generally

duller than adults, and more weakly patterned overall, first-calendar-year birds can have variable head and neck patterns, with more extensive white around the ear-coverts and a duller or smaller rufous cheek patch, which may be lacking completely in some birds (Carboneras et al., 2020; Cramp & Simmons, 1977; Reeber, 2015). Young birds also typically show less white on the flanks than adults. This is shown in an image of two captive birds that display equal levels of variation, and show even less red on the face than the 'Meidum Geese' (https://www.dudleyzoo.org.uk/wp-content/uploads/Red-Breasted-Goose-06092017–7-e1507721913279-180x150.jpg), similar to the illustrations in Cramp and Simmons (1977).

Further variation in the face and neck pattern of red-breasted geese is visible among a flock of wild birds on the wintering grounds in Bulgaria (https://www.neophron.com/the-first-red-breasted-geese-are-here/). In this example, particularly note the younger individual centre, mid-distance, showing unusual amounts of white on the face, with reduced black and red, and the bird in the right foreground, with more black on the face and neck than is typical, and a different pattern of white as a result, which also partially obscures the red of the cheeks. Among other, presumed, wild birds, an adult in Germany also appears to lack any visible red on the face (https://macaulaylibrary.org/asset/197486241#_ga=2.170536672.1563421481.1613990720-2000280272.1583423099). Romilio (2021) does not appear to have considered this degree of age-related variation shown by red-breasted geese, leading to his suggestion that the differences between the two 'Meidum Geese' must reflect sex-related plumages, which would be a key distinction from red-breasted goose. In fact, sexual dimorphism is virtually unknown among true geese (Kear 2005), which would make such variation of clear taxonomic significance, but only if proven. For now, Romilio's contention that the apparent differences between the two birds are sex-related is pure supposition.

Even if captive geese were more likely to exhibit plumage anomalies than wild birds, due to the effects of inbreeding or hybridization, the Egyptians are known to have domesticated geese (Bailleul-LeSeur, 2013), making it plausible that the 'Meidum Geese' were not even wild birds. However, it seems unlikely that inbreeding or hybridization would have resulted in the phenotypes depicted on the Chapel of Itet artwork. Red-breasted geese are known to hybridize with several species, such as greater white-fronted goose (*Anser albifrons*) and barnacle goose (*Branta leucopsis*), but the resulting hybrids tend to lack the bright markings of the red-breasted goose and develop 'drab' plumage colours instead (Ottenburghs et al., 2016; Reeber, 2015). Inbreeding in captivity could have contributed to the aberrant plumage patterns of the 'Meidum Geese'. However, this explanation is not supported by red-breasted geese in modern waterfowl collections, in which this species displays the phenotypic variation that is observed also in wild populations.

Additional traps for the unwary exist, which although perhaps not relevant to the specific case at issue here, must be kept in mind by those seeking to identify species in ancient Egyptian art. Colour is known to have served a highly symbolic purpose at this period in Egypt, with colours divided into four basic groups, black, white/silver, green/blue, and red/orange/yellow, and each group possessing a different meaning and concept, e.g., youth, royalty, and divinity. As noted by Yeakel et al. (2014) in their survey of mammal extinctions in Egypt, among unambiguous depictions of known species are several evidently fictitious animals for which no scientific basis exists.

Western Egypt's paleolandscape was considerably wetter and more mesic prior to 2400 BCE, so potentially more suitable for overwintering geese as a consequence (Wendorf et al., 1976, Butzer, 1977), and red-breasted goose is a known constituent of the Egyptian avifauna, albeit only a vagrant in the modern era (Meinertzhagen, 1930, Goodman & Meininger, 1989). The same modern-day status is also true for the other two species of geese apparently depicted in the Chapel of Itet (Goodman & Meininger 1989). With these points in mind, our review of ornithological work pertaining to taxonomic enigmas suggests that none of the three hypotheses offered by Romilio (2021) is necessarily the most parsimonious explanation. The Chapel of Itet artwork represents only a partially accurate depiction, perhaps based on the artist's memory or a second-hand description, of a well-known modern-day species whose regular winter range potentially reached Egypt in prehistory when the region's paleolandscape was far less arid and more suitable for Palearctic geese (Yeakel et al., 2014).

CRediT authorship contribution statement

Guy M. Kirwan: Conceptualization and preparation of first draft; all other authors: review and editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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